MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
UZHHOROD NATIONAL UNIVERSITY
FACULTY OF MEDICINE
DEPARTMENT OF BIOCHEMISTRY AND PHARMACOLOGY

Biochemistry test bank
Part 1. Introduction to biochemistry. General principles of metabolism.

Self-preparation manual for medieal students

Uzhhorod – 2021

УДК 577.1(075.8)=111

Унорядннкн:
- зав. кафедри біохімії та фармакології медичного факультету ДВНЗ «УжНУ», к.мед.н., доц. **Ростока Ларнса Мнхайлівна,**
- асистент кафедри біохімії та фармакології медичного факультету ДВНЗ «УжНУ» **Бурмістрова Яна Юріївна**
- асистент кафедри біохімії та фармакології медичного факультету ДВНЗ «УжНУ» **Сіткар Андрій Дмнтровнч**

Методична розробка для студентів складено у відповідності з вимогами освітньо-професійної програми підготовки магістра.

РЕЦЕНЗЕНТИ:
Фабрі З.Й. – д.б.н., професор кафедри біохімії та фармакології медичного факультету ДВНЗ «УжНУ»
Сірчак Є.С. – д.мед.н., професор, зав. кафедри пропедевтики внутрішніх хвороб медичного факультету ДВНЗ «УжНУ»

Затверджено на засіданні Вченої ради медичного факултету ДВНЗ «УжНУ»
від 15.11.2021 р., протокол №2.

FOREWORD

In order to improve the preparation of students of higher medical educational institutions for practical classes in biochemistry and better understending of theoretical material, test bank in the discipline have been arranged. This manual provides tests of following topics: structure, properties and functions of informational biomolecules (proteins and nucleic acids), fundamentals of biological catalisis (enzymes and coenzymes), general principles of metabolism and common metabolic pathways, biological oxidation and bioenergetics. The tests are divided into five chapters, each of which includes tasks of different types of difficulty: multiple choice questions, theoretical questions, writing the missing word, drawing the structure of biomolecules, situational tasks and questions of higher difficulty levels. It is important that the organization of situational tasks is related to clinical cases and practical medicine.

Biological chemistry is a fundamental medical discipline. A perfect understanding of the theoretical material is the basis for the study of clinical disciplines, interpretation of laboratory parameters and future medical practice.

Chapter I. Amino acids. Peptides. Proteins.

List of the exam questions:

I. Amino acids: definition, classification (by side-chain polarity, by side-chain functional group, nutritional classification).
2. Structure of proteinogenic amino acids. Properties of amino acids: chirality of amino acids, acid-base properties, ability to form peptide bonds.
3. The formation of tripeptide.
4. Nonstandart amino acids: structure and localization.
5. Proteins: definition, functions. Levels of protein structure. Peptide bond properties. Domain and oligomeric proteins.
6. Physical and chemical properties of proteins. Denaturation of proteins.
7. Protein classification.
8. Common characteristic and biological role of individual classes of proteins: albumins, globulins, histones, protamins, complex proteins etc.

Multiple Choice Questions:

1. A 30-year-old man has a hypoenergetic state associated with a violation of the functional state of the cytochromes of the respiratory chain of mitochondria, which by chemical nature are:
a. Hemproteins
b. Glycoproteins
c. Flavoproteins
d. Lipoproteins
e. Retinolproteins

2. A 40-year-old man was hospitalized due to carbon monoxide poisoning. Which of the following hemoglobin fractions will be elevated in this patient?
a. Carboxyhemoglobin
b. Methemoglobin
c. Carbhemoglobin
d. Oxyhemoglobin
e. Glycosylated hemoglobin

3. A 58-year-old man has signs of atherosclerotic lesions of the cardiovascular system. The increase in which of the following indicators of biochemical analysis of blood is most characteristic of this condition?
a. LDL level
b. Chylomicron level
c. LDH5 activities
d. HDL level
e. Pancreatic lipase activities

4. A patient with acute myocardial infarction underwent anticoagulant therapy with an antithrombin III activator that counteracts intravascular coagulation. Choose a drug.
a. Heparin

b. Hyaluronic acid
c. Chondroitin sulfate
d. Tetracycline
e. Histamine

5. A prosthetic group of complex proteins joins the polypeptide chain through various bonds. Through which group does the phosphoric acid residue join the proteins in phosphoproteins?
a. OH-group serine
b. CH-group of methionine
c. NH-lysine group
d. SH-group of cysteine
e. COO-glutamine group

6. A structural feature of fibrillar proteins is the formation of multimolecular filamentous complexes - fibrils, which consist of several parallel polypeptide chains. Name the fibrillar protein that is part of the hair, skin, nails.
a. Alpha-keratin
b. Albumin
c. Prothrombin
d. Globulin
e. Histon

7. Albumins, blood plasma proteins that are synthesized in the liver and perform certain functions. Specify one of them:
a. Transport of drugs
b. The formation of blood clots
c. Transport of carbon dioxide
d. Oxygen transport
e. Antibody production

8. Along with normal types of hemoglobin in the body of an adult may be present pathological. Specify one of them:
a. HbS
b. HbF
c. HbA2
d. HbCO2
e. HbO2

9. Amino acids exhibit:
a. only acidic properties
b. amphoteric properties
c. only basic properties
d. only oxidizing properties

10. Amino acids that are not synthesized in the human body are called:
a. metabolic;
b. synthetic;
c. essential;
d. non-essential.

11. Amino acids that are synthesized in the human body are called:
a. metabolic;
b. synthetic;
c. essential;
d. non-essential.

12. Ammonium sulfate is used in the isolation of enzymes from the homogenate. What method can be used to purify the enzyme from it?
a. Dialysis
b. Ultracentrifugation
c. Filtering
d. Chromatography
e. Electrophoresis

13. Among the methods used in practice to study metabolism is one that allows the separation, identification and quantification of substances. Name it.
a. Electrophoresis
b. Spectrophotometry
c. X-ray diffraction analysis
d. Manometry
e. Ultracentrifugation

14. An electrophoretic examination of the patient's serum revealed interferon. In the zone of which fraction is this protein?
a. Gamma globulins
b. Beta globulins
c. Alpha-2-globulins
d. Alpha-1-globulins
e. Albums

15. As a result of oxidase reactions, hydrogen peroxide is formed, which is a toxic substance for the body. Glutathione plays an important role in its recovery. Name the amino acids that are part of glutathione:
a. Glutamic acid, cysteine, glycine
b. Aspartic acid, valine, serine
c. Phenylalanine, lysine, tyrosine
d. Lysine, methionine, tryptophan
e. Isoleucine, histidine, alanine

16. Atherosclerosis is a disease that is associated with impaired metabolism of cholesterol, which is transported by lipoproteins. Indicate which of the lipoproteins leads to the development of this disease?
a. LDL
b. HDL
c. VLDL
d. Chylomicrons
e. Triglycerides

17. Atherosclerosis is a disease that is associated with impaired metabolism of cholesterol, which is transported by lipoproteins. Indicate which of the lipoproteins leads to the development of this disease?
a. LDL
b. HDL
c. VLDL
d. Chylomicrons
e. Triglycerides

18. Blood tests revealed structural changes in erythrocytes and hemoglobin. Which amino acid substitution in the hemoglobin beta chain can lead to this?
a. Glutamic acid on valine
b. Aspartic acid on valine
c. Aspartic acid on leucine
d. Glutamic acid on serine
e. Glutamic acid to alanine

19. Both simple and complex proteins are present in the human body. What is the difference in the structure of complex proteins from simple ones?
a. The presence of a non-protein component
b. Lack of non-protein component
c. Spatial organization of a protein molecule
d. A sequence of amino acid residues
e. The number of amino acid residues

20. Changes in the level of plasma lipoproteins indicate a pathology of lipid metabolism. Elevated levels of which lipoproteins can lead to the development of atherosclerosis?
a. Low density lipoprotein (beta-LP)
b. High Density Lipoproteins (alpha-LP)
c. Structural lipoproteins
d. Chylomicrons
e. Medium Density Lipoproteins

21. Choose from the following amino acids non-essential:
a. Tryptophan
b. Methionine
c. Valine
d. Lysine
e. Glutamate

22. Choose from the list of hemoprotein:
a. Catalase
b. Chondroitin sulfuric acid
c. Hyaluronic acid
d. Ikhtulin
e. Vitelin

23. Choose from the list of phosphoproteins:
a. Catalase

b. Hemosiderin
c. Transferrin
d. Interferon
e. Caseinogen

24. Choose the correct continuation of the phrase : "Essential amino acids" are those that ...:
a. Positively charged
b. Negatively charged
c. Synthesized in the body
d. Not synthesized in the body
e. No charge

25. Choose the definition of "denaturation":
a. Destruction of disulfide bonds in the tertiary structure
b. Destruction of hydrogen bonds in the secondary structure
c. Destruction of all levels of organization of the protein molecule, except the primary structure
d. Destruction of the primary structure of the protein to amino acids
e. Destruction of the Quaternary structure to the Tertiary

26. Cyanides are strong poisons for the human body. Which connection would be best to connect them?
a. Methemoglobin
b. Carboxyhemoglobin
c. Carbhemoglobin
d. Oxyhemoglobin
e. Gem

27. Cytochrome C is used to improve tissue respiration in neonatal asphyxia and to restore oxidative processes in the body. To which class of substances does this compound belong?
a. Hemoproteins
b. Phosphoproteins
c. Nucleoproteins
d. Lipoproteins
e. Glycoproteins

28. Dietary protein is called complete if it contains all available:
a. essential amino acids;
b. non-essential amino acids;
c. metabolic amino acids;
d. non-metabolic amino acids.

29. Dietary protein is called defective if it does not contain all available:
a. essential amino acids;
b. non-essential amino acids;
c. metabolic amino acids;
d. non-metabolic amino acids.

30. During heat treatment of food there are irreversible changes in the spatial structure of the protein. This process is called:
a. Renaturation
b. Denaturation
c. Salting
d. Dialysis
e. Hydration

31. During heat treatment of food there are irreversible changes in the spatial structure of the protein. This process is called:
a. Denaturation
b. Renaturation
c. Salting
d. Dialysis
e. Hydration

32. During the absorption of fats in the wall of the small intestine chylomicrons are formed. What lipids are transported in the composition of chylomicrons?
a. Triglycerides, phospholipids, cholesterol and its esters
b. Only triglycerides
c. Triglycerides and phospholipids
d. Cholesterol and its esters
e. Phospholipids, cholesterol and its esters

33. Erythrocyte hemoglobin binds and carries oxygen from the lungs to the tissues. What is the level of structural organization of hemoglobin provides respiratory function in the blood:
a. Quaternary
b. Tertiary
c. Secondary
d. Primary
e. Doesn't matter

34. For peptide bond is characterized by:
a. cyclochain tautomerism
b. cis-trans - isomerism
c. keto-enol tautomerism
d. enantiomeric

35. For the separation of albumins and globulins in clinical and biochemical practice use the method of salting. What substance can cause protein salting?
a. Neutral salts
b. Organic solvents
c. Alkaloids
d. Acids
e. Basics

36. From the list below, select a complex protein - chromoprotein:
a. Tobacco mosaic virus
b. Hemoglobin

c. Caseinogen
d. Vitelin
e. Ihtulin

37. Give an example of an oligomeric protein having a supramolecular structure:
a. Tobacco mosaic virus
b. Globulin
c. Albumin
d. Myoglobin
e. Insulin

38. Hemoglobin has the property of forming a very stable, life-threatening compound with carbon monoxide. What it the name?
a. Carboxyhemoglobin
b. Methemoglobin
c. Carbhemoglobin
d. Oxyhemoglobin
e. Myoglobin

39. Hemoglobin is a complex protein that transports oxygen to the body and removes carbon dioxide from it. Indicate to which class of substances it belongs.
a. Chromoproteins
b. Glycoproteins
c. Lipoproteins
d. Nucleoproteins
e. Metalloproteins

40. Heparin is a powerful natural anticoagulant that is synthesized in mast cells. What is the chemical nature of this compound?
a. Heteropolysaccharide
b. Simple protein
c. Complex protein
d. Homopolysaccharide
e. Phospholipid

41. Heparin is a typical proteoglycan in which several polysaccharide chains are linked to a protein nucleus. Indicate in which body tissue it is synthesized.
a. Liver
b. Heart valves
c. Cartilage
d. Bone
e. Connective tissue

42. If the safety rules were not observed, the concentration of carbon monoxide in the air increased. What kind of hemoglobin will increase?
a. Carboxyhemoglobin
b. Cyanohemoglobin
c. Oxyhemoglobin
d. Methemoglobin

e. Carbhemoglobin

43. In a patient with atherosclerosis, biochemical analysis of blood plasma revealed an increase in blood plasma:
a. Low density lipoprotein
b. Chylomicrons
c. Intermediate density lipoproteins
d. High density lipoproteins
e. Triacylglycerols

44. n a protein molecule, amino acids are linked together by:
a. hydrogen bond;
b. disulfide bond;
c. ionic bond;
d. covalent bond.

45. In clinical practice, the method of salting is used to fractionate serum proteins and other biological fluids. What compounds are used for this purpose?
a. Alkali metal salts
b. Detergents
c. Acids
d. Salts of heavy metals
e. Alkalis

46. In many diseases, to confirm the diagnosis in biochemical laboratories, the analysis of protein fractions is performed using the electrophoretic method. What property of proteins underlies this method?
a. Presence of charge
b. Optical activity
c. Ability to swell
d. High molecular weight
e. High viscosity

47. In the clinic for parenteral protein nutrition, use protein hydrolyzate drugs. The completeness of hydrolysates is determined by the presence of essential amino acids. Indicate which of the following amino acids is essential:
a. Methionine
b. Tyrosine
c. Alanine
d. Glycine
e. Cysteine

48. In the closed garage, the driver was in a car with the engine running. After a while he felt a headache, vomiting began. The formation of which compound leads to this state?
a. Carboxyhemoglobin
b. Cyanmethemoglobin
c. Deoxyhemoglobin
d. Methemoglobin
e. Oxyhemoglobin

49. In the electrophoretic separation of serum proteins, albumin exhibits the most pronounced electronegative properties. Which amino acid is found in large quantities in albumin molecules and determines their acidic properties?
a. Glutamic acid
b. Leucine
c. Lysine
d. Alanine
e. Tryptophan

50. In the formation of the tertiary structure of most globular proteins, nonpolar amino acid residues are immersed in the internal hydrophobic phase of the molecule. Name one of these hydrophobic amino acids.
a. Valine
b. Lysine
c. Arginine
d. Glutamic acid
e. Aspartic acid

51. In the pharmaceutical industry, proteins are isolated from biological fluids, which are used as pharmaceuticals in treatment. Specify which method is used for this:
a. Sequencing
b. Denaturation
c. Electrophoresis
d. Salting
e. Dialysis

52. In the pharmaceutical industry, proteins are isolated from biological fluids, which are used as pharmaceuticals in treatment. Specify which method is used for this:
a. Salting
b. Denaturation
c. Electrophoresis
d. Sequencing
e. Dialysis

53. In the process of catabolism of hemoglobin, iron is released, which in a special transport protein enters the bone marrow and is again used for the synthesis of hemoglobin. This transport protein is
a. Transferrin (siderophylline)
b. Transcobalamin
c. Haptoglobin
d. Ceruloplasmin
e. Albumin

54. It is known that one of the functions of blood proteins is water retention. Name which fraction of proteins performs this function.
a. Albumins
b. Alpha Globulins
c. Prothrombins

d. Fibrinogen
e. Gamma Globulins

55. Lidase is used in the clinic for resorption of scars after burns and operations, as well as hematomas. This drug contains an enzyme that breaks down:
a. Hyaluronic acid
b. Chondroitin-4-sulfate
c. Keratan sulfate
d. Heparin
e. Dermatansulfate

56. Lipoproteins are complex proteins that are part of biological membranes and blood plasma. Specify the main function of plasma lipoproteins:
a. Energy
b. Plastic
c. Transport
d. Regulatory
e. Catalytic

57. Many proteins have a Quaternary structure, ie consist of several polypeptide chains, each of which has its own characteristic ordered conformation. Specify one of these proteins.
a. Hemoglobin
b. Myoglobin
c. Albumin
d. Alpha-1-globulin
e. Prealbumin

58. Name the connections that are involved in the formation and maintenance of the secondary structure in proteins.
a. Hydrogen
b. Peptide
c. Hydrophobic interactions
d. Ionic
e. Disulfide

59. Name the heterocyclic amino acid:
a. Serine
b. Lysine
c. Methionine
d. Tyrosine
e. Tryptophan

60. Name the proteins that are part of deoxyribonucleoproteins:
a. Prolamins
b. Glutelins
c. Globulins
d. Albumins
e. Histones

61. Nitrogen oxides can oxidize Fe2 + in the hemoglobin molecule to Fe3 + to form its derivative, which is unable to attach oxygen. Name this substance:
a. Methemoglobin
b. Carboxyhemoglobin
c. Carbhemoglobin
d. Oxyhemoglobin
e. Deoxyhemoglobin

62. One of the functions of proteins is to protect the body from infectious diseases. What prophylactic antiviral drug of nonspecific protection is recommended during a flu epidemic?
a. Interferon
b. Thymosin
c. Thymolin
d. Albumin
e. Albucid

63. One of the indicators of metabolism is the level of total protein in the serum. Quantitative determination of protein in clinical and biochemical laboratories is based on:
a. Biuret reaction
b. Ninhydrin reaction
c. Xanthoprotein reaction
d. Fol's reactions

64. One of the indicators of metabolism is the level of total protein in the serum. Quantitative determination of protein in clinical and biochemical laboratories is based on:
a. Biuret reaction
b. Ninhydrin reaction
c. Xanthoprotein reaction
d. Fol's reactions
e. Nitroprusside reaction

65. Parenteral nutrition is recommended for a patient with a damaged esophagus. Indicate which of the following pharmaceuticals is a hydrolyzate of amino acids?
a. Hydrolysin
b. Asparkam
c. Rheopolyglucin
d. Polyglucin
e. Panangin

66. Patient D. complains of liver dysfunction. In parallel with other drugs and diet, the doctor suggested that D. eat more cheese. What compound is found in cheese that is involved in the normalization of liver function?
a. Methionine
b. Tryptophan
c. Glutamate
d. Aspartate
e. Alanine

67. Protein consists of proteinogenic amino acids. In what position must the amino group be?

a. alpha position
b. beta position
c. gamma position
d. delta position
e. etta-position

68. Protein denaturation is caused by the following factors:
a. radiation, ultraviolet
b. bromine water
c. 0.9% NaCl solution
d. 5% glucose solution

69. Proteins are high molecular weight natural compounds that are condensates:
a. alpha-amino acids
b. mononucleotides
c. monosaccharides
d. triglycerides

70. Proteins have a high level of spatial organization. What connections are involved in the formation and stabilization of the secondary structure of the protein macromolecule?
a. Hydrogen
b. Essential
c. Hydrophobic
d. Ionic
e. Van der Waals Forces

71. Proteins that consist of amino acid residues and a non-protein component are called:
a. proteins;
b. proteids;
c. globular;
d. fibrillar.

72. Proteins that consist only of amino acid residues are called:
a. proteins;
b. proteids;
c. globular;
d. fibrillar.

73. Salting is used in the technology of obtaining pharmaceutical protein preparations. What is the method to get high of low molecular weight impurities?
a. Dialysis
b. Denaturation
c. Sequencing
d. Salting
e. Electrophoresis

74. Select an essential amino acid from the list below:
a. Glycine
b. Lysine

c. Serine
d. Alanine
e. Tyrosine

75. Sickle cell anemia is caused by a mutation in a gene that is responsible for the synthesis of the protein part of hemoglobin. The polar amino acid is replaced by a non-polar one, which leads to a decrease in the solubility of hemoglobin and a change in the solubility of erythrocytes. Indicate which replacement takes place nin the hemoglobin molecule?
a. Glutamic acid - to valine
b. Alanine - to phenylalanine
c. Glutamic acid - to aspartic acid
d. Valin - to serine
e. Glutamic acid - to lysine

76. Small organic compounds containing an amino group and a carboxyl group are called:
a. peptides;
b. polypeptides;
c. amino acids;
d. proteins.

77. Some proteins in the body exhibit buffering properties. Due to the content of which amino acid does hemoglobin show its buffering properties?
a. Histidine
b. Valine
c. Isoleucine
d. Threonine
e. Alanine

78. Specify a complex protein that performs a protective function against viral infection and tumor lesions:
a. Ferritin
b. Glutathione
c. Glucagon
d. Interferon
e. Secretin

79. Specify an amino acid that lacks an asymmetric carbon atom:
a. Isoleucine
b. Leucine
c. Valine
d. Methionine
e. Glycine

80. Specify the level of structural organization of the protein molecule, for which it is possible to consider the physicochemical properties and biological activity:
a. Secondary
b. Primary
c. Only tertiary
d. Quaternary only

e. Quaternary and Tertiary

81. Specify the main types of bonds characteristic of the primary structure of a protein molecule:
a. Hydrophobic
b. Hydrogen
c. Disulfide
d. Ionic interactions
e. Peptide

82. Specify the main types of bonds that are characteristic of the secondary structure of a protein molecule:
a. Relationships
b. Essential
c. Peptide
d. Hydrogen
e. Van der Waals Forces

83. Specify the method of purification of protein from low molecular weight impurities:
a. Salting
b. Dialysis
c. Electrophoresis
d. Hydrolysis
e. Denaturation

84. Specify the most modern and accurate method of determining the three-dimensional configuration of the protein:
a. Hydrolysis
b. Ultracentrifugation
c. X-ray diffraction analysis
d. Chromatography
e. Electrophoresis

85. Specify the preparatory operation used to study the amino acid composition of purified protein:
a. Hydrolysis
b. Salting
c. Denaturation
d. Freezing
e. Dissolution

86. Specify the principle that underlies the classification of complex proteins:
a. Amino acid composition
b. Solubility
c. The chemical nature of apoprotein
d. Chemical nature of the prosthetic group
e. Ability to denature

87. Specify the principle underlying the classification of complex proteins:
a. Chemical nature of the protein component

b. Amino acid composition
c. Solubility
d. Chemical nature of the prosthetic group
e. Ability to renaturation

88. Specify the principle underlying the method of electrophoretic separation of proteins:
a. The size of a protein molecule
b. Ability to adsorb
c. Specificity of the protein
d. Ability to hydrolyze
e. The magnitude of the protein charge

89. Specify the qualitative response to the peptide bond:
a. Foil
b. Adamkevich
c. Piotrovsky
d. Millon
e. Mulder

90. The alpha helix is a form of secondary structure of the protein. Indicate which connections stabilize this structure.
a. Hydrogen
b. Ionic
c. Hydrophobic
d. Intermolecular interaction
e. Peptide

91. The basis of the structural classification of amino acids is the structure of the side radical. Which of the following amino acids is a diaminomonocarboxylic acid?
a. Lysine
b. Proline
c. Valine
d. Leucine
e. Methionine

92. The basis of the structural classification of amino acids is the structure of the side radical. Which of the following amino acids is a diaminomonocarboxylic acid?
a. Lysine
b. Proline
c. Valine
d. Leucine
e. Methionine

93. The biosynthesis of collagen, the main connective tissue protein, is associated with post-translational modifications that lead to the formation of mature collagen fibrils. The basis of collagen formation is the process of:
a. Hydroxylation
b. Proteolysis
c. Phosphorylation

d. Carboxylation
e. Glycosylation

94. The blood protein fibrinogen is classified according to a certain group of complex proteins. Namely:
a. Glycoproteins
b. Metalloproteins
c. Lipoproteins
d. Nucleoproteins
e. Phosphoproteins

95. The carbohydrate component of proteoglycans is represented by glycosaminoglycans (GAG). Which of the glycosaminoglycans is localized mainly in the liver, lungs, vascular wall?
a. Heparin
b. Hyaluronic acid
c. Keratan sulfate
d. Dermatansulfate
e. Chondroitin sulfate

96. The change in the native structure of the protein under the action of various factors, which leads to the deployment of the protein molecule and the loss of biological activity, is called:
a. coagulation;
b. denaturation;
c. renaturation;
d. destruction.

97. The connective tissue fibrillar proteins include collagen, elastin and reticulin. Specify the amino acid that is only part of collagen and the determination of which in biological fluids is used to diagnose connective tissue diseases:
a. Proline
b. Phenylalanine
c. Lysine
d. Glycine
e. Hydroxyproline

98. The dipeptide carnosine increases the efficiency of ion pumps in muscle cells. Indicate from which amino acids it is formed?
a. Histidine, L-alanine
b. Histidine, D-alanine
c. Histidine, glycine
d. Histidine, valine
e. Histidine, cysteine

99. The doctor, before prescribing the patient protein parenteral nutrition, prescribed a laboratory study of the electrophoretic spectrum of blood proteins. What are the physicochemical properties of proteins used by this method?
a. Presence of charge
b. Viscosity
c. Inability to denature

d. Hydrophilicity and ability to swell
e. Optical activity

100. The donor of the methyl group for methylation of drugs is the active form of one of the amino acids. Select it:
a. Methionine
b. Glutamine
c. Glutamate
d. Cysteine
e. Glycine

101. The drug tannin is used in practical medicine as an astringent in acute and chronic intestinal diseases. The astringent effect of tannin is related to its ability:
a. Denature proteins
b. Hydrolyze proteins
c. Renature proteins
d. Salt proteins
e. Oxidize proteins

102. The first protein, the structure of which was deciphered - is:
a. insulin
b. albumin
c. hemoglobin
d. haptoglobin

103. The following types of isomerism are characteristic of amino acids:
a. lactim-lactam
b. cis-trans
c. structural, enantiomeric
d. keto-enol

104. The irreversible process of destruction of the primary structure of the protein under the action of various factors is called:
a. coagulation;
b. denaturation;
c. renaturation;
d. destruction.

105. The isoelectric state of amino acids is their existence in the form of:
a. anion
b. bipolar ion
c. cation
d. carbation

106. The main substance of the intercellular matrix of connective tissue is formed by proteoglycans, the carbohydrate component of which are glycosaminoglycans. Which glycosaminoglycan plays an important role in regulating tissue permeability?
a. Hyaluronic acid
b. Heparin

c. Hemoglobin
d. Keratan sulfate
e. Heparan sulfate

107. The patient has an excretion of ionized copper in the urine, its deposition in organs and tissues. Indicate which protein synthesis is disrupted, which leads to the following consequences.
a. Ceruloplasmin
b. Transferrin
c. Properdin
d. Haptoglobin
e. Cryoglobulin

108. The patient has elevated levels of low-density lipoprotein and very low-density lipoprotein in the blood plasma. What pathology do these changes indicate?
a. Atherosclerosis
b. Gastritis
c. Leukemia
d. Gout
e. Osteoarthritis

109. The patient has impaired vascular permeability. Name the connective tissue protein, the synthesis of which is disrupted.
a. Collagen
b. Myoglobin
c. Albumin
d. Globulins
e. Ceruloplasmin

110. The patient is in the department - an artificial kidney. Specify the method used to purify his blood from low molecular weight compounds.
a. Dialysis
b. Electrophoresis
c. Denaturation
d. Hydrolysis
e. Salting

111. The patient was diagnosed with sickle cell anemia related to hemoglobinopathies. Replacing which amino acid with valine leads to this disorder?
a. Glutamic acid
b. Arginine
c. Methionine
d. Histidine
e. Tryptophan

112. The patient was prescribed glycosaminoglycan after surgery, which has anticoagulant action. Name this substance:
a. Heparin
b. Chondroitin-4-sulfate
c. Hyaluronic acid

d. Keratan sulfate
e. Chondroitin-6-sulfate

113. The patient with chronic kidney disease on examination revealed edema. Biochemical analysis of blood indicates hypoproteinemia. Which condition is most likely to be associated with a decrease in plasma protein fraction?
a. Decrease in albumin
b. Reduction of globulins
c. Reduction of fibrinogen
d. Reduction of ceruloplasmin
e. Reduction of transferrin

114. The peptide bond between amino acids is formed between:
a. carboxy group of the first amino acid and amino group of the second amino acid
b. amino group of the first amino acid and carboxy group of the second amino acid
c. between the carboxy groups of two amino acids
d. between the amino groups of two amino acids

115. The presence of protein in the solution can be detected by color reactions. Which of the following reactions will give a negative result with complete hydrolysis of the protein?
a. Biuretova
b. Ningidrinov
c. Xanthoprotein
d. Foil
e. Sakaguchi

116. The primary structure of a protein is:
a. spatial stacking of the molecule in the globule;
b. combining several subunits into a macromolecule;
c. spatial stacking of the molecule in a spiral;
d. a certain sequence of amino acids in the chain.

117. The primary structure of the protein is stabilized:
a. ionic bonds
b. by the forces of Van der Waals
c. peptide bonds
d. hydrogen bonds

118. The products of hydrolysis of complex proteins can be:
a. beta- and alpha-amino acids
b. alpha-amino acids and monosaccharides
c. only alpha-amino acids
d. monosaccharides only

119. The protein mixture is separated by:
a. extraction
b. electrophoresis
c. evaporation
d. condensation

120. The quaternary structure of a protein is:
a. spatial stacking of the molecule in the globule;
b. combining several subunits into a macromolecule;
c. spatial stacking of the molecule in a spiral;
d. a certain sequence of amino acids in the chain.

121. The secondary structure of the protein is stabilized :
a. ionic bonds
b. by the forces of Van der Waals
c. peptide bonds
d. hydrogen bonds

122. The secondary structure of the protein is:
a. spatial stacking of the molecule in the globule;
b. combining several subunits into a macromolecule;
c. spatial arrangement of the molecule in a spiral;
d. a certain sequence of amino acids in the chain.

123. The study of the spatial conformation of proteins is carried out using a certain method. Specify it.
a. X-ray diffraction analysis
b. Dialysis
c. Salting
d. Electrophoresis
e. Isoelectric focusing

124. The tertiary structure of the protein is:
a. spatial stacking of the molecule in the globule;
b. combining several subunits into a macromolecule;
c. spatial stacking of the molecule in a spiral;
d. a certain sequence of amino acids in the chain.

125. The transport form of lipids in the blood are lipoproteins. Which of the lipoprotein fractions transports cholesterol from peripheral tissues to the liver?
a. HDL
b. LDL
c. IDL
d. Chylomicrons
e. VLDL

126. To a patient suffering from joint disease, the doctor prescribed an ointment, the active ingredient of which is glycosaminoglycan - an important component of cartilage. What the compound it?
a. Chondroitin sulfate
b. Heparin
c. Glycogen
d. Arabinosis
e. Vitelin

127. To accelerate the healing of the wound of the mucous membrane in the oral cavity, the patient was prescribed a drug that is a thermostable protein contained in humans in tears, saliva, breast milk, and can be found in freshly laid chicken eggs. It is known that it is a factor of natural resistance of the organism and is called:
a. Imanin
b. Complement
c. Interleukin
d. Interferon
e. Lysozyme

128. To determine sulfur-containing amino acids use the reaction:
a. with Pb (NO2
b. Xanthoprotein
c. with Cu (OH) 2
d. Ninhydrin
e. Biuretov

129. To reduce the activity of the blood coagulation system, a natural anticoagulant is prescribed. Name it.
a. Heparin
b. Ascorbic acid
c. Vitamin B12
d. Allopurinol
e. Vikasol

130. What hemoglobin derivative will predominate in the blood of a patient who has signs of hypercapnia?
a. Carbhemoglobin
b. Oxyhemoglobin
c. Carboxyhemoglobin
d. Methemoglobin
e. Glycosylated hemoglobin

131. When the inflammatory process is activated, some autoimmune and infectious diseases, the level of acute phase proteins in the blood plasma increases sharply. Which of the following proteins is able to form a gel when cooling the serum?
a. C-reactive protein
b. Haptoglobin
c. Alpha 2-macroglobulin
d. Ceruloplasmin
e. Cryoglobulin

132. Which gas forms a stable compound with hemoglobin in the blood?
a. CO
b. O2
c. N2
d. CO2
e. NO

133. Wilson-Konovalov disease disrupts the transport of copper, which leads to the accumulation of this metal in brain and liver cells. With the violation of the synthesis of which protein is it associated?

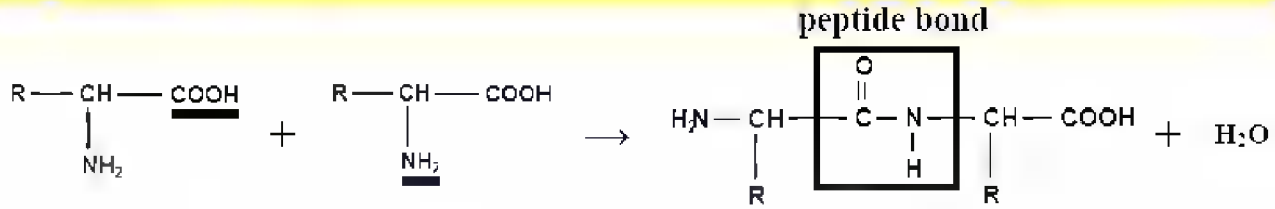
a. Metallothionein
b. Haptoglobin
c. Transcobalamin
d. Siderophylline
e. Ceruloplasmin

Theoretical questions:

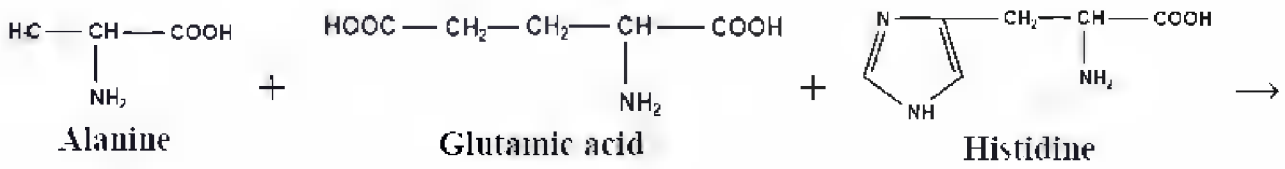
1. Why is phenylalanine a non-polar amino acid and tyrosine a polar one? What's the difference?
2. Can non-essential amino acids be synthesized in the human body? Do the human body need them at all?
3. What are the specifics in formation of peptide bond between proline and other amino acids?
4. What the amino acid isomers are used for protein synthesis? Which amino and carboxy groups of amino acids (alpha, beta, gamma...) are involved in the synthesis?
5. What proteinogenic amino acids contain sulfur? Which of these amino acids has a thiol group?
6. What functional chemical groups provide acidic and basic properties of amino acids?
7. Whether are present non-proteinogenic amino acids in the human body? 1f yes, give examples.
8. What functional chemical groups provide hydrophobic and hydrophilic properties of amino acids?
9. Whether are present heterocyclic 1mino acids in the human body? 1f yes, give examples.
10. Explain why amino acids have both basic and acidic properties?
11. What is the chirality of amino acids? Which of the amino acid isomers are present in Living Organisms?
12. Which hydroxy-containing amino acids are acyclic in structure and which are cyclic?
13. Why is albumin a simple protein and hemoglobin is a complex one? What's the difference?
14. Give at least two examples of proteins with fibrillar structure. What function do they perform in the human body?
15. Explain why edema occurs when the level of blood albumin decreases?
16. Give examples of proteins of each class of globulins. Which protein transports the copper?
17. Explain why histones are able to bind nucleic acids?
18. What part of hemoglobin transports oxygen? What heme-containing proteins carry electrons?
19. What physical factors lead to Denaturation of proteins? 1s the protein able to Renaturation if chemical factor destroys peptide bonds?

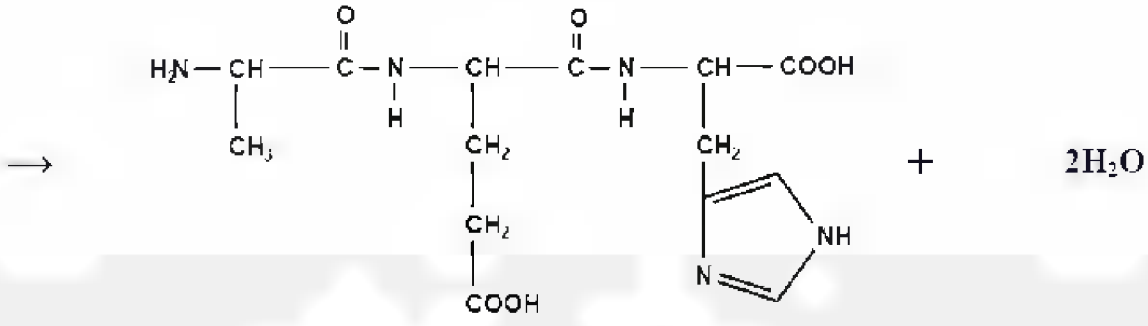
20. Why do albumins and histones have different charges? What is the isoelectric point of a protein?
21. What types of chemical bonds in the tertiary structure of the protein do you know? Give examples of amino acids which form them.
22. Give an example of a protein consisting of protomers. What chemical bonds stabilize its structure?
23. What prosthetic groups of proteins do you know? How is the prosthetic group of chromoproteins different from others?
24. Give at least three examples of chromoproteins.What chromoproteins with the same prosthetic groups do you know?
25. Give examples of proteins with a hydrophobic prosthetic group and with a negatively charged prosthetic group.
26. What prosthetic groups of proteins are polymers? What class of complex proteins are they included?
27. What blood proteins do you know? Give examples of simple and complex blood proteins.
28. Give at least two examples of proteins that perform several functions.
29. Give at least six examples of protein functions and give examples of specific proteins for each of them.
30. What simple and complex proteins have a globular structure? Why are there no fibrillar proteins in the blood?

The tripeptide formation:
Example

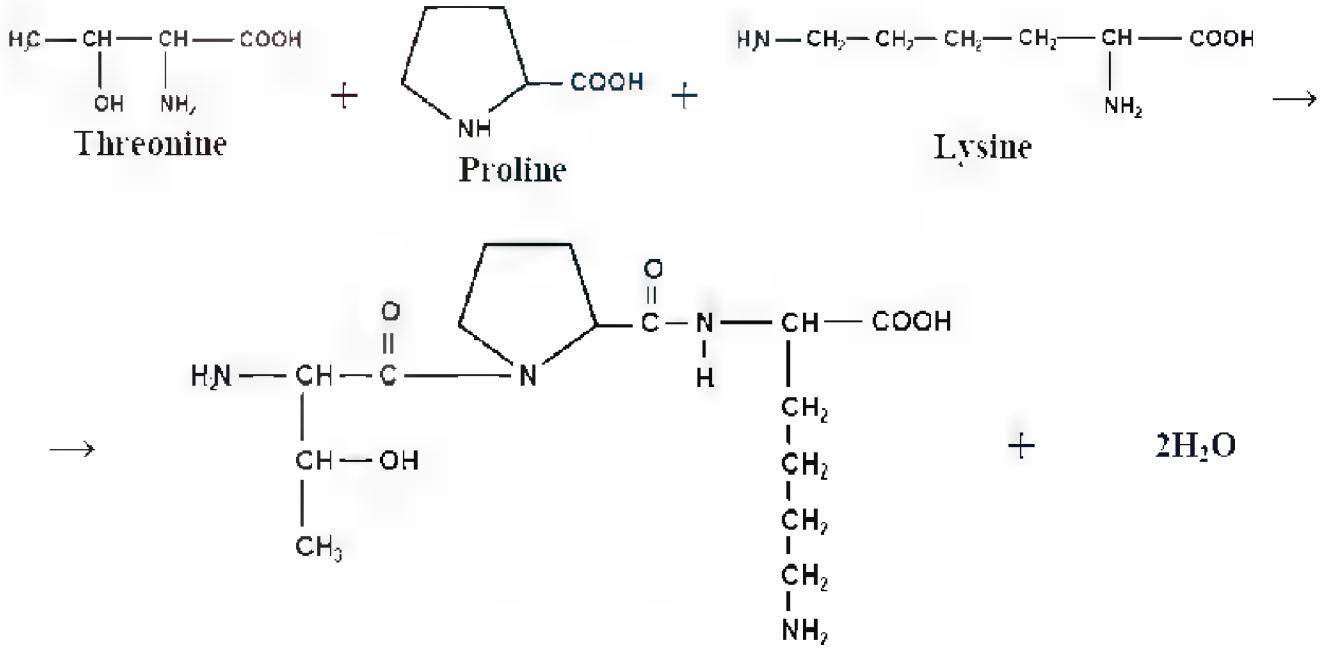


1.





2.



Threonyl-Prolyl-Lysine

Write the pentapeptide structure:

1. Ala , Asn , Pro, Asp , Arg
2. Ala , Asn , Pro, Lys , Arg
3. Ala , Asn , Pro, Lys , His
4. Ala , Cys , Pro, Gln , Arg
5. Ala , Cys , Pro, Gln , His
6. Gly , Asn , Pro, Asp , Arg
7. Gly , Asn , Pro, Lys , Arg
8. Gly , Asn , Pro, Lys , His
9. Gly , Cys , Pro, Asn , Arg
10. Gly , Cys , Pro, Asn , His
11. Ile , Gln , Pro, Asp , Lys
12. Ile , Gln , Pro, Glu , Lys
13. Ile , Met , Pro, Asn , Gln
14. Ile , Met , Pro, Asn , Gln
15. Ile , Met , Pro, Cys , Arg
16. Leu , Cys , Pro, Tyr , Glu
17. Leu , Ile , Pro, Asn , Arg
18. Leu , Ile , Pro, Asn , His
19. Leu , Ile , Pro, Gln , Arg
20. Leu , Ile , Pro, Thr , His
21. Met , Phe , Pro, Gln , Asp
22. Met , Phe , Pro, Gln , Glu
23. Met , Phe , Pro, Thr , Cys
24. Met , Phe , Pro, Thr , Glu
25. Met , Phe , Pro, Thr , Lys
26. Phe , Gly , Pro, Thr , Tyr
27. Phe , Gly , Pro, Tyr , Asn
28. Phe , Ser , Pro, Gln , Asp
29. Phe , Ser , Pro, Gln , Glu
30. Phe , His , Pro, Gln , Arg
31. Ser , Gln , Pro, Glu , Lys
32. Ser , Thr , Pro, Asp , Glu
33. Ser , Thr , Pro, Cys , Glu
34. Ser , Thr , Pro, Cys , Lys
35. Ser , Thr , Pro, Glu , Lys
36. Trp , Gly , Pro, Asn , Asp
37. Trp , Gly , Pro, Gln , Asp
38. Trp , Gly , Pro, Ser , Arg
39. Trp , Gly , Pro, Thr , Glu
40. Trp , Phe , Pro, Gly , Thr
41. Val , Asn , Pro, Gln , Glu
42. Val , Asp , Pro, Lys , Arg
43. Val , Cys , Pro, Asp , His
44. Val , Glu , Pro, Lys , Arg
45. Val , Ile , Pro, Thr , Arg
46. Val , Leu , Pro, Arg , His
47. Asp , Leu , Pro, Trp , Arg
48. Glu , Leu , Pro, Trp , His
49. Asn , Leu , Pro, Tyr , Arg
50. Gln , Met , Pro, Asn , Arg
51. Cys , Met , Pro, Gln , Arg
52. Cly , Met , Pro, Tyr , Asn
53. Tyr , Phe , Pro, Asp , Arg
54. Met , Ser , Pro, Asn , His
55. Lys , Thr , Pro, Cys , Gln
56. Arg , Thr , Pro, Gln , Asp
57. His , Trp , Pro, Asp , Lys
58. Ser , Trp , Pro, Cys , Asp
59. Val , Tyr , Pro, Asp , Lys
60. His , Tyr , Pro, Glu , Lys

Chapter II. Nucleotides. Nucleic acids.

List of the exam questions:

1. Purine and pyrimidine nitrogen bases. Structure and functions of nucleotides and nucleosides. Minor nucleotides.
2. Formation of trinucleotide. Nucleotide polarity.
3. Nucleic acids: definition. Structure, properties and functions of DNA. Chargaff rules.
4. Types, structure and functions of RNA.

Multiple Choice Questions:

1. A double-stranded biopolymer, the monomers of which are deoxyribonucleotides, is called .
a. DNA;
b. RNA;
c. ATP;
d. cAMP.
2. A patient diagnosed with gastric cancer was prescribed a drug that is a derivative of the pyrimidine nitrogenous base, it is antimetabolite. Name this drug .
a. 5-Fluorouracil
b. Adenine
c. Cytosine
d. 5-Methyluracil
e. Guanine
3. A single-chain biopolymer, the monomers of which are ribonucleotides, is called .
a. DNA;
b. RNA;
c. ATP;
d. cAMP.
4. A specific sequence of nitrogenous bases in a DNA molecule encoding a single amino acid in a protein molecule, called .
a. genetic information;
b. genome;
c. gene;
d. triplet.

5. An analogue of dUMP - 5 fluorouracil was used to treat a cancer patient, which blocked the synthesis of thymidine. Which enzyme is blocked by this drug?
a. Thymidylate synthase
b. Thymidine phosphorylase
c. Thymidine kinase
d. Dehydroorotate dehydrogenase
e. Ribonucleotide reductase

6. ATP consists of residues .
a. adenine, ribose, two molecules of phosphoric acid
b. adenine, ribose, one molecule of phosphoric acid
c. adenine, ribose, three molecules of phosphoric acid
d. adenine, ribose, three molecules of sulfuric acid

7. Between the complementary nitrogenous bases A and T there are hydrogen bonds in the amount of .
a. 1
b. 2
c. 3
d. 4

8. Between the residues of pentose and phosphoric acid in the nucleotide there is a connection .
a. ester
b. anhydride
c. peptide
d. phosphodiester

9. Choose the orientation of polynucleotide chains relative to each other in the secondary structure of B-form DNA .
a. Parallel
b. Perpendicular
c. Antiparallel
d. Folded
e. Intermittent

10. Chromatin contains piston proteins that have a positive charge. Which of the following amino acids is present in large quantities in histone proteins and carries a positive charge?
a. Lysine
b. Threonine
c. Valine
d. Alanine
e. Serine

11. Complementary nitrogenous bases in the DNA molecule are .
a. A - G
b. U - C
c. A - T
d. G - U

12. DNA in living organisms performs the function of .
a. preservation of hereditary information and energy saving of the organism;
b. storage and transmission of hereditary information;
c. realization and reproduction of hereditary information;
d. energy saving and catalysis of chemical reactions of the organism.

13. DNA molecules have .
a. amphoteric structure
b. liquid - crystalline structure
c. structure of liquefied gas
d. mosaic structure

14. Each of the two strands of the parent DNA molecule serves as a template for the synthesis of a polynucleotide chain that complements - this is the principle .
a. complementarity;
b. self-recovery;
c. genetic coding;
d. semi-conservatism.

15. Guanilic acid consists of .
a. guanine and pentose
b. guanine and hexose
c. guanine, pentose and phosphoric acid
d. guanine, pentose and sulfuric acid

16. In addition to the main nitrogenous bases, more than 50 minor ones have been found in the structure of tRNA so far. Name one of them.
a. Dihydrouracil
b. Uracil
c. 5-methyluracil
d. Cytosine
e. Adenine

17. In eukaryotic cells, DNA is in a protein-bound form. Specify the proteins that bind to and stabilize the DNA strand .
a. Histones
b. Globulins
c. Prolamines
d. Albumins
e. Glutelins

18. In nucleosides, the type of bond between the nitrogenous base and the carbohydrate .
a. N - glycosidic
b. O - glycosidic
c. ester
d. amide

19. In the ATP molecule, energy is stored in .
a. ester connections
b. anhydride bonds
c. glycosidic ligaments
d. hydrogen bonds

20. In the chromosomes of nuclear nuclei, DNA binds to proteins with histones to form structures called nucleosomes. The nucleus of the nucleosome is formed by eight molecules of histones. Which of the following amino acids in large quantities is part of these proteins?
a. Lysine
b. Valine
c. Leucine
d. Serine
e. Methionine

21. In the GDP molecule, the number of anhydride bonds is .
a. 1
b. 2
c. 3
d. 4

22. Knowing the chemical structure of biologically active substances, we can conclude about their biological functions in the body. To which class of biologically active substances belongs a polynucleotide constructed from deoxyribomononucleotides?
a. DNA
b. Proteins
c. RNA
d. Polysaccharide
e. Lipids

23. Mononucleotides are .
a. phosphates of nucleotides
b. phosphates of carbohydrates
c. phosphates of nucleosides
d. triglyceride phosphates

24. Name the proteins that are part of deoxyribonucleoproteins .
a. Prolamins
b. Glutelins
c. Globulins
d. Albumins
e. Histones

25. Nitrogen bases in the DNA molecule, between which there is a double hydrogen bond .
a. thymine and guanine;
b. adenine and thymine;
c. cytosine and adenine;
d. guanine and cytosine.

26. Nucleic acids are biopolymers whose structural units are .
a. mononucleotides connected by phosphodiester bonds
b. the mononucleotides connected among themselves by glycosidic communications
c. mononucleotides connected by anhydride bonds
d. mononucleotides connected by hydrogen bonds

27. Nucleic acids ensure the preservation and transmission to descendants of hereditary information, as well as mechanisms for its implementation. Which nucleic acid carries information about the number and order of amino acid residues in the protein molecule?
a. mRNA
b. tRNA
c. 18SrRNA
d. mnRNA
e. 28SrRNA

28. Nucleoproteins contain a significant number of simple proteins that stabilize their structure and have a basic character. Indicate which proteins are .
a. Protamines and histones
b. Albumins and globulins
c. Proteinoids
d. Prolamins and glutelins
e. Lipoproteins

29. Nucleosides are .
a. O - glycosides, the aglycone of which are nitrogenous bases
b. N - glycosides, the aglycone of which are nitrogenous bases
c. N - glycosides, the aglycone of which is phosphoric acid
d. N - glycosides whose aglycone is sphingosine

30. Nucleosides include .
a. thymidine
b. adenine
c. thymosin
d. TMP

31. Nucleotides are monomers of nucleic acids. What compounds can be formed by complete hydrolysis of ribonucleotides?
a. Orthophosphoric acid, ribose, uracil
b. Guanine, deoxyribose, orthophosphoric acid
c. Cytosine, thymine, orthophosphoric acid
d. Orthophosphoric acid, adenine, deoxyribose
e. Ribose, thymine, cytosine

32. Phosphodiester bond occurs between the residues .
a. nitrogenous base and phosphoric acid
b. pentose and phosphoric acid
c. pentose
d. nitrogenous bases

33. Plays an important role in the energy metabolism of the cell, transfers energy and is its universal source for all vital processes of living organisms .
a. DNA;
b. RNA;
c. ATP;
d. cAMP.

34. RNA in living organisms performs the function of .
a. preservation of hereditary information and energy saving of the organism;
b. preservation and transmission of hereditary information;
c. realization and reproduction of hereditary information;
d. energy saving and catalysis of chemical reactions of the organism.

35. Some synthetic pyrimidine and purine derivatives are used as antimetabolite drugs. Find the following .
a. 5-fluorouracil
b. Adenine
c. Guanine
d. Cytosine
e. Thyme

36. Specify a compound complementary to cytosine in the secondary structure of DNA .
a. Adenine
b. Xanthine
c. Guanine
d. Hypoxanthine
e. Methyluracil

37. Specify a compound that cannot be a structural component of mRNA .
a. Adenine
b. Pseudouridylic acid
c. Cytosine
d. Thyme
e. Guanine

38. Specify a non-DNA structural component .
a. dAMP
b. dGMP
c. dCMP
d. dTMP
e. dUMP

39. Specify ribonucleoside triphosphate .
a. GTP
b. ADP
c. cGMP
d. cAMP
e. dGTP

40. Specify the carbohydrate that is part of DNA nucleotides .
a. alpha-D-glucopyranose
b. beta-D-fructofuranoses
c. beta-D-ribofuranose
d. beta-D-2-deoxyribofuranose
e. D-arabinose

41. Specify the carbohydrate that is part of the nucleotides inherent in RNA .
a. beta-D-ribofuranose
b. raffinose
c. beta-D-fructofuranoses
d. beta-D-2-deoxyribofuranose
e. beta-D-galactopyranose

42. Specify the component characteristic of DNA .
a. AMP
b. GMP
c. CMP
d. dTMP
e. dUMP

43. Specify the factor, the presence of which in the environment determines the tautomeric form (lacto-lactim) of oxy derivatives of purine and pyrimidine .
a. Temperature
b. pH
c. Accumulation of purines in the cell
d. Accumulation of uracil in the cell
e. Accumulation of ATP in the cell

44. Specify the heterocyclic compound that underlies the structure of adenine .
a. Purine
b. Pyrimidine
c. Imidazole
d. Tryptophan
e. Cyclopentaneperhydrophenanthrene

45. Specify the level of structural organization of the DNA molecule in which the polynucleotide chains are held (stabilized) by hydrogen bonds .
a. Primary
b. Secondary
c. Tertiary
d. Quaternary
e. Super Spiral

46. Specify the minor nitrogenous base of the pyrimidine series .
a. Cytosine
b. Uracil
c. 5-Methylcytosine
d. Timin
e. Adenine

47. Specify the minor nitrogenous basis of the purine series .
a. Adenine
b. Guanine
c. Purine
d. 1-Methylguanine
e. Uracil

48. Specify the monomers of nucleic acids .
a. Nucleosides
b. Nucleotides
c. Nitrogen bases

d. Amino acids
e. Mononucleoside-5'-monophosphate

49. Specify the nitrogenous base - a derivative of pyrimidine .
a. Adenine
b. Thyme
c. Guanine
d. Pyridoxine
e. Imidazole

50. Specify the nitrogenous base, which is not part of the RNA polynucleotide chain .
a. Adenine
b. Guanine
c. Cytosine
d. Uracil
e. Thyme

51. Specify the nucleotide .
a. 2'-Deoxyguanosine
b. Adenilic acid
c. Uridine
d. Adenosine
e. 2'-Deoxycytidine

52. Specify the type of bond between mononucleotide fragments in polynucleotide chains .
a. Ioni
b. 3 ', 5' -Phosphodiester
c. Pyrophosphate
d. Hydrogen
e. Peptide

53. The ATP molecule consists of the following structural parts .
a. carbohydrate component, nitrogenous base and one residue of phosphoric acid;
b. carbohydrate component, nitrogenous base and two residues of phosphoric acid;
c. carbohydrate component, nitrogenous base and three residues of phosphoric acid;
d. carbohydrate component and nitrogenous base.

54. The ATP molecule does not contain .
a. adenine;
b. triphosphate;
c. ribose;
d. deoxyribose.

55. The ATP molecule is .
a. nucleoside;
b. nucleotide;
c. purine base;
d. pyrimidine base.

56. The biological role of information (matrix) RNA is that it .
a. transfers genetic information;
b. transfer DNA;
c. transfers amino acids;
d. transfer ribosomes.

57. The biological role of transport RNA is .
a. transfers genetic information;
b. transfer DNA;
c. tolerates amino acids;
d. transfer ribosomes.

58. The composition of nitrogenous bases of DNA and RNA differs. Which heterocyclic nitrogenous base is not part of DNA?
a. Uracil
b. Cytosine
c. Guanine
d. Thyme
e. Adenine

59. The composition of RNA includes residues of the following nitrogenous bases .
a. A, G, C, U
b. A, G, T, U
c. A, G, C, T
d. A, G, T, P

60. The composition of the DNA molecule includes a carbohydrate .
a. ribose;
b. ribulosis;
c. deoxyribose;
d. glucose.

61. The composition of the RNA molecule includes a carbohydrate .
a. ribose;
b. ribulosis;
c. deoxyribose;
d. glucose.

62. The DNA molecule does not include a nitrogenous base .
a. guanine;
b. adenine;
c. cytosine;
d. uracil.

63. The DNA molecule has the following levels of spatial organization (conformation) .
a. primary structure;
b. primary and secondary structure;
c. primary, secondary and tertiary structure;
d. primary, secondary, tertiary and quaternary structure.

64. The DNA region of a cell that carries encoded information about the amino acid sequence of one polypeptide chain of a protein is called .
a. genetic information;
b. genome;
c. gene;
d. triplet.

65. The method of recording the sequence of amino acids in protein molecules using the sequence of nucleotides in nucleic acids is called .
a. genetic code;
b. genome;
c. gene;
d. triplet.

66. The nucleoside molecule consists of the following structural parts .
a. carbohydrate component, nitrogenous base and one residue of phosphoric acid;
b. carbohydrate component, nitrogenous base and two residues of phosphoric acid;
c. carbohydrate component, nitrogenous base and three residues of phosphoric acid;
d. carbohydrate component and nitrogenous base.

67. The nucleotide molecule consists of the following structural parts .
a. carbohydrate component, nitrogenous base and one residue of phosphoric acid;
b. carbohydrate component, nitrogenous base and two residues of phosphoric acid;
c. carbohydrate component, nitrogenous base and three residues of phosphoric acid;
d. carbohydrate component and nitrogenous base.

68. The polynucleotide chain of mRNA in the eukaryotic cell contains information about .
a. The primary structure of all polypeptide chains of a protein
b. Primary structure of one polypeptide chain
c. Quaternary protein structure
d. The primary structure of DNA
e. Primary structure of t-RNA

69. The primary structure of nucleic acids is a linear polynucleotide chain that has a specific structure and order of nucleotides. What connections stabilize this structure?
a. 3 ′, 5′-Phosphodiester
b. Peptide
c. Glycosides
d. Disulfide
e. Hydrogen

70. The principle of complementarity of construction of a nucleic acid molecule corresponds to the following specificity of pairing of nitrogenous bases .
a. A - U and G - T;
b. A - T and G - C;
c. A - G and C - T;
d. A - C and U - T.

71. The principle of complementarity of construction of a nucleic acid molecule corresponds to the following specificity of pairing of nitrogenous bases .
a. A - U and G - T;
b. A - C and U - T;
c. A - G and C - T;
d. A - T and G - C.

72. The process of repairing DNA damage caused by various chemical and physical factors, which ensures the transmission of hereditary information in an unchanged form, is called .
a. renaturation;
b. denaturation;
c. replication;
d. reparation.

73. The process of self-reproduction of a DNA molecule, which provides accurate copying of hereditary information and its transmission as a result of cell division, is called .
a. renaturation;
b. denaturation;
c. replication;
d. reparation.

74. The result of the ATP hydrolysis reaction is the formation of .
a. ADP and H2O;
b. AMP and H2O;
c. AMP and H3PO4;
d. ADP and H3PO4.

75. The RNA molecule does not include a nitrogenous base .
a. guanine;
b. adenine;
c. cytosine;
d. thymine.

76. The RNA molecule has the following levels of spatial organization (conformation) .
a. primary structure;
b. primary and secondary structure;
c. primary, secondary and tertiary structure;
d. primary, secondary, tertiary and quaternary structure.

77. The secondary structure of DNA is stabilized by bonds .
a. ester
b. phosphodiester
c. hydrogen
d. disulfide

78. The set of DNA molecules that carry the genetic information of a given organism, encoded in genes, is called .
a. genetic code;
b. genome;

c. gene;
d. triplet.

79. The unique biological role of a universal intracellular transporter of hormones, performs .
a. DNA;
b. RNA;
c. ATP;
d. cAMP.

80. Thymidine consists of residues .
a. thymine and ribose
b. thymine and deoxyribose
c. thymine, ribose and phosphate
d. thymine, deoxyribose and phosphate

81. Type of connection between mononucleotides in a DNA molecule .
a. 1 '- 2' phosphodiester
b. 3 '- 5' phosphodiester
c. 2 '- 5' phosphodiester
d. 4 '- 5' phosphodiester

82. What is the antitumor effect of 5-fluorouracil related to?
a. With the conversion of 5-fluorouracil to 5-fluoro-UMP
b. With inhibition of carbamoyl phosphate synthetase II activity
c. With activation of dihydrouracil dehydrogenase
d. With excessive formation of dihydrothymine
e. With inhibition of thioredoxin reductase activity

3rd level difficulty questions:

1. A single-stranded DNA molecule contains 40 nucleotides and has the sequence 5'-(GA)20-3'.Which will be a characteristic of this one single strand?
a. The single-stranded chain will contain both ribose and deoxyribose.
b. The single-stranded chain will contain both purines and pyrimidines.
c. The single-stranded chain will contain one 5'-end and one 3'-end.
d. The single-stranded chain will contain multiple phosphodiester bonds each nlinking a 2'-carbon and a 5'-carbon.

2. A single-stranded DNA molecule contains 40 nucleotides and has the sequence 5'-(GA)20-3'.When this single strand binds to a complementary DNA strand,
a. the complementary strand has the sequence 5'-(CT)20-3' and a cruciform structure could form.
b. the complementary strand has the sequence 5'-(CT)20-3' and a Z-DNA structure could form.
c. the complementary strand has the sequence 5'-(TC)20-3' and an H-DNA structure could form.
d. the complementary strand has the sequence 5'-(TC)20-3' and a hairpin structure could form.

3. A single-stranded DNA molecule contains 40 nucleotides and has the sequence 5'-(GA)20-3'.When this single strand binds to a complementary DNA strand to form a B-DNA structure,
a. half the base-pairs will be A-G pairs and half will be C-T pairs.
b. each base will form at least two hydrogen bonds with a base in the opposite strand.

c. the two strands will form an antiparallel left-handed helix with 12 base¬ pairs per turn.
d. there will be covalent phosphodiester bonds between the two strands.

4. A single-stranded DNA molecule contains 40 nucleotides and has the sequence 5'-(GA)20-3'.Which of the following forces can stabilize a normal DNA double-helix?
a. Base-stacking is a non-covalent interaction that occurs between the relatively hydrophobic bases in the interior of the helix.
b. Base-pairing is a non-covalent interaction that occurs between adjacent bases in the same strand of the DNA molecule.
c. The hydrophilic sugar-phosphate groups are on the exterior of the helix where they can interact with each other.
d. The deoxyribose rings form N-glycosidic bonds with the phosphate groups that link neighboring nucleotides.

5. A single-stranded DNA molecule contains 40 nucleotides and has the sequence 5'-(GA)20-3'.Which of the following double-stranded DNA molecules would denature at about the same temperature as the double-stranded molecule containing a 5'-(GA)20-3' strand?
a. a molecule which contains a (GC)20 strand
b. a molecule which contains a (TA)20 strand
c. a molecule which contains a (GACT)10 strand
d. a molecule which contains a (GGGA)10 strand

6. A single-stranded DNA molecule contains 40 nucleotides and has the sequence 5'-(GA)20-3'.Which characteristic will be shared when comparing the single 5'-(GA)20-3' strand to another single-stranded DNA molecule with the sequence 5'-(AT)20-3'?
a. Both contain a palindromic sequence.
b. Both can form the same secondary structures.
c. Both could hybridize to the same RNA molecule.
d. Both will have the same overall charge.

7. A single-stranded DNA molecule contains 40 nucleotides with equal amounts of A, C, G, and T. This DNA strand can combine with a complementary DNA strand to form a double-stranded DNA molecule.Which structural feature is found in the single-stranded DNA molecule?
a. It can have a negatively-charged backbone composed of nitrogenous bases.
b. Each 3',5'-phosphodiester bond will contain one phosphate group linking two deoxyribose sugars.
c. It can have one end with a 5'-phosphate group while the other end has a 2'-hydroxyl group.
d. Each purine and pyrimidine will be paired with a complementary base.

8. A single-stranded DNA molecule contains 40 nucleotides with equal amounts of A, C, G, and T. This DNA strand can combine with a complementary DNA strand to form a double-stranded DNA molecule.Which is a possible sequence and structure for this DNA molecule?
a. If the single-stranded molecule has the sequence 5'-(ATGC)10, then its double- stranded form could assume a Z-DNA structure.
b. If the single-stranded molecule has the sequence 5'-(GATC)10, then its double-stranded form could assume an H-DNA structure.
c. If the single-stranded molecule has the sequence 5'-(CTGA)10, then its double-stranded form could assume a hairpin structure.

d. If the single-stranded molecule has the sequence 5'-(TGAC)10, then its double-stranded form could assume a cruciform structure.

9. A single-stranded DNA molecule contains 40 nucleotides with equal amounts of A, C, G, and T. This DNA strand can combine with a complementary DNA strand to form a double-stranded DNA molecule.Which characteristic does this double-stranded molecule have when it forms a B- DNA structure?
a. The two strands will have parallel orientation and identical sequences.
b. The helix will be right-handed with 12 base-pairs per turn.
c. Every base-pair will contain one purine and one pyrimidine.
d. There are both covalent and non-covalent bonds between the two chains.

10. A single-stranded DNA molecule contains 40 nucleotides with equal amounts of A, C, G, and T. This DNA strand can combine with a complementary DNA strand to form a double-stranded DNA molecule.Which force can stabilize a DNA double-helix?
a. Hydrophobic bases are found in the interior of the helix where each base¬pair is stabilized by the same number of hydrogen bonds.
b. Hydrophilic sugar-phosphate groups are found on the exterior of the helix where they can interact with water.
c. Non-covalent N-glycosidic bonds can form between nitrogenous bases in opposite strands in the helix.
d. Covalent base-stacking interactions can occur between adjacent bases within the same strand in the helix.

11. A single-stranded DNA molecule contains 40 nucleotides with equal amounts of A, C, G, and T. This DNA strand can combine with a complementary DNA strand to form a double-stranded DNA molecule.Which of the following double-stranded DNA molecules would denature at a lower temperature than the 40 base-pair double-stranded molecule described above?
a. a 40 base-pair molecule in which 25% of the bases are adenines
b. a 30 base-pair molecule in which 40% of the bases are guanines
c. a 20 base-pair molecule in which 10% of the bases are thymines
d. a 10 base-pair molecule in which 20 % of the bases are cytosines

12. A single-stranded DNA molecule contains 40 nucleotides with equal amounts of A, C, G, and T. This DNA strand can combine with a complementary DNA strand to form a double-stranded DNA molecule.Which characteristic will this double-stranded DNA molecule share with a double-stranded RNA molecule of the same size?
a. Both will have secondary structure.
b. Both will contain inverted repeats.
c. Both will be degraded by base.
d. Both will contain four types of base-pairs.

13. Genetic material is examined in several organisms. A new virus, virus X, is isolated and studied. Which molecule is most likely to be the genetic material of virus X?
a. a linear DNA molecule containing 10,000 base-pairs
b. a linear RNA molecule containing plasmids
c. a circular DNA molecule containing nucleosomes
d. a circular RNA molecule with a molecular weight of 10 billion

14. Genetic material is examined in several organisms. Assume that DNA molecules are studied in a variety of organisms and found to have the following properties. Which property would be consistent with the hypothesis that genetic material is composed of DNA?
a. DNA in all organisms is composed of the same nucleotides.
b. DNA in an organism remains constant as the organism ages.
c. DNA from two different organisms has the same base composition.
d. DNA is different in two different cells of the same organism.

15. Genetic material is examined in several organisms. Histones
a. are negatively-charged globular proteins.
b. contain both a-helix and в-pleated sheet.
c. have molecular weights in excess of 100,000.
d. contain high amounts of basic amino acids.

16. Genetic material is examined in several organisms. If the following experimental results were obtained, which would be evidence against DNA being the genetic material?
a. The base composition of DNA is the same in two different cells of the same organism.
b. The viral components labeled with 32P remain outside the cell during a successful infection.
c. The transforming factor isolated from a virulent bacterium is sensitive to deoxyribonucleases.
d. The base composition of DNA in an organism remains constant as the organism ages.

17. Genetic material is examined in several organisms. Which are characteristics of bacterial genetic material?
a. It is double-stranded and supercoiled.
b. It is single-stranded and relaxed.
c. It is circular and compacted into palindromes.
d. It is linear and attached to a protein scaffold.

18. Genetic material is examined in several organisms. Which describes the structural properties of a eukaryotic chromosome?
a. It contains a double-helix composed of nucleosomes each with four million base-pairs.
b. It is one double-stranded linear DNA molecule bound to proteins for compaction.
c. It is arranged into a 30 nm fiber which is attached to the cell membrane.
d. It contains linker regions which are arranged into loops and coiled to form a helix.

19. Genetic material is examined in several organisms. Which is a characteristic of eukaryotic genetic material?
a. Eukaryotic genetic material consists of supercoiled circular DNA molecules complexed with proteins into chromosomes.
b. Eukaryotic genetic material consists of relaxed linear DNA molecules complexed with RNA into a 30 nm fiber.
c. Eukaryotic genetic material is compacted by wrapping the double-helix around histone proteins to form nucleosomes.
d. Eukaryotic genetic material is compacted by folding linker regions around non-histone proteins to form a scaffold.

20. Genetic material is examined in several organisms. Which is a property of both viral genetic material and bacterial genetic material?
a. Both can be double-stranded, circular DNA.

b. Both can be single-stranded, linear RNA.
c. Both can be compacted into inverted repeats.
d. Both can be compacted into plasmids.

21. Genetic material is examined in several organisms. Which of the following experimental results, if obtained, would be evidence against proteins being the genetic material?
a. The viral components labeled with 35S are found inside the bacterial cell during a successful infection.
b. The viral components labeled with 32P are found outside the bacterial cell during a successful infection.
c. The transforming factor isolated from a virulent bacterium is resistant to proteases.
d. The transforming factor isolated from a virulent bacterium is resistant to deoxyribonucleases.

22. Genetic material is examined in several organisms. Which property is shared by the five histone proteins?
a. They are acidic proteins with relatively large molecular weights.
b. They are multimeric proteins with high levels of Arg and Lys.
c. They are fibrous proteins with high amounts of a-helix.
d. They are globular proteins with a positive charge.

23. The components and structures of common nucleotides are compared. Which structural feature is shared by both uracil and thymine?
a. Both contain two keto groups.
b. Both contain one methyl group.
c. Both contain a five-membered ring.
d. Both contain three nitrogen atoms.

24. The components and structures of common nucleotides are compared. Which component is found in both adenosine and deoxycytidine?
a. Both contain a pyranose.
b. Both contain a 1,1'-N-glycosidic bond.
c. Both contain a pyrimidine.
d. Both contain a 3'-OH group.

25. The components and structures of common nucleotides are compared. Which property is shared by both GDP and AMP?
a. Both contain the same charge at neutral pH.
b. Both contain the same number of phosphate groups.
c. Both contain the same purine.
d. Both contain the same furanose.

26. The components and structures of common nucleotides are compared. Which characteristic is shared by purines and pyrimidines?
a. Both contain two heterocyclic rings with aromatic character.
b. Both can form multiple non-covalent hydrogen bonds.
c. Both exist in planar configurations with a hemiacetal linkage.
d. Both exist as neutral zwitterions under cellular conditions.

27. The components and structures of common nucleotides are compared. Which property is found in nucleosides and nucleotides?
a. Both contain a nitrogenous base, a pentose, and at least one phosphate group.
b. Both contain a covalent phosphodister bond that is broken in strong acid.
c. Both contain an anomeric carbon atom that is part of a β-N-glycosidic bond.
d. Both contain an aldose with hydroxyl groups that can tautomerize.

28. The structures of nucleotides and their components are studied. Which characteristic is shared by both adenine and cytosine?
a. Both contain one methyl group.
b. Both are anomeric.
c. Both contain one keto group.
d. Both are heterocyclic.

29. The structures of nucleotides and their components are studied. Which component is found in both guanosine and uridine?
a. Both contain an aldohexose.
b. Both contain three hydroxyl groups.
c. Both contain a 1',9 - bond.
d. Both contain a pyranose.

30. The structures of nucleotides and their components are studied. Which property is shared by both CTP and dTDP?
a. Both contain the same sugar.
b. Both contain the same charge at cellular pH.
c. Both contain a planar six-membered ring.
d. Both contain phosphodiester bonds.

31. The structures of nucleotides and their components are studied. Which characteristic is found in both purines and pyrimidines?
a. They both have aromatic rings that undergo substantial tautomerization at neutral pH.
b. They both are weak bases that can be positively charged at neutral pH.
c. They both have multiple pKa values that result in zwitterion forms.
d. They both can form stable N-glycosidic bonds with β D-ribofuranose.

32. The structures of nucleotides and their components are studied. Which is a general property of both nucleosides and nucleotides?
a. Both contain a pentose in the form of a furanose.
b. Both contain at least one 5'-phosphate group.
c. Both contain a nitrogenous base that forms covalent H-bonds.
d. Both contain a hemiacetal or hemiketal bond.

Missing Words:

1. Write the missing words.cAMP is formed from _____ by the enzyme _____.
2. Write the missing words.Chromatin consists of a long double- stranded _____ molecule.
3. Write the missing words.Cocoa contains the purine base containing substituent _____.

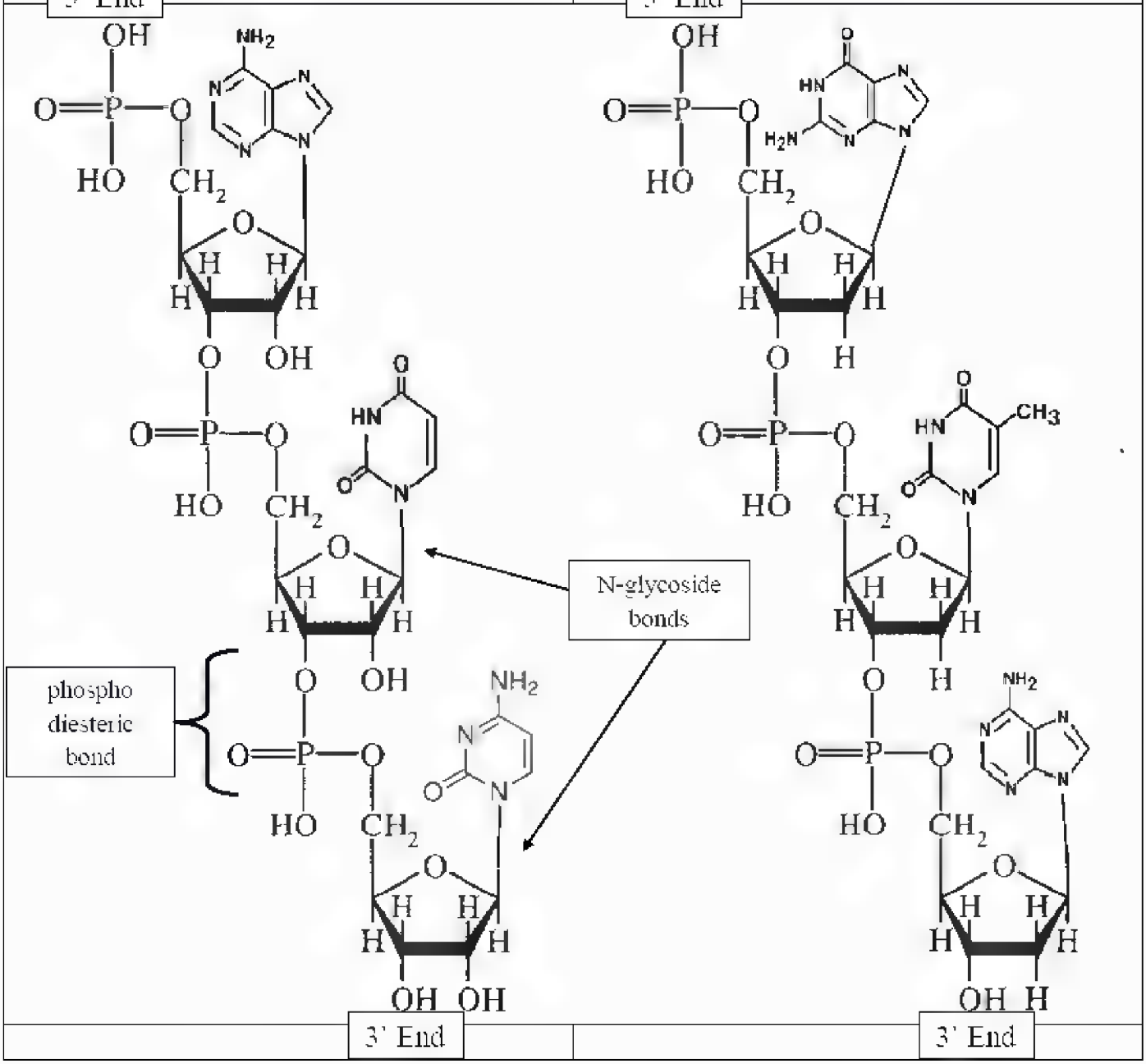
4. Write the missing words.Cyclic AMP is destroyed in tissues by its conver¬sion to _____ by the enzyme _____.
5. Write the missing words.DNA molecules are long and its length is_____ times greater than its breadth.
6. Write the missing words.DNA produces a_____ which helps in placing _____ in the code for protein synthesis.
7. Write the missing words.For each gene in the DNA molecule, there is a _____ strand and its complimentary _____ strand.
8. Write the missing words.Nucleoproteins are conjugated proteins contain¬ing _____ and a basic protein like _____ or _____.
9. Write the missing words.One tRNA corresponds to each of the_____ amino acids required for_____ synthesis.
10. Write the missing words.Ribosomes are _____ particles and reticular granules of _____ in diameter.
11. Write the missing words.Tea contains the purine base containing substituent _____.
12. Write the missing words.The base thymine of DNA is replaced by the base in _____.
13. Write the missing words.The formation of RNA template is directed by _____.
14. Write the missing words.The heterogeneous nuclear RNA (HnRNA) mol¬ecules are _____ processed to generate the molecules which then enter the cytoplasm to serve as templates for _____ synthesis.
15. Write the missing words.The messenger RNA is the most_____ in size and stability.
16. Write the missing words.The strand which is transcribed into an RNA molecule is referred to as the _____ of the DNA.
17. Write the missing words.The unit of genetic information is the_____ or_____.
18. Write the missing words.The_____ loop at the end of a base-paired stem of tRNA recognizes the codon of the template _____.
19. Write the missing words.Two strands of double helical molecules are _____.

Theoretical questions:

1. Differences between RNA and DNA by primary structure.
2. Differences between RNA and DNA by secondary structure.
3. Differences between RNA and DNA by tertiary structure.
4. How the DNA is protected from nuclease action?
5. How the mRNA is protected from nuclease action?
6. List the functions of nucleotides and the corresponding derivatives that perform them.
7. Transmission and realizing genetic information, central dogma (short description).
8. What is the specific in the mRNA strucrute?
9. What is the specifics in the the formation of glycoside, phosphoesteric and phosphodiesteric bonds in nucleotides?
10. What is the specific in the tRNA strucrute?
11. What properties of histones and non-histine proteins helps in the genetic material packaging?
12. Which type of RNA dont need proteins for the fomation of tertiary sructure? How looks this structure?

The trinucleotide formation:
Examle

A-U-C	G-T-A
In **RNA** structure	In **DNA** structure
Nitrogenous bases: A. U. G. C Sugar - **Ribose**	Nitrogenous bases: A. T. G. C Sugar - **2-deoxyribose**



Write the trinucleotide structure:

1. A,G,U	5. A,C,G	9. A,T,C	13. C,U,G	17. T,C,A	21. U,A,G	25. G,C,U
2. A,T,C	6. A,G,C	10. A,U,G	14. C,U,G	18. T,C,A	22. U,A,G	26. G,U,A
3. G,A,T	7. A,G,U	11. C,T,A	15. G,A,C	19. T,C,A	23. U,C,G	27. G,U,A
4. G,C,U	8. A,U,G	12. C,T,A	16. G,A,T	20. T,G,A	24. U,C,G	28. U,A,G

Chapter III. Enzymes.

List of the exam questions:

1. General principles of catalysis.
2. The structure and properties of enzymes. Active and allosteric sites of enzyme, their structure and function.
3. Mechanism of enzyme action: Michaelis and Menten theory, Emil Fisher theory, Koshland theory, the modern "induced fit" hypothesis.
4. Enzyme specificity to substrate.
5. Isoenzymes: definition, role in clinical diagnostic.
6. Kinetics of enzymatic reactions.
7. Determination of enzyme activity.
8. Effect of enzyme concentration, substrate concentration, pH and temperature on enzymatic reaction rate.
9. Classification and nomenclature of enzymes. Definition and the reaction equation of oxydoreductases, transferases, hydrolases, lyases ect.
10. Cofactors and coenzymes vitamins.
11. Inhibitors and activators of enzymes: irreversible, competitive and non-competitive inhibitors, mechanism and examples.
12. Multienzymes complexes.
13. Regulation of enzyme activity: allosteric, covalent modification, limited proteolysis ect. Enzyme compartmentalization.
14. Most important enzymes in clinical diagnostic.
15. Enzymes therapy: replacement treatment, proteolytic and depolymerizing action, inhibitors of enzymes.

Multiple Choice Questions:

Enzymes

1. 12 hours after an accute attack of retrosternal pain a patient presented a jump of aspartate aminotransferase activity in blood serum. What pathology is this deviation typical for?

a. Myocardium infarction
b. Diabetes insipidus
c. Collagenosis
d. Diabetes mellitus
e. Viral hepatitis

2. A 27-year-old patient was found having pathological signs in the liver and cerebrum. A sharp decrease of copper level was determined in the blood plasma, whereas the urine concentration of the metal proved to be increased. A supposed diagnosis is Willson's disease. What blood plasma enzyme activity is it necessary to test to confirm the diagnosis?

a. Xanthine oxidase.
b. Carboanhydrase.
c. Ceruloplasmin.

d. Leucine aminopeptidase.
e. Alcohol dehydrogenase.

3. A 30-year-old male patient with acute pancreatitis has been found to have a disorder of ncavitary protein digestion. The reason for such condition can be the hyposynthesis and nhyposecretion of the following enzyme :
a. Pepsin
b. Dipeptidase
c. Amylase
d. Lipase
e. Trypsin

4. A 42-year man suffering from gout has increased level of uric acid in the blood. Allopurinol was prescribed to decrease the level of uric acid. Competitive inhibitor of what enzyme is allopurinol?
a. Xanthineoxidase
b. Adenosinedeaminase
c. Adeninephosphoribosiltransferase
d. Hypoxantinphosphoribosiltransferase
e. Guaninedeaminase

5. A 46-year-old female patient has a continuous history of progressive muscular (Duchenne's) dystrophy. Which blood enzyme changes will be of diagnostic value in this case?
a. Pyruvate dehydrogenase
b. Lactate dehydrogenase
c. Creatine phosphokinase
d. Glutamate dehydrogenase
e. Adenylate cyclase

6. A 47-year-old patient was brought to an emergency department with the diagnosis of myocardial infarction. What lactate dehydrogenase (LDH) fraction's activity would prevail in the patient's blood serum during the first two days after hospitalization?
a. LDH4
b. LDH6
c. LDH3
d. LDH1
e. LDH5

7. A 49-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 tones are decreased. Laboratory studies revealed high activity of creatine kinase and LDH1. What disease are these symptoms typical for?
a. Acute myocardial infarction
b. Diabetes mellitus
c. Acute pancreatitis
d. Cholelithiasis
e. Stenocardia

8. A 50-year-old woman was brought to an emergency clinic with the diagnosis of myocardial infarction. The activity of what enzyme will prevail in her blood plasma during the first two days after hospitalization?
a. Alkaline phosphatase.
b. γ -Glutamyl transpeptidase.
c. Aspartate aminotransferase.
d. Acidic phosphatase.
e. Hexokinase.

9. A competitive inhibitor of an enzyme
a. Increases Km but does not affect Vmax
b. Decreases Km but does not affect Vmax
c. Increases Vmax but does not affect Km
d. Decreases Vmax but does not affect Km
e. Decreases both Vmax and Km.

10. A considerable rise of activities of MB-form of creatine kinase and LDH1 is revealed in the blood of a patient. Name the most probable pathology.
a. Hepatitis
b. Myocardial infarction
c. Rheumatism
d. Pancreatitis
e. Cholecystitis

11. A man of 50 years who abused alcohol for a long time arose pain in the abdomen. The doctor suspected acute pancreatitis. The increased activity of which enzyme in the blood confirms this diagnosis?
a. transaminase
b. amylase
c. lipase
d. lactate dehydrogenase
e. creatine phosphokinase

12. A newborn child had dyspepsia phenomena (diarrhea, vomiting) detected after feeding with milk. After additional feeding with glucose the morbid symptoms disappeared. The insufficient activity of what enzyme that takes part in the carbohydrates breakdown causes the indicated disorders?
a. Saccharase.
b. Amylase.
c. Lactase.
d. Isomaltase.
e. Maltase.

13. A newborn develops dyspepsia after the milk feeding. When the milk is substituted by the glucose solution the dyspepsia symptoms disappear. The newborn has the subnormal activity of the following enzyme :
a. Amylase
b. Maltase
c. Invertase

d. Isomaltase
e. Lactase.

14. A newborn develops dyspepsia after the milk feeding. When the milk is substituted by the glucose solution the dyspepsia symptoms disappear. The newborn has the subnormal activity of the following enzyme :
a. Amylase
b. Maltase
c. Invertase
d. Isomaltase
e. Lactase.

15. A patient with acute pancreatitis to prevent autolysis of the pancreas should be :
a. Protease inhibitors
b. Insulin
c. Complex pancreatic enzymes
d. Antibiotics
e. Sulfanilamides

16. A patient with methanol poisoning was prescribed oral or intravenous ethanol administration at high doses. What is biochemical mechanism of such treatment?
a. Acceleration of methanol excretion by gastrointestinal tract
b. Increase of methanol detoxication by liver
c. Competitive inhibition of alcohol dehydrogenase
d. Uncompetitive inhibition of alcohol dehydrogenase
e. Allosteric activation of alcohol dehydrogenase.

17. A qualitative composition of product's molecule is completely identical to substrate's one, but the structure is different. Name the enzyme class :
a. Oxidoreductase;
b. Hydrolase
c. Lyase
d. Ligase
e. Isomerase.

18. A structural analogue of vitamin B2 - acrichine - is prescribed in case of enterobiosis. The inhibition of what enzymes of microorganisms does this preparation cause?
a. Cytochrome oxidase
b. FAD-dependent dehydrogenases
c. Peptidases
d. NAD-dependent dehydrogenases
e. Amino transferases.

19. A substrate molecule is split upon enzyme action, and the water is used for the product's structure formation. Name the enzyme class :
a. Oxidoreductase
b. Hydrolase
c. Lyase
d. Ligase

e. Isomerase.

20. Absolute inherent specificity of the enzyme :
a. amylase
b. pepsin
c. urease
d. alcohol dehydrogenase
e. phosphatase

21. Activity of which enzyme in the blood the most increases during the first hours of myocardial infarction :
a. glutamate dehydrogenase
b. aspartate dehydrogenase
c. alaninaminotransferase
d. lactate dehydrogenase
e. creatine phosphokinase

22. After 12 hours of acute pain behind the breastbone, the essential rise of blood plasma aspartate aminotransferase activity occured. What pathology are the mentioned symptoms typical of?
a. Collagenose.
b. Viral hepatitis.
c. Myocardial infarction.
d. Insulin dependent diabetes mellitus.
e. Diabetes insipidus.

23. After addition of pancreatic extract into a test tube with starch solution disapperance of blue color in iodine test was observed. Under the action of which pancreatic enzyme the starch is completely hydrolyzed?
a. α-Amylase
b. Chymotrypsin
c. Lipase
d. Aldolase
e. Trypsin.

24. As called the site of the enzyme molecule that is responsible for joining the substrate and its transformation into a product of the reaction?
a. Active Center
b. allosteric center
c. adsorption center
d. The hydrophobic center
e. Contact Center

25. At what temperature denaturation of most of enzymes?
a. -10-0°C.
b. 10-20°C
c. 20-30°C
d. 30-40°C
e. 50-60°C

26. Bacteriostatic effect of sulfanilamides consists in the fact that they compete with PABA the stage of formation :
a. cobalamin
b. Folate
c. biotin
d. Niacin
e. Thiamine

27. Bile acids activate :
a. lipase
b. amylase
c. trypsin
d. pepsin
e. sucrase.

28. By limited proteolysis converts :
a. Pepsinogen to pepsin
b. Trypsinogen to chymotrypsin
c. Trypsinogen to trypsin
d. Chymotrypsinogen to trypsin
e. Elastase in proelastazu

29. Cell enzymes are denaturates at pH :
a. 1.0
b. 5.0
c. 6.0
d. 7.0
e. 8.0.

30. Cell enzymes denaturate at pH :
a. 5.0
b. 5.5
c. 6.0
d. 7.0
e. 11.0.

31. Cyanides are extremely powerful cell's poison which can cause death of the human body. Which enzyme blocking in tissue respiration is basic in this action?
a. Catalase
b. Superoxide dismutase
c. Cytochrome oxidase
d. Hemoglobin reductase
e. Glucose-6-phosphatdehydrogenase

32. Cyanides block the action of cytochrome oxidase, being combined with iron ions, which are the active center of the enzyme. What type of inhibition occurs?
a. Allosteric
b. non- competitive

c. Reversible
d. Competitive

33. Does the substrate and enzyme concentration on the rate of enzyme reactions?
a. No effect
b. Affects under optimal conditions
c. Affects only the initial phase
d. Affects the terminal phase reaction
e. Affects only at t
f. 250C

34. During the necropsy of a 20-year-old girl a pathologist concluded that the death of the patient had resulted from poisoning by cyanides. The activity of what enzyme is mostly inhibited bycyanides?
a. Malate dehydrogenase.
b. Cytochrome oxidase.
c. Heme synthase.
d. Aspartate aminotransferase.
e. Carbamoyl phosphate synthetase.

35. Enzymes are the catalysts of protein nature. Name the property of enzymes which is not npresented at the inorganic catalysts :
a. Ability to the denaturation
b. Wide specificity
c. Inert to chemical substrates
d. Big half-life
e. Ability to lowering the energy to activate the reaction.

36. For the diagnosis of acute pancreatitis in urine determine enzyme activity :
a. amylase (diastase)
b. lactate dehydrogenase
c. creatine kinase
d. aldolase
e. alanine aminotransferase

37. For the treatment of tuberculosis isoniazid – structural analog of nicotinamide and pyridoxine – is prescribed. Which type of inhibition is caused by isoniazid?
a. Irreversible
b. Competitive
c. Noncompetitive
d. Uncompetitive
e. Allosteric.

38. From the statements are true :
a. Km independent of pH, temperature and ionic force of enzymatic reactions
b. Vmax not depend on the concentration of enzyme
c. Km depends on the concentration of enzyme

d. Km equal to the substrate concentration at which the enzyme reaction rate is half of Vmax
e. Km equal to the substrate concentration at which the enzyme reaction speed is maximum

39. Gordox, which is an inhibitor of :
a. Trypsin
b. Elastase
c. Carboxypeptidase
d. Chymotrypsin
e. Gastricsin

40. Heavy metals inhibit enzymes which have sulfhydryl groups. Which amino acid is used for reactivation of these enzymes?
a. Histidine
b. Isoleucine
c. Cysteine
d. Aspartate
e. Glycine.

41. Histidine decarboxylase catalyzes the conversion of histidine to vasoactive mediator histamine, belongs to the class :
a. isomerase
b. oxidoreductases
c. liase
d. transferase
e. hydrolase

42. How do the enzymes influence on activation energy level :
a. increase
b. decrease
c. do not change.

43. How inhibitors acting during competitive inhibition?
a. Inhibitor connected to the contact area of the active center of the enzyme
b. Inhibitor joins the enzyme-substrate complex
c. Inhibitor binds coenzyme
d. Inhibitor connects with the enzyme in the allosteric center
e. Inhibitor connected to the substrate

44. How many classes of enzymes are there?
a. 4
b. 5
c. 6
d. 7
e. 9.

45. How many classes of enzymes?
a. 4

b. 6
c. 12
d. 2
e. 8

46. Hydrochloric acid activates :
a. lipase
b. amylase
c. trypsin
d. pepsin
e. sucrase.

47. If the temperature of incubating environment is raised from 0° C up to 40° C the activity of human enzymes is usually increased. Find the cause of this change :
a. The probability of ES complex formation is increased
b. A denaturation of enzymes occurs
c. The enzyme molecular charge changes
d. The substrate molecular charge changes
e. Enzyme action specificity increase.

48. In a human body chymotrypsin is produced by the pancreas as the inactive precursor called chymotrypsinogen. What intestinal lumen enzyme leads to the transforming of chymotrypsinogen into the catalytically active enzyme molecule?
a. Aminopeptidase
b. Enterokinase
c. Pepsin
d. Trypsin
e. Carboxypeptidase.

49. In a human body trypsin is produced by the pancreas as the inactive precursor called trypsinogen. What intestinal lumen enzyme leads to the transforming of trypsinogen into the catalytically active enzyme molecule?
a. Aminopeptidase
b. Enterokinase
c. Pepsin
d. Trypsin
e. Carboxypeptidase.

50. In a patient with acute viral hepatitis A (Botkin's disease). Growing activity of which enzyme in the blood confirms the destruction of hepatocytes?
a. alanine aminotransferase
b. amylase
c. creatine kinase
d. trypsin
e. hexokinase

51. In a patient's blood the activities of lactate dehydrogenase (LDH4, LDH5), alanine aminotransferase, carbamoyl ornithinetransferase are increased. What organ is the pathological process developing in?
a. In skeletal muscles.
b. In the myocardium (myocardial infarction is possible).
c. In the liver (hepatitis is possible).
d. In kidneys.
e. In connective tissue.

52. In an environment that contains succinate and enzyme succinate dehydrogenase (SDH), added inhibitor malonate. Enzyme activity resumed with increasing substrate concentration. What type of inhibition :
a. Allosteric
b. Irreversible
c. Reversible non-competitive
d. Reversible
e. Reversible competitive

53. In human saliva there is an enzyme able to hydrolyze the α-1,4-glucosidic bonds in the molecule of starch. Name this enzyme.
a. α-Amylase.
b. Phosphatase.
c. Fructofuranosidase.
d. β-Galactosidase.
e. Lysozyme.

54. In human saliva there is an enzyme that renders potent bactericidal action due to the ability to destroy peptidoglycanes of the bacterial wall. Name this enzyme.
a. Phosphatase.
b. α-Amylase.
c. Trypsin.
d. Lysozyme.
e. Ribonuclease.

55. In medical practice for the treatment of alcoholism widely used teturam, which is an inhibitor aldehyde dehydrogenase. Increased blood metabolite which causes aversion to alcohol?
a. methanol
b. Ethanol
c. Acetic acid
d. Acetaldehyde
e. Pyruvate

56. In the patient's blood found increased activity of creatine kinase MB form, LDH and AST. Damage of what organ indicates these changes?
a. cardiac muscle
b. liver
c. striated muscles
d. kidney
e. brain

57. In the practice of alcoholism treatment, the use of desulphiram, which is the inhibitor of nacetaldehyde dehydrogenase, is widespread. The increase of what metabolite in blood results in the evolving of disgust to alcohol?

a. Methanol
b. Ethanol
c. Malonic dialdehyde
d. Propionic aldehyde
e. Acetic aldehyde.

58. In tissue homogenates allocated enzymes that catalyze the mutual conversion of lactate and pyruvate. The proteins differ in electrophoretic mobility and molecular weight. These enzymes are called :

a. cofactors
b. holoenzymes
c. coenzymes
d. isoenzymes
e. proenzyme

59. In what units express the specific activity of the enzyme in medical enzymology (in CI)?

a. Units of activity (U) per 1 liter of biological fluids
b. Units of activity (U) per 100 ml of biological liquid
c. Units of activity (U) per 10 ml of biological liquid
d. Units of activity (U) per 1 ml of biological liquid
e. Units of activity (U) per 0.1 ml of biological liquid

60. Inhibitor of acetylcholinesterase is :

a. sulfa drugs
b. cyanides
c. arsenic acid
d. organophosphate compounds
e. malonic acid.

61. Inhibitor of cytocrome oxidase is :

a. sulfa drugs
b. cyanides
c. heavy metals
d. organophosphate compounds
e. malonic acid.

62. Inhibitor of succinate dehydrogenase is :

a. sulfa drugs.
b. cyanides
c. succinic acid
d. organophosphate compounds
e. malonic acid.

63. Inhibitors of folic acid synthesis is :

a. heavy metals

b. cyanides
c. sulfa drugs
d. organophosphate compounds
e. malonic acid.

64. Instant death occurs due to cyanide poisoning. What is the biochemical mechanism of cyanides' unfavorable action at the molecular level?
a. Inhibition of cytochrome oxidase
b. Chemical bonding to the substrates of citric acid cycle
c. Blockage of succinate dehydrogenase
d. Inactivation of oxygen molecule
e. Inhibition of cytochrome b.

65. International unit (IU) is defined as amount of enzyme that converts :
a. μmol of substrate per minute
b. mmol of substrate per second
c. mol of substrate per second
d. μmol of substrate per hour
e. mmol of substrate per minute

66. Isoenzymes widely used in the diagnosis of diseases. Thus, in case of myocardial infarction analyze isozyme composition :
a. alanine aminotransferase
b. aspartate aminotransferase
c. lactate dehydrogenase
d. malate dehydrogenase
e. protein kinase

67. Katal is defined as amount of enzyme that convert :
a. μmol of substrate per minute
b. mmol of substrate per second
c. mol of substrate per second
d. μmol of substrate per hour
e. mmol of substrate per minute.

68. Km equals to the substrate concentration when the reaction rate is :
a. minimal
b. maximal
c. half of maximal
d. quarter of maximal.

69. Lactate dehydrogenase (LDH) isoenzymes catalyze the transformation of pyruvate to lactic acid in different types of tissues. Point out the structural distinctive peculiarity of each LDH isoenzyme :
a. Different native protein structure
b. Different level of structural organization in native molecule
c. Different by the type of coenzyme in native molecule
d. Different by the quantity of subunits
e. Different by the combination of subunits, forming a native molecule.

70. Lipoic acid was excluded from diet of the experimental animals, and during this process the inhibition of their pyruvate dehydrogenase complex was observed. What is lipoic acid for this enzyme?
a. Allosteric regulator
b. Substrate
c. Inhibitor
d. Coenzyme
e. Product

71. Modern systematic nomenclature is built as :
a. Substrate name + suffix "ase"
b. Substrate name + chemical reaction + suffix "ase"
c. Substrate name + type substrate connections in the substrate
d. Substrate name : the name of the co-substrate - the type of chemical reactions IEC + suffix "ase"
e. Name of the substrate name + active groups that interact with substrates

72. Name the enzyme for which proserin is a competitive inhibitor :
a. Acetylcholinesterase
b. Succinate dehydrogenase
c. Lactate dehydrogenase
d. Aspartate transaminase
e. Creatine phosphokinase

73. One of the important properties of enzymes is their action specificity. Check up a kind of specificity for lipase :
a. Absolute substrate specificity
b. Absolute grouped substrate specificity
c. Stereochemical specificity
d. Relative grouped substrate specificity
e. Relative substrate specificity (reaction specificity).

74. One of the important properties of enzymes is their action specificity. Check up a kind of specificity for urease :
a. Absolute substrate specificity
b. Absolute grouped substrate specificity
c. Stereochemical specificity
d. Relative grouped substrate specificity
e. Relative substrate specificity (reaction specificity).

75. One of the important properties of enzymes is their action specificity. Check up a kind of specificity for pepsin :
a. Absolute substrate specificity
b. Absolute grouped substrate specificity
c. Stereochemical specificity
d. Relative grouped substrate specificity
e. Relative substrate specificity (reaction specificity).

76. One of the important properties of enzymes is their action specificity. Check up a kind of specificity for glucosooxidase :
a. Absolute substrate specificity
b. Absolute grouped substrate specificity
c. Stereochemical specificity
d. Relative grouped substrate specificity
e. Relative substrate specificity (reaction specificity).

77. One of the important properties of enzymes is their action specificity. Check up a kind of specificity for arginase :
a. Absolute substrate specificity
b. Absolute grouped substrate specificity
c. Stereochemical specificity
d. Relative grouped substrate specificity
e. Relative substrate specificity (reaction specificity).

78. One of the important properties of enzymes is their action specificity. Check up a kind of specificity for isomaltase :
a. Absolute substrate specificity
b. Absolute grouped substrate specificity
c. Stereochemical specificity
d. Relative grouped substrate specificity
e. Relative substrate specificity (reaction specificity).

79. One way of regulating the activity of enzymes in the human body is their covalent modification. Which option covalent modification occurs in regulating the activity of glycogen phosphorylase and glycogen synthetase enzymes?
a. ADP-ribosylation
b. Methylation
c. Phosphorylation-dephosphorylation
d. Hydrolysis
e. Sulphonation

80. Only one factor can influence the charge of amino acid radicals in the active centre of enzyme. Name this factor :
a. The presence of a competitive inhibitor
b. The surplus of a product
c. pH medium
d. Pressure
e. Temperature

81. Optimal conditions for the determination of the enzyme activity in the pancreatic juice are :
a. 5 oC; pH 8.0; high concentration of substrates
b. 20 oC; pH 6.5; low concentration of substrates
c. 40 oC; pH 8.0; high concentration of substrates
d. 50 oC; pH 1.0; low concentration of substrates
e. 40 oC; pH 5.0; high concentration of substrates.

82. Optimal conditions for the determination of the enzyme activity in the blood are :
a. 5 oC; pH 7.3; high concentration of substrates
b. 20 oC; pH 6.5; low concentration of substrates
c. 40 oC; pH 7.3; high concentration of substrates
d. 50 oC; pH 5.8; low concentration of substrates
e. 70 oC; pH 7.8; high concentration of substrates.

83. Optimal pH for determining of enzyme activity in blood is :
a. 1.5-2.5
b. 5.0-5.5
c. 6.8-7.2
d. 7.3-7.4
e. 7.5-8.0.

84. Optimal pH for determining of enzyme activity in gastric juice of adults is :
a. 2.0
b. 5.0
c. 7.0
d. 9.0
e. 11.0.

85. Optimal pH for determining of enzyme activity in urine is :
a. 2.0
b. 5.0
c. 7.0
d. 9.0
e. 11.0.

86. Optimal temperature for determining of enzyme activity in blood is :
a. 0-5 0C
b. 10-20 0C
c. 20-40 0C
d. 60-70 0C
e. 80-100 0C.

87. Optimum pH for amylase of saliva is :
a. 1.5-2.5
b. 5.0-5.5
c. 7.0-7,5
d. 8.5-9.0
e. 9.5-10.

88. Optimum pH for enzymes of cell cytoplasm is :
a. 1.5-2.5
b. 5.0-5.5
c. 7.0-7.6
d. 8.5-9.0
e. 9.0-9.5.

89. Optimum pH for lipase of pancreatic juice is :
a. 1.5-2.5
b. 5.0-5.5
c. 6.0
d. 7.5-8.0
e. 8.5-9.0.

90. Optimum pH for pepsin action :
a. 2-3
b. 3-4
c. 1-2
d. 4-5
e. 6-8

91. Optimum pH for pepsin of gastric juice is :
a. 1.5-2.5
b. 5.0-5.5
c. 7.0
d. 7.5-8.0
e. 8.5-9.0.

92. Optimum pH for trypsin of pancreatic juice is :
a. 1.5-2.5
b. 5.0-5.5
c. 6.0
d. 7.5-8.0
e. 8.5-9.0.

93. Part of the proteins catabolism in the cell conducted with the participation enzymes - acid hydrolases (cathepsin) located at :
a. lysosomes
b. endoplasmic reticulum
c. cytosol
d. mitochondria
e. golgi complex

94. Pathological processes associated with the development of hypoxia can be caused by incomplete reduction of an oxygen molecule in the electron transport chain and accumulation of hydrogen peroxide. Choose the enzyme which breaks the hydrogen peroxide.
a. Catalase.
b. Cytochrome oxidase.
c. Succinate dehydrogenase.
d. a-Ketoglutarate dehydrogenase.
e. Aconitase.

95. Patient's amylase activity in the urine excesses the normal values in ten times as much. Point out the possible diagnosis :
a. Viral hepatitis
b. Diabetes mellitus

c. Acute pancreatitis
d. Influenza
e. Angina.

96. Post-translational covalent modification is an important factor in the regulation of the enzymes' activity. Choose the mechanism of regulation of glycogen phosphorylase and glycogen synthetase activities from the following :
a. ADP-ribosylation
b. Methylation
c. Adenylation
d. Restricted proteolysis
e. Phosphorylation-dephosphorylation.

97. Post-translational covalent modification is an important factor in the regulation of the enzymes' activity. Choose the mechanism of regulation of glycogen phosphorylase and glycogen synthetase activities from the following :
a. ADP-ribosylation
b. Methylation
c. Adenylation
d. Restricted proteolysis
e. Phosphorylation-dephosphorylation.

98. Potassium cyanide is a very dangerous poison that causes instantaneous death of a human organism. What mitochondrial enzyme is affected by potassium cyanide?
a. Cytochrome P450.
b. Flavine enzymes.
c. Cytochrome b.
d. NAD+-dependent dehydrogenases.
e. Cytochrome oxidase (cytochrome aa3).

99. Preparations mercury, arsenic, bismuth are inhibitors of enzymes with thiol group (SH-groups) in the active centers. Which amino acid is used to reactivate these enzymes?
a. glycine
b. valine
c. cysteine
d. glutamate
e. serine

100. Proteins digestion in the stomach constitutes the initial stage of protein destruction in a human digestive tract. Name the enzymes, which take part in the protein digestion in the stomach.
a. Chymotrypsin and lysozyme.
b. Trypsin.
c. Pepsin and gastrixin.
d. Enteropeptidase and elastase.
e. Carboxypeptidase and aminopeptidase.

101. Researchers isolate 5 isoenzymic forms of lactate dehydrogenase from the human blood serum and studied their properties. What property indicates that the isoenzymic forms were isolated from the same enzyme?

a. The same physicochemical properties
b. Catalyzation of the same reaction
c. The same electrophoretic mobility
d. Tissue localization
e. The same molecular weight

102. Sodium chloride activates :
a. lipase
b. amylase
c. trypsin
d. pepsin
e. sucrase.

103. Some infectious diseases caused by bacteria are treated with sulfanilamides which block the synthesis of bacteria growth factor. What is the mechanism of their action?
a. They are antivitamins of para-amino benzoic acid
b. They inhibit the absorption of folic acid
c. They are allosteric enzyme inhibitors
d. They are involved in redox processes
e. They are allosteric enzyme activators.

104. Some terms are used for the description of non-protein part of an enzyme. Point out the term nof non-protein part, which easily dissociates from polypeptide chain :
a. Apoenzyme
b. Coenzyme
c. Prosthetic group
d. Cofactor
e. Metal ions.

105. Stereo chemical specificity of this enzyme is :
a. Catalyze the transformation of one type of chemical bonds
b. Catalyze the transformation of one into another structural isomer
c. Catalyze the conversion of only one substrate
d. Catalyze the conversion of compounds D- or L-row
e. All answers are correct

106. Succinate dehydrogenase catalyses the dehydrogenation of succinate. Malonic acid HOOC-CH-COOH is used to interrupt the action of this enzyme. Choose the inhibition type :
a. Limited proteolysis
b. Competitive
c. Non-competitive
d. Dephosphorylation
e. Allosteric.

107. Sulfanilamide drugs are used for treatment of infectious diseases. What is the mechanism of bacteria growth inhibition of the drugs?
a. Inhibition of the intracellular protein synthesis
b. Inhibition of the SH enzyme groups of the microorganisms
c. Inhibition of cell wall synthesis of the microorganism

d. Allosteric inhibition of bacterial enzymes
e. They are structural analogs of para-aminobenzoic acid required for the synthesis of folic acid.

108. The activities of amylase in the patient's urine and blood are increased, trypsin is present in the urine. What organ is the pathological process taking place in?
a. Liver
b. Pancreas
c. Stomach
d. Kidney
e. Intestine.

109. The activities of lactate dehydrogenase (LDH1, LDH2), aspartate aminotransferase, creatine kinase in the blood of a patient are increased. In which of the following organs is the pathological process probably developing?
a. In the myocardium (the initial stage of myocardial infarction).
b. In the skeletal muscles (dystrophy, atrophy).
c. In the kidneys and adrenal glands.
d. In the connective tissue.
e. In the liver and kidneys.

110. The composition of LDH-1 subunits is :
a. HHHH
b. HHHM
c. HHMM
d. HMMM
e. MMMM.

111. The composition of LDH-2 subunits is :
a. HHHH
b. HHHM
c. HHMM
d. HMMM
e. MMMM.

112. The composition of LDH-3 subunits is :
a. HHHH
b. HHHM
c. HHMM
d. HMMM
e. MMMM.

113. The composition of LDH-4 subunits is :
a. HHHH
b. HHHM
c. HHMM
d. HMMM
e. MMMM.

114. The composition of LDH-5 subunits is :
a. HHHH
b. HHHM
c. HHMM
d. HMMM
e. MMMM.

115. The determination of activity of what enzyme in the urine is required as a diagnostic test for the verification of acute pancreatitis?
a. Amylase.
b. Lactate dehydrogenase.
c. Creatine kinase.
d. Aldolase.
e. Alanine aminopeptidase.

116. The determination of which of the below listed enzymes is most informative for the disease during the first hours after the myocardial infarction?
a. Glutamate dehydrogenase.
b. Aspartate aminotransferase.
c. Alanine aminotransferase.
d. Lactate dehydrogenase.
e. Creatine kinase.

117. The doctor did not give a proper assessment to amylase urine analysis that showed an increase its activity in 10 times. The patient may be in danger by autolysis of pancreas caused by enzymes :
a. trypsin
b. amylase
c. aldolase
d. pepsin
e. phosphorylase

118. The dramatic rise of a certain enzyme activity in the blood and urine of a patient who suffered from acute pancreatitis was detected. Name this enzyme.
a. α-Amylase.
b. Pepsin.
c. Dipeptidase.
d. Saccharase.
e. Lactase.

119. The elevated activity of alaninaminotransferase (ALT) in the blood is indication of :
a. hepatitis
b. muscle dystrophy
c. acute pancreatitis
d. myocardial infarction
e. stomach disease.

120. The elevated activity of amylase in the blood is indication of :
a. hepatitis

b. muscle dystrophy
c. acute pancreatitis
d. myocardial infarction
e. stomach disease.

121. The elevated activity of aspartate aminotransferase (AST) in the blood is indication of :
a. kidney disease
b. muscle dystrophy
c. acute pancreatitis
d. myocardial infarction
e. stomach disease.

122. The elevated activity of creatin phosphokinase in the blood is indication of :
a. hepatitis
b. muscle dystrophy
c. acute pancreatitis
d. kidney disease
e. stomach disease.

123. The elevated activity of creatinphosphokinase (CPK) in the blood is indication of :
a. hepatitis
b. kidney disease
c. acute pancreatitis
d. myocardial infarction
e. stomach disease.

124. The elevated activity of lipase in the blood is indication of :
a. hepatitis
b. muscle dystrophy
c. acute pancreatitis
d. myocardial infarction
e. stomach disease.

125. The enzyme ammonia ligase that catalyzes the formation of glutamine, belongs to the class :
a. isomerase
b. oxidoreductases
c. ligase
d. transferase
e. hydrolase

126. The enzyme having the code 1.1.1.27, belongs to a class
a. Transferase
b. Hydrolase
c. Isomerase
d. Oxidoreductases
e. Lyase

127. The enzyme leads to transfer of structural fragment from one substrate to another with the formation of two products. What this enzyme class :
a. isomerase
b. oxidoreductases
c. ligase
d. transferase
e. hydrolase

128. The enzymes involved in the synthesis of substances using energy belong to the class :
a. isomerase
b. oxidoreductases
c. ligase
d. transferase
e. hydrolase

129. The evidence of protein nature of enzymes is physical and chemical properties, except :
a. Amphotery
b. Termolability
c. The dependence of activity on pH
d. Denaturation by the action of acids and alkalis
e. Ability to dialysis

130. The formation and secretion of trypsin is disturbed in case of pancreas diseases. The hydrolysis of which of the following substances is impaired in this case?
a. Proteins.
b. Lipids.
c. Carbohydrates.
d. Nucleic acids.
e. Phospholipids.

131. The formation and secretion of trypsin is disturbed in case of pancreas diseases. The hydrolysis of which of the following substances is impaired in this case?
a. Proteins.
b. Lipids.
c. Carbohydrates.
d. Nucleic acids.
e. Phospholipids.

132. The optimal pH for enzymes of cell cytoplasm varies from 7,2 to 7,6. Point out possible nchanges in the structure of active site of such enzymes at pH-7,0 :
a. Changes are not present
b. Radicals of amino acids get negative charge
c. Neutralization of negatively charged radicals
d. Formation of ester bonds between radicals
e. Destruction of the active center.

133. The optimal pH medium for the action of arginase is :
a. 1,5 – 2,5
b. 6,8 – 7,0

c. 6,8 – 7,8
d. 7,0 – 8,5
e. 10,0 – 11,0

134. The patient 12 hours after an acute attack of retrosternal pain found increased activity of AST in serum. For what pathology these changes is characterized :
a. myocardial infarction
b. hepatitis
c. collagenosis
d. diabetes
e. diabetes insipidus

135. The protective function of human saliva is realized in some ways, including the presence of an enzyme which shows bactericidal action accomplished by the lysis of membrane polysaccharides complexes of staphylococci and streptococci. Choose this enzyme from the following :
a. Collagenase.
b. β - Amylase.
c. Oligo[1→6]-glucosidase.
d. Lysozyme.
e. β -Glucuronidase.

136. To reduce blood pressure for patient appointed captopril - angiotensin-converting enzyme that converts anhitensin I to angiotensin II (proenzyme to enzyme) by :
a. Metylation
b. Phosphorylation
c. Deamination
d. Limited proteolysis
e. Decarboxylation

137. Treatment course of bacterial pneumonia included benzylpenicillin sodium salt. What is the mechanism of its antimicrobial action?
a. Inhibition of the intracellular protein synthesis
b. Inhibition of the SH enzyme groups of the microorganisms
c. Inhibition of cell wall synthesis of the microorganism
d. Inhibition of the cholinesterase activity
e. Antagonism with the paraaminobenzoic acid.

138. Trypsin catalyzes the cleavage of peptide bonds in proteins. What type of enzyme specificity inherent in this?
a. Stereo
b. Relative
c. Absolute
d. Chemical
e. All answers are correct

139. Trypsinogen activators are :
a. Hydrochloric acid
b. Enterokinase

c. Chymotrypsinogen
d. Carboxypeptidase
e. Amylase

140. Unknown enzyme was added into two test tubes. The first tube contained starch, the second one – sucrose. After 10 min. incubation the solution in the first tube gives the positive Feling reaction, in the second one – negative. What enzyme was added?
a. lipase
b. sucrase
c. amylase
d. nuclease
e. lactase.

141. Unknown enzyme was added into two test tubes. The first tube contained starch, the second one – sucrose. After 10 min incubation the solution in the first tube gives the negative Feling reaction, in the second one –positive. What enzyme was added?
a. lipase
b. sucrase
c. amylase
d. nuclease.
e. lactase.

142. Unknown enzyme was added into two test tubes. The first tube contained starch, the second one –lactose. After 10 min incubation the solution in the first tube gives the negative Feling reaction, in the second one –positive. What enzyme was added?
a. lipase
b. sucrase
c. amylase
d. nuclease
e. lactase.

143. Unknown enzyme was added into two test tubes. The first tube contained maltose, the second one – sucrose. After 10 min incubation the solution in the first tube gives the positive Feling reaction, in the second one – negative. What enzyme was added?
a. lipase
b. sucrase
c. maltase
d. nuclease
e. lactase.

144. Unknown enzyme was added into two test tubes. The first tube contained glycogen, the second one – sucrose. After 10 min incubation the solution in the first tube gives the negative Feling reaction, in the second one –positive. What enzyme was added?
a. lipase
b. sucrase
c. amylase
d. nuclease
e. lactase.

145. What are the mechanisms to reduce the energy barrier during enzymatic reactions?
a. The formation of additional covalent bonds between apo and coenzyme
b. The formation of an intermediate enzyme-substrate (ES) complex
c. Participation of macroergic compounds (ATP) in enzymatic catalysis
d. Reducing the area of the contact area between the enzyme and substrate
e. Conformation change of enzyme by action of allosteric effectors.

146. What are the relationships involved in the formation of enzyme-substrate complex?
a. Ester
b. Disulfide
c. Glycoside
d. Peptide
e. Hydrogen, electrostatic, hydrophobic

147. What condition is developed in the absence of phenylalanine-4-monooxygenase?
a. Phenylketonuria
b. Alkaptonuria
c. Galactosemia
d. Hyperglycemia
e. Hypoglycemia.

148. What covalent modification is used mainly for regulation of enzyme activity?
a. carboxylation
b. methylation
c. amination
d. phosphorylation
e. acetylation.

149. What enzyme activated by bile acids :
a. Pancreatic lipase
b. Trypsinogen
c. Chymotrypsinogen
d. Carboxy Peptidases
e. Proelastase

150. What enzyme profile is characteristic of acute pancreatitis?
a. ALT, amylase, AST
b. lipase, ALT, amylase
c. CPK, trypsin, LDH
d. AST, LDH, lipase
e. amylase, lipase, trypsin.

151. What enzyme profile is characteristic of heart disease?
a. ALT, amylase, AST
b. lipase, ALT, amylase
c. CPK, trypsin, LDH-4
d. AST, LDH-3, lipase
e. AST, CPK, LDH-1.

152. What enzyme profile is characteristic of liver disease?
a. ALT, amylase
b. lipase, AST
c. CPK, trypsin
d. ALT, LDH-5
e. AST, LDH-1.

153. What enzymes catalyze the reactions of protein-enzyme dephosphorylation?
a. protein hydrolases
b. protein synthetases
c. protein phosphatases
d. protein kinases
e. protein oxidases.

154. What enzymes catalyze the reactions of protein-enzyme phosphorylation?
a. protein hydrolases
b. protein synthetases
c. protein phosphatases
d. protein kinases
e. protein oxidases.

155. What enzymes catalyze the reactions of protein-enzyme phosphorylation?
a. protein hydrolases
b. protein synthetases
c. protein phosphatases
d. protein kinases
e. protein oxidases.

156. What inhibitor has anti-inflammatory action?
a. arsenic acid
b. penicillin
c. sulfa drug
d. aspirin
e. malonic acid.

157. What inhibitors are belonging to pesticides?
a. arsenic acid
b. cyanides
c. sulfa drugs
d. organophosphate compounds
e. malonic acid.

158. What inhibitors are nerve toxins?
a. penicillins
b. aspirin
c. sulfa drugs
d. organophosphate compounds
e. malonic acid.

159. What inhibitors have bacteriostatic action?
a. arsenic acid
b. cyanides
c. sulfa drugs
d. organophosphate compounds
e. malonic acid.

160. What is competitive inhibitor of succinate dehydrogenase :
a. Fumarate
b. Alanine
c. Succinate
d. α -Ketoglutarate
e. Malonate.

161. What is optimal temperature for enzyme-drugs storage :
a. 0-5 0C
b. 10-20 0C
c. 30-40 0C
d. 50-60 0C
e. 70-80 0C.

162. What is the cause of primary enzymopathologies?
a. Liver diseases
b. Genetic disorders
c. Trauma
d. Ischemia
e. Brain diseases.

163. What is the chemical nature of enzymes?
a. Carbohydrates
b. Lipids
c. Proteins
d. Nucleic acids
e. Polysacharides.

164. What is the mechanism of inhibition of folic acid synthesis by sulfanilamide drugs?
a. Irrreversible
b. Enzyme denaturation
c. Competitive
d. Noncompetitive
e. Binding to allosteric site of enzyme.

165. What is the Michaelis constant?
a. The concentration of the enzyme at which the reaction rate is maximum enzyme concentration at which the reaction rate is half of the maximum
b. The concentration of the reaction product at which the reaction rate is half of the maximum
c. The substrate concentration at which the reaction rate is half the maximum
d. The ratio of the concentrations of enzyme and substrate

166. What is the optimum pH of most enzymes?
a. 1,5 – 3,5
b. 3,5 – 6,5
c. 6,0 – 8,0
d. 8,5 – 9,0
e. 9,0 – 10,0

167. What kind of reactions is catalyzed by hydrolases?
a. Hydrolytic cleavage of substrates
b. Transfer of hydrogen atoms between substrates
c. Addition to double bonds
d. Formation of bonds with ATP cleavage
e. Transposition of functional groups between substrates

168. What medicines should be prescribed to a patient with acute pancreatitis to prevent pancreas autolysis?
a. Proteases activators
b. Proteases inhibitors
c. Trypsin
d. Chymotrypsin
e. Amylase.

169. What medicines should be prescribed to a patient with acute pancreatitis to prevent pancreas autolysis?
a. Proteases activators
b. Proteases inhibitors
c. Trypsin
d. Chymotrypsin
e. Amylase.

170. What of the following enzyme, referring to multyenzyme complexes :
a. malate dehydrogenase
b. pyruvate decarboxylase
c. lactate dehydrogenase
d. pyruvate dehydrogenase
e. alcohol dehydrogenase

171. What promotes the formation of enzyme-substrate complex?
a. Spatial compliance active site to the substrate
b. Compliance allosteric center to the substrate
c. The presence of metal ions in the substrate
d. The presence of metal ions in the allosteric center
e. The chemical composition of the substrate

172. What reactions catalyzed by hydrolases?
a. substrates dehydration
b. hydrolytic cleavage substrate
c. Nonhydrolytic cleavage substrate

d. Disintegration of compounds using the energy of ATP
e. Burst double bonds in the substrates

173. What reactions catalyzed by oxidoreductase?
a. Transfer of certain chemical groups
b. Synthesis
c. Redox
d. isomerization
e. hydrolysis

174. What substances can act as allosteric effectors?
a. Low molecular weight metabolites and hormones
b. Macromolecular compounds
c. Glycoprotein
d. Macroergic compounds
e. Lipoproteins

175. When newborn baby eating mother's milk vomiting, flatulence, and diarrhea appeared. On a hereditary deficiency of which enzyme should be thinking about?
a. lactase
b. maltase
c. isomerase
d. oligo-1,6-glucosidase
e. pepsin

176. Which enzyme can be used to accelerate the absorption of some drugs that are administered parenterally (eg, electrophoresis)?
a. hyaluronidase
b. amylase
c. lysozyme
d. RNA'ase
e. fibrinolysin

177. Which mechanism of allosteric regulation of enzyme activity?
a. denaturation of enzyme molecule
b. changes of enzyme quantity
c. phosphorylation-dephosphorylation of enzyme molecule
d. conformational change of enzyme molecule
e. partial proteolysis of enzyme molecule.

178. Which mechanism of allosteric regulation of enzyme activity?
a. denaturation of enzyme molecule
b. changes of enzyme quantity
c. phosphorylation-dephosphorylation of enzyme molecule
d. conformational change of enzyme molecule
e. partial proteolysis of enzyme molecule.

179. Which mechanism of proenzyme conversion into the active enzyme?

a. denaturation of enzyme molecule
b. changes of enzyme quantity
c. phosphorylation-dephosphorylation of enzyme molecule
d. conformational change of enzyme molecule
e. partial proteolysis of enzyme molecule.

180. Which mechanism of regulation of enzyme activity by covalent modification?
a. denaturation of enzyme molecule
b. changes of enzyme quantity
c. phosphorylation-dephosphorylation of enzyme molecule
d. conformational change of enzyme molecule
e. partial proteolysis of enzyme molecule.

181. Which of the enzymes have relative specificity?
a. Pepsin, lipase
b. Urease, xanthine oxidase
c. Arginase, sucrase
d. Amylase, carbonic anhydrase
e. Lactase, maltase

182. Which substance activates pepsinogen?
a. Trypsin
b. Enterokinase
c. Chymotrypsin
d. Pepsin
e. Protein kinase.

183. Which substance activates trypsinogen?
a. HCl
b. enterokinase
c. chymotrypsin
d. pepsin
e. protein kinase.

184. Which substrate competes with malonic acid for the active site of succinate dehydrogenase?
a. Fumaric acid
b. Succinic acid
c. Pyruvate
d. Lactate
e. Oxaloacetate

185. Which vitamin is an activator of enzymes oxidoreductases?
a. Vitamin C
b. Vitamin PP
c. Vitamin B1
d. Vitamin B6
e. Vitamin B2

186. Which way of regulating enzyme activity is irreversible?
a. covalent modification
b. allosteric regulation
c. partial proteolysis.

187. Which way of regulating enzyme activity is the basis for the feedback inhibition?
a. covalent modification
b. allosteric regulation
c. partial proteolysis.

188. Which way of regulation of enzyme activity is the basis for the feedback inhibition?
a. Covalent modification;
b. Allosteric regulation;
c. Partial proteolysis.

189. You need to degrade carbohydrate. What enzyme will you use :
a. proteinase
b. oxidase
c. nuclease
d. lipase
e. glycosidase.

190. You need to degrade DNA. What enzyme will you use :
a. proteinase
b. oxidase
c. nuclease
d. lipase
e. transferase

Coenzymes

1. A 36-year-old female patient has a history of B2-hypovitaminosis. The most likely cause of specific symptoms (epithelial, mucosal, cutaneous, corneal lesions) is the deficiency of :
a. Flavin coenzymes
b. Cytochrome A1
c. Cytochrome oxidase
d. Cytochrome B
e. Cytochrome C

2. A newborn child has convulsions that have been observed after prescription of vitamin B6. This most probable cause of this effect is that vitamin B6 is a componet of the following enzyme :
a. Glutamate decarboxylase.
b. Pyruvate dehydrogenase.
c. Ketoglutarate dehydrogenase.
d. Aminolevulinate synthase.
e. Glycogen phosphorylase.

3. A newborn child has convulsions that have been observed after prescription of vitamin B6. This most probable cause of this effect is that vitamin B6 is a componet of the following enzyme :

a. Glutamate decarboxylase
b. Pyruvate dehydrostase
c. Netoglubarate dehydromine
d. Aminolevulinate synthase
e. Glycogen phosphorylase

4. A number of diseases can be diagnosed by evaluating activity of blood transaminases. What vitamin is one of cofactors of these enzymes?

a. B6
b. B2
c. B1
d. B8
e. B5

5. A number of diseases can be diagnosed by evaluating activity of blood transaminases. What vitamin is one of cofactors of these enzymes?

a. B6
b. B2
c. B1
d. B8
e. B5

6. According to clinical indications a patient was administered pyridoxal phosphate. What processes is this medication intended to correct?

a. Transamination and decarboxylation of aminoacids
b. Oxidative decarboxylation of ketonic acids
c. Desamination of purine nucleotide
d. Synthesis of purine and pyrimidine bases
e. Protein synthesis

7. According to clinical indications a patient was administered pyridoxal phosphate. What processes is this medication intended to correct?

a. Transamination and decarboxylation of aminoacids
b. Oxidative decarboxylation of ketoacids
c. Desamination of purine nucleotide
d. Synthesis of purine and pyrimidine bases
e. Protein synthesis

8. Activities of aminotransferases are usually determined for diagnostics of certain diseases What vitamin is included in the enzymes as cofactor?

a. B1
b. B2
c. B5
d. B6
e. H.

9. Adenosylcobalamine catalyzes the reaction of intramolecular transport :
a. hydrogen atoms
b. protons
c. electron
d. methyl groups
e. hydroxyl groups

10. An infant, who was on synthetic formula feeding, developed signs of vitamin B1 deficiency. What reactions does this vitamin take part in?
a. Keto acid oxidative decarboxylation
b. Amino acids transamination
c. Amino acids decarboxylation
d. Proline hydroxylation
e. Redox reactions

11. At the patient of 36 years old with chronic alcoholism, in blood pyruvate accumulation is developed, in erythrocytes - decrease in activity transketolase takes place. Name the coenzyme form of vitamin which insufficiency the specified changes are caused?
a. Thiamine pyrophosphate
b. Carboxybiotin
c. Methyl cobalamin
d. Phospho pyridoxal
e. Tetrahydrofolate

12. At the patient of 43 years with chronic atrophic gastritis, megaloblastic anemia observes. Urinalysis shows increasing of methylmalonic acid. What hypovitaminosis occurrence of the specified infringement caused?
a. Vitamin B12
b. Vitamin B2
c. Vitamin B3
d. Vitamin B5
e. Vitamin B1

13. Biotin carries next group :
a. Acetyl
b. Methyl
c. Carboxyl
d. Hydroxyl
e. Phosphate

14. Coenzyme A is the derivative of vitamin :
a. B1
b. B2
c. B5
d. B6
e. H.

15. Coenzyme A participates in numerous important metabolic reactions. It is a derivative of the following vitamin :

a. Pantothenic acid
b. Calciferol
c. Thiamine
d. Niacin
e. Ubiquinone

16. Coenzyme carboxybiotin is the derivative of vitamin :
a. B1
b. B2
c. B3
d. B6
e. H

17. Coenzyme FMN is the derivative of vitamin :
a. B1
b. B2
c. B3
d. B6
e. H

18. Coenzyme for amino acid decarboxylation is :
a. FH4
b. KoA
c. PALP
d. TDP
e. NAD

19. Coenzyme for γ-glutamylcarboxylase are vitamin :
a. A
b. K
c. D
d. E
e. PP

20. Coenzyme form vit B2 :
a. TDP, TPP
b. FAD, FMN
c. NAD +, NADP +
d. ATP, ADP
e. CoA-SH, acetyl CoA

21. Coenzyme forms of pantothenic acid (vitamin B3) are :
a. FAD, FMN
b. TDF, TTF
c. NAD +, NADP +
d. CoA-SH
e. PALP

22. Coenzyme NADP is the derivative of vitamin :

a. B1
b. B3(PP)
c. B5
d. B6
e. H.

23. Coenzyme PALP is the derivative of vitamin :
a. B1
b. B2
c. B3
d. B6
e. H.

24. Coenzymes that contain vitamin B6 :
a. Cobamine
b. Pyridoxal
c. Flavin
d. Nicotinamide
e. Folate

25. Enzymes catalase and peroxidase contain metal :
a. Cu.
b. Zn
c. Na.
d. Fe.
e. Ca.

26. Examination of a patient suffering from frqeuent haemorrhages in the inner organs and mucous membranes revealed proline and lysine being included in collagen fibers. Impairment of their hydroxylation is caused by lack of the following vitamin :
a. C
b. E
c. K
d. A
e. D

27. Examination of a patient with frqeuent hemorrhages from internals and mucous membranes revealed proline and lysine being a part of collagene fibers. What vitamin absence caused disturbance of their hydroxylation?
a. Vitamin C
b. Vitamin K
c. Vitamin A
d. Thiamine
e. Vitamin E

28. For diagnostics of certain illnesses the determination of blood transaminases activity is required. Which vitamin is a component of the cofactor for this enzymes?
a. B1
b. B2

c. B3
d. B5
e. B6.

29. For diagnostics of some diseases activity of the transaminases in the blood is defined. What vitamin is a cofactor part of these enzymes?
a. B6
b. B2
c. B1
d. B8
e. B5

30. From the given vitamin-like substance component of the respiratory chain is :
a. Lipoic Acid
b. Ubiquinone
c. Para-aminobenzoic acid
d. Choline
e. Carnitine

31. Group II vitamin coenzymes includes :
a. Ubiquinone, heme
b. ATP, GTP
c. TDP, PALP
d. Phosphates of carbohydrates and nucleosides
e. Glutathione, carnitine

32. Heme (cofactor of the mitochondrial cytochrome chain) transports :
a. The hydrogen atoms
b. Protons
c. Electrons
d. Methyl groups
e. Hydroxyl groups

33. Hydroxylation of endogenous substrates and xenobiotics rqeuires a donor of protons. Which of the following vitamins can play this role?
a. Vitamin C
b. Vitamin P.
c. Vitamin B6.
d. Vitamin D
e. Vitamin A

34. Hypovitaminosis C leads to a decrease in the formation of organic matrix, delay remineralization processes, impaired collagen synthesis, because this vitamin as a cofactor in the process of :
a. Transamination of alanine and aspartate
b. Carboxylation of proline and lysine
c. Deamination of glutamate and aspartate
d. Hydroxylation of proline and lysine
e. Amination of lysine and proline

35. In case of enterobiasis acrihine - the structural analogue of vitamin B_2 - is administered. The synthesis disorder of which enzymes does this medicine cause in microorganisms?
a. FAD-dependent dehydrogenases.
b. Cytochromeoxidases.
c. Peptidases.
d. NAD-dependent dehydrogenases.
e. Aminotransferases.

36. In case of enterobiasis acrihine - the structural analogue of vitamin B2 - is administered. The synthesis disorder of which enzymes does this medicine cause in microorganisms?
a. FAD-dependent dehydrogenases
b. Cytochromeoxidases
c. Peptidases
d. NAD-dependet dehydrogenases
e. Aminotransferases

37. In case of enterobiasis acrihine - the structural analogue of vitamin B2 - is administered. The synthesis disorder of which enzymes does this medicine cause in microorganisms?
a. FAD-dependent dehydrogenases
b. Cytochromeoxidases
c. Peptidases
d. NAD-dependet dehydrogenases
e. Aminotransferases

38. In case of enterobiosis acrichine - the structural analogue of vitamin B2- is administered. The synthesis disorder of which enzymes does this medicine cause in microorganisms?
a. Cytochrome oxidases
b. FAD-dependent dehydrogenases
c. Peptidases
d. NAD-dependent dehydrogenases
e. Aminotransferases.

39. In case of vitamin B6 disorders of amino acid transamination takes place. Which class of enzyme catalyses these reactions?
a. Oxidoreductases
b. Hydrolases
c. Lyases
d. Ligases
e. Transferases.

40. In clinical practice tuberculosis is treated with izoniazid preparation - that is an antivitamin able to penetrate into the tuberculosis bacillus. Tuberculostatic effect is induced by the interference with replication processes and oxidation-reduction reactions due to the buildup of pseudo-coenzyme :
a. NAD
b. FAD
c. FMN.
d. TDP.

e. CoQ.

41. In clinical practice tuberculosis is treated with izoniazid preparation - that is an antivitamin able to penetrate into the tuberculosis bacillus. Tuberculostatic effect is induced by the interference with replication processes and oxidation-reduction reactions due to the buildup of pseudo-coenzyme :
a. NAD
b. FAD
c. FMN
d. TDP
e. CoQ

42. In clinical practice tuberculosis is treated with izoniazid preparation - that is an antivitamin able to penetrate into the tuberculosis bacillus. Tuberculostatic effect is induced by the interference with replication processes and oxidation-reduction reactions due to the buildup of pseudo-coenzyme :
a. NAD
b. FAD
c. FMN
d. TDP
e. CoQ

43. In experimental animals lipoic acid was excluded from the food, while they observed inhibition pyruvate dehydrogenase multyenzyme complex. Lipoic acid for this enzyme are :
a. The product
b. The substrate
c. The inhibitor
d. The allosteric regulator
e. The coenzyme

44. In the clinic got 1-year-old child with signs of damage limbs and torso. After the examination deficiency of muscles carnitine is detected. Biochemical basis of this disease is a violation of the process :
a. Regulation of Ca2 + in mitochondria
b. transport of fatty acids into the mitochondria
c. substrate phosphorylation
d. Utilization of lactic acid
e. Oxidative phosphorylation

45. In the treatment of many diseases cocarboxylase (thiamine pyrophosphate) is used to provide cells with energy. This will start the process :
a. decarboxylation of amino acids
b. Deamination glutamate
c. Oxidative decarboxylation of pyruvate
d. Deamination biogenes amines
e. Oxidative phosphorylation

46. Izoniazid preparation is used in clinical practice to treat tuberculosis. Tuberculostatic effect is induced by the interference with replication processes and oxidation-reduction reactions due to the buildup of pseudo-coenzyme :
a. NAD.
b. TMP.
c. FMN.
d. THF.
e. CoQ.

47. Malaria is treated with structural analogs of vitamin B2 (riboflavin). These drugs disrupt the synthesis of the following enzymes in plasmodium :
a. FAD-dependent dehydrogenase
b. Cytochrome oxidase
c. Peptidase
d. NAD-dependent dehydrogenase
e. Aminotransferase

48. Megaloblastic anemia is the result of violation of the processes methylation of uracil, leading to disruption synthesis of deoxythymine nucleotides. This is due to deficiency of vitamin and coenzyme :
a. B9 and FH4
b. B3 and CoA
c. B6 and PALP
d. B1 and TDP
e. PP and NAD

49. Nicotinamide coenzyme form :
a. TDP, TPP
b. FAD, FMN
c. NAD +, NADP +
d. ATP, ADP
e. CoA-SH, acetyl CoA

50. Pediatrist has examined the baby after an epileptiform fit, which receives artificial feeding. The baby has dermatitis also. At laboratory inspection decrease alanine-and aspartate aminotransferase activity of erythrocytes is established. What vitamin deficiency can be assumed?
a. Pyridoxine
b. Ascorbic acid
c. Cobalamin
d. Riboflavin
e. Calciferol

51. Plasmic factors of blood coagulation are exposed to post-translational modification with the participation of vitamin K. It is necessary as a cofactor in the enzyme system of gamma-carboxylation of protein factors of blood coagulation due to the increased affinity of their molecules with calcium ions. What amino acid is carboxylated in these proteins?
a. Glutamic
b. Valine
c. Serine

d. Phenylalanine
e. Arginine

52. Pyridoxal phosphate assigned to the patient to correction of processes :
a. Synthesis of purine and pyrimidine bases
b. Oxidative decarboxylation of ketoacids
c. Deamination purine nucleotides
d. Transamination and amino acid decarboxylation
e. protein synthesis

53. Structural analogs of vitamin B2 (riboflavin) prescribed for patients with malaria. Violation of the synthesis of which plasmodium enzymes cause these drug?
a. Peptidase
b. Cytochromeoxydase
c. FAD-dependent dehydrogenases
d. NAD-dependent dehydrogenase
e. Aminotransferase

54. TDP is involved in the process of :
a. Decarboxylation of amino acids
b. Deamination of amino acids
c. Decarboxylation α-keto acids
d. Transamination of amino acids
e. Hydroxylation of amino acids

55. Tetrahydrobiopterin is involved in :
a. hydroxylation
b. decarboxylation
c. deamination
d. Transamination
e. demethylation

56. The 37-year-old patient with a background of long-term use of antibiotics appeared increased bleeding after minor injuries. Is marked reduced activity of clotting factors II, VII, X, lengthening of blood clotting time. These changes are caused by vitamin deficiency :
a. A
b. K
c. D
d. C
e. E

57. The newborn child had signs of hemorrhagic disease due to hypovitaminosis K. Development of disease due to the fact that vitamin K is :
a. inhibits the synthesis of heparin
b. Cofactor for prothrombin synthesis
c. specific inhibitor of antithrombin
d. affects the proteolytic activity of thrombin
e. Is cofactor for γ- glutamylcarboxylase

58. To prevent postoperative bleeding a 6 y.o. child was administered vicasol that is a synthetic analogue of vitamin K. Name post-translational changes of blood coagulation factors that will be activated by vicasol :
a. Carboxylation of glutamin acid.
b. Phosphorylation of serine radicals.
c. Partial proteolysis.
d. Polymerization.
e. Glycosylation.

59. To prevent postoperative bleeding a 6 y.o. child was administered vicasol that is a synthetic analogue of vitamin K. Name post-translational changes of blood coagulation factors that will be activated by vicasol :
a. Carboxylation of glutamin acid
b. Phosphorylation of serine radicals
c. Partial proteolysis
d. Polymerization
e. Glycosylation

60. To prevent postoperative bleeding a 6-year-old child was administered vicasol that is a synthetic analogue of vitamin K. Name post-translational changes of blood coagulation factors that will be activated by vicasol :
a. Carboxylation of glutamic acid
b. Phosphorylation of serine radicals
c. Partial proteolysis
d. Polymerization
e. Glycosylation

61. Vitamin B1 (thiamin) is a part of coenzyme :
a. Coenzyme A
b. FMN, FAD
c. NAD, NADP
d. TPP
e. PALP.

62. Vitamin B1 deficiency causes disturbance of oxidative decarboxylation of α-ketoglutaric acid. This leads to the impaired synthesis of the following coenzyme :
a. Thiamine pyrophosphate
b. Nicotinamide adenine dinucleotide
c. Flavine adenine dinucleotide
d. Lipoic acid
e. Coenzyme A

63. Vitamin B1 deficiency results in disturbance of oxidative decarboxylation of α-ketoglutaric acid. This will disturb synthesis of the following coenzyme :
a. TPP.
b. (NAD).
c. (FAD).
d. THF.
e. CoA

64. Vitamin B1 deficiency results in disturbance of oxidative decarboxylation of α-ketoglutaric acid. This will disturb synthesis of the following coenzyme :
a. Thiamine pyrophosphate
b. Nicotinamide adenine dinucleotide (NAD)
c. Flavine adenine dinucleotide (FAD)
d. Lipoic acid
e. Coenzyme A

65. Vitamin B1 is a component of coenzyme :
a. FH4
b. KoA
c. PALP
d. TDP
e. NAD

66. Vitamin B2 (riboflavin) is a part of coenzyme :
a. Coenzyme A
b. FMN, FAD
c. NAD, NADP
d. TPP
e. PALP.

67. Vitamin B3 (niacin) is a part of coenzyme :
a. Coenzyme A
b. FMN, FAD
c. NAD, NADP
d. TPP
e. PALP.

68. Vitamin B6 (pyridoxine) is a part of coenzyme :
a. Coenzyme A
b. FMN, FAD
c. NAD, NADP
d. TPP
e. PALP.

69. Vitamin E is involved in the formation of double bonds in the molecules of fatty acids in the enzyme :
a. isomerase
b. lyase
c. dehydratase
d. desaturase
e. methyltransferase

70. Vitamin PP is part of the respiratory chain in the form of coenzyme :
a. NAD +
b. FAD
c. FMN

d. PALP
e. CoA-SH

71. What coenzymes are biological redox agents?
a. Coenzyme A
b. FMN, FAD
c. Biotin
d. TPP
e. PALP.

72. What coenzymes are biological redox agents?
a. Coenzyme A
b. NAD, NADP
c. Biocytin
d. TPP
e. PALP.

73. What vitamin transfers oligosaccharide residues through the cell membrane for glycoprotein synthesis :
a. K
b. E
c. PP
d. A
e. C

74. What vitamin-like substance containing polyizoprene long "tail" and is a component of the respiratory chain :
a. Vitamin B15
b. para-aminobenzoic acid
c. Lipoic acid
d. Vitamin U
e. Ubiquinone

75. What vitamin-like substens participates in the process of oxidative decarboxylation of pyruvate :
a. Ascorbic acid
b. Folate
c. Ubiquinone
d. Lipoic acid
e. para-aminobenzoic acid

76. Certain infections caused by bacteria are treated with sulphanilamides that block the synthesis of bacterial growth factor. What is the mechanism of these drugs action?
a. They are antivitamins of p-aminobenzoic acid.
b. They inhibit the folic acid absorption
c. They are allosteric enzyme inhibitors
d. They are involved in redox processes
e. They are allosteric enzymes

Situational Tasks:

1. In order to diagnose myocardial infarction in the serum determine the activity of CPK and AST.
a) Give the full names of these enzymes.
b) To which classes do they belong according to the International Classification of Enzymes.
c) Which of them has isoenzyme forms? Which isoform activity increases during a heart attack?

2. A patient with suspected acute pancreatitis was brought to the emergency clinic.
a) Increased activity of which enzymes in the blood and urine will confirm the diagnosis?
b) The activity of which of the enzymes of the pancreas in the urine is determined by the method of Wolgemut?
c) Indicate the normal values of the activity of this enzyme in the urine.

3. A 58-year-old patient was hospitalized with complaints of chest pain, sudden weakness, sweating, fear, dizziness. Preliminary diagnosis - myocardial infarction.
a) The activity of which enzymes must be determined in the patient's blood?
b) Which of them have isoenzyme forms?
c) Which isoenzyme activity is the most informative in the first hours of myocardial infarction?

4. Organophosphorus compounds are neuroparalytic poisons used as insecticides and war poisons (sarin, tabun).
a) The concentration of which neurotransmitter increases with their action?
b) The activity of which enzyme inhibits organophosphorus compounds? Explain the mechanism.
c) What type of inhibitors do they belong to?

5. Methotrexate is a structural analogue of folic acid used as an antitumor agent (cytostatic).
a) Which enzyme activity is inhibited by methotrexate?
b) What type of inhibitors does it belong to?
c) The synthesis of which coenzyme and which compounds is disturbed?

6. Indirect anticoagulants (dicoumarins) disrupt the synthesis of prothrombin and other blood clotting proteins in the liver.
a) Structural analogues of which vitamin are they?
b) The activity of which enzyme is inhibited by dicoumarins?
c) What type of inhibition occurs?

7. Histidine decarboxylase - an enzyme that catalyzes the conversion of the amino acid histidine to a vasoactive histamine mediator by cleavage of CO_2.
a) What class of enzymes does it belong to?
b) Is this enzyme simple or complex in structure?
c) Which prosthetic group is part of its active center?

8. Hexokinase - an enzyme that catalyzes the phosphorylation of glucose.
a) What class of enzymes does it belong to?
b) Is this enzyme simple or complex in structure?
c) What is the term called complex enzymes? What parts do they consist of and what function do they perform?

9. Cyanides block the action of cytochrome oxidase (CHO), combining with transition metal ions that are part of the active center of the enzyme.
a) What kind of braking takes place?
b) With which metal do cyanides interact in the active center of the CHO?
c) Which coenzyme contains this metal and what function does it perform?

10. Malonate was added to the medium containing succinate and succinate dehydrogenase (SDH). At the same time, the oxidation of succinate with the participation of LDH slowed down.
a) Name the type of inhibition.
b) How does the Michaelis constant and Vmax change under these conditions?
c) How can you restore the activity of the enzyme?

11. One of the ways to regulate the activity of enzymes in the human body is their covalent modification.
a) What covalent modification occurs in the regulation of glycogen phosphorylase and glycogen synthetase activity?
b) What two types of enzymes provide this type of regulation?
c) Give other examples of covalent modification of enzymes.

12. In order to diagnose liver damage (hepatitis, cirrhosis) in the serum determine the activity of LDH and ALT.
a) Give the full names of these enzymes.
b) To which classes (according to the International Classification of Enzymes do they belong?
c) Which of them has isoenzyme forms? Which isoform activity increases in hepatitis?

13. Preparations of mercury, arsenic, bismuth are inhibitors of enzymes having thiol groups (SH-groups) in active centers.
a) Name the type of inhibition.
b) How does the Michaelis constant (Km) and Vmax change under these conditions?
c) What amino acid is used to reactivate these enzymes?

14. Captopril is an antihypertensive drug that is a competitive inhibitor of angiotensin-converting enzyme (ACE). ACE is a carboxydipeptidyl peptidase that converts the angiotensin I proenzyme to the angiotensin II enzyme.
a) Name the mechanism of activation of angiotensin I in angiotensin II.
b) What type of chemical bonds are hydrolyzed by peptidases? What kind of specificity of their action?
c) To which class of enzymes do peptidases belong?

15. In pathological conditions accompanied by hypoxia, a toxic product accumulates in the tissues - hydrogen peroxide (H2O2), which causes oxidative damage to cell membranes.
a) What enzymes neutralize H2O2 in cells?
b) Name the cofactors involved in the neutralization of H2O2.
c) Explain the mechanism of action of a cofactor containing iron.

16. In order to improve redox processes in clinical practice, patients are prescribed vitamin PP.
a) What coenzyme forms of this vitamin do you know?
b) Specify the energy yield during the oxidation of their reduced forms in mitochondria?
c) Give examples of redox processes in which they participate.

17. In malaria, drugs are prescribed - structural analogues of vitamin B2 (riboflavin).
a) Disorders of the synthesis of which enzymes in Plasmodium cause these drugs?
b) Which coenzymes contain riboflavin?
c) Give the mechanism of their action.

18. Erythrocytes contain a powerful antioxidant - a tripeptide that contains the SH group. At its deficiency there is a peroxide hemolysis of erythrocytes.
a) Name this tripeptide. What amino acids are part of it?
b) Explain the mechanism of its action.
c) What role does this coenzyme play in H2O2 neutralization?

19. A chemical plant worker with signs of poisoning was hospitalized. An increased concentration of arsenate was found in the woman's hair, and an increased content of pyruvate was found in her blood.
a) Violation of which process caused the arsenate?
b) Which coenzyme is blocked by arsenate.
c) Which multi-enzyme complexes include this coenzyme?

20. The respiratory chain includes a coenzyme (vitamin-like substance), which is not associated with the apoenzyme.
a) Name this coenzyme. What group does he belong to?
b) Explain the mechanism of its action.
c) What other coenzymes are part of the respiratory chain?

21. In the process of metabolism of some amino acids, fatty acids and cholesterol, methylmalonic acid (methyl-malonyl-CoA) is formed, which has a neurotoxic effect.
a) Which coenzyme is involved in its metabolism?
b) Which metabolite of CAC (Krebs cycle) is converted by methylmalonic acid with the participation of this coenzyme?
c) What is the name of the enzyme of which it is a part?

22. In the synthesis of nucleotides and DNA, an important role is played by a vitamin coenzyme that carries single-carbon fragments. When it is deficient, hematopoiesis is disrupted and macrocytic anemia occurs.
a) Name this coenzyme.
b) From which vitamin and with which enzyme is it formed?
c) What single-carbon fragments does it carry?

23. In order to diagnose lesions of the pancreas (acute pancreatitis, pancreatic necrosis) in the serum and urine determine the activity of amylase and trypsin.
a) To which classes do they belong according to the International Classification of Enzymes.
b) What types of chemical bonds break down these enzymes? List the substrates of these enzymes.
c) Which of these enzymes is also produced by the salivary glands?

24. After surgical removal of a part of a stomach at patients there is a malignant macrocytic anemia of Addison-Birmer that is connected with the broken absorption of vitamin B12.
a) Which coenzyme group 2 is formed from vitamin B12?
b) What enzymes is it part of and in what reactions is it involved?
c) Disruption of the synthesis of which substances causes Addison-Birmer anemia?

25. In order to diagnose myocardial infarction in the serum determine the activity of LDH.
a) Give the full name of the enzyme and the class (according to International Classification of Enzymes to which it belongs?).
b) Explain the structure of LDH isoenzymes
c) Name the localization of LDH isoenzymes.

26. Pepsin hydrolyzes peptide bonds in the process of digestion of proteins in the stomach.
a) To which class of enzymes (according to International Classification of Enzymes it belongs?).
b) What type of chemical bonds breaks down this enzyme? List the substrates of this enzyme.
c) Is pepsin structurally a simple or complex enzyme? What is the pH optimum it has?

27. At the patient with chronic gastritis decrease in activity of pepsin is noted, pH of gastric juice makes 5,0.
a) Name the mechanism of regulation of pepsin activity.
b) For what purpose are such patients prescribed to take a weak solution of hydrochloric acid before meals?
c) What type of specificity is characteristic of this enzyme?

28. In acute pancreatitis is the activation of proteolytic enzymes (trypsin, chymotrypsin) in the cells of the pancreas. To avoid autolysis of the pancreas (self-digestion of its own proteins) in the preclinical stage, complete starvation and cooling of the abdominal wall in the area of the pancreas is recommended.
a) What can explain the need to use these measures?
b) In what units is the activity of trypsin and other enzymes measured
c) Which amino acids are most often part of the active site of these enzymes?

29. The patient after a stroke to restore muscle mobility was prescribed, among other drugs, proserine.
a) The activity of which enzyme inhibits proserine?
b) What type of inhibitors does it belong to?
c) The concentration of which metabolite (neurotransmitter) will increase in the muscles under the action of proserine?

30. After taking sulfonamide drugs, the patient developed bloating and diarrhea due to a violation of the intestinal microflora (dysbacteriosis).
a) What is the mechanism underlying the bactericidal action of sulfonamides?
b) What type of inhibitors are sulfonamides?
c) Which vitamin should be prescribed to the patient?

31. A 50-year-old woman with a diagnosis of myocardial infarction was admitted to the intensive care unit. Which enzyme activity will be highest during the first two days?

32. An 18-year-old boy with a liver parenchyma is more likely to have elevated levels of an enzyme in his serum. What is the enzyme and why?

33. An increase in the activity of LDH-1, LDH-2, AST, creatine phosphokinase was detected in the patient's blood. In which organ is the most probable development of the pathological process? And why?

34. Analysis of the patient's blood revealed a significant increase in the activity of the CF form of CPK (Creatine PhosphoKinase) and LDH-1. What is the disease? And why did this pathology occur?

35. In a patient with acute pancreatitis in the analysis of blood and urine found an increase in the activity of one of the enzymes, which confirms the diagnosis of the disease. What name of enzyme? And explain why?

36. In regulating the activity of enzymes takes place in the way of their postsynthetic covalent modification. Which of the mechanisms regulates the activity of glycogen phosphorylase and glycogen synthetase?

37. Name the enzyme, the determination of which in the blood is most informative in the first hours after myocardial infarction. And explain why?

38. The activity of the isoenzyme LDH1 is high in the patient's serum. In which organ does the pathological process take place? And explain why?

39. When studying the properties of the enzyme, an unknown substance was added to the enzyme-substrate system. As a result, the Michaelis constant has doubled. What phenomenon took place?

40. Which enzyme activity should be determined for diagnostic and prognostic purposes, if a patient with cardiac muscle pathology was admitted to the clinic?

Chapter IV. Introduction to metabolism.

List of the exam questions:

1. General principles of metabolism. Anabolism and catabolism.
2. Stages of biomolecules catabolism. Central metabolic pathways.
3. Oxidative decarboxylation of pyruvate: reactions, enzymes, regulation.
4. Tricarboxylic acid cycle (Krebs cycle): reactions, enzymes, regulation.
5. Krebs cycle functions. Energy balance of Krebs cycle.

Multiple Choice Questions:

1. A patient was administered into hospital with a diagnosis diabetes mellitus type I. In metabolic changes the decrease of oxaloacetate synthesis rate is detected What metabolic pathway is damaged as a result?

A. Tricarboxylic acid cycle
B. Glycolysis
C. Cholesterol biosynthesis
D. Glycogen mobilization
E. Urea synthesis

2. Substrate phosphorylation is a process of phosphate residue transfer from macroergic donor substance to ADP or some other nucleoside diphosphate. What enzyme of tricarboxylic acid cycle participates in reaction of substrate phosphorylation.

A. Succinyl CoA synthase (Succinyl thiokinase)
B. Citrate synthase
C. Succinate dehydrogenase
D. Fumarase
E. Alpha-ketoglutarate dehydrogenase complex

3. Examination of a patient revealed II grade obesity. It is known that he consumes a lot of sweets and rich food, has sedentary way of life. That's why anabolic metabolism has the priority in his organism. Which of the following pathways is amphibolic?

A. Cycle of tricarboxylic acids
B. Glyconeogenesis
C. Lipolysis
D. Glycolysis
E. Fatty acids oxidation

4. In a patient are manifested symptoms of intoxication with arsenic compounds. What metabolic process is damaged taking into account that arsen containing substances inactivate lipoic acid.

A. Oxidative decarboxylation of a-ketoglutarate
B. Fatty acids biosynthesis
C. Neutralization of superoxide anions
D. Coupling of oxidation and phopsphorylation
E. Microsomal oxidation

5. Mitochondria are subcellular organelles and are present in a cytoplasm of every cell except mature red blood cells, bacteria, blue-green algae. What method is used principally for their isolation?

A. Differential centrifugation

B. Gel-filtration
C. Chromatography
D. Electrophoresis
E. Spectrophotometry

6. A biochemistry graduate student isolates all the enzymes of the TCA cycle and adds oxaloacetate and acetyl CoA, including the appropriate energy precursors, cofactors, and water. Which of the following will not be a direct product of his experiment?

A. ATP
B. GTP
C. NADH
D. CO2
E. FADH2

7. A 24-year-old woman presents with diarrhea, dysphagia, jaundice, and white transverse lines on the fingernails (Mee lines). The patient is diagnosed with arsenic poisoning, which inhibits which one of the following enzymes?

A. a-ketoglutarate dehydrogenase
B. Isocitrate dehydrogenase
C. Citrate synthase
D. Malate dehydrogenase
E. Succinate dehydrogenase

8. Enzymes of tricarboxylic acids cycle oxidize acetyl-CoA and produce 3 molecules of reduced NAD and one molecule of reduced FAD. Where are localized these enzymes?

A. In mitochondrial matrix
B. On plasma membrane
C. On external mitochondrial membrane
D. In cell cytoplasm
E. On inner mitochondrial membrane

9. A 2-year-old boy has damaged energy exchange due to inhibition of oxidation processes and ATP synthesis. There is the decrease of Citric acid cycle metabolites content in his blood, too. It was proposed to think about probable inhibition of succinate dehydrogenase in boy's tissues as the reason of his state. Name the inhibitor for this enzyme:

A. Malonate
B. Aspartate
C. Malate
D. Glutamate
E. Citrate

10. Vitamin B1 (thiamine) deficiency will cause the decrease of the rate of Citric Acid Cycle because one enzyme system in this process is in need of its derivative as coenzyme TPP. Name it:

A. Alpha-ketoglutarate dehydrogenase complex
B. Isocitrate dehydrogenase
C. Citrate synthase
D. Pyruvate dehydrogenase complex
E. Malate dehydrogenase

11. Pyruvic acid supplies energy to cells through the TCA cycle when oxygen is present (aerobic respiration). Before pyruvic acid enters the TCA cycle it must be converted to:

A. Acetyl CoA
B. Citrate
C. Lactate

D. a-Ketoglutarate
E. Succinate

12. Most of the metabolic pathways are either anabolic or catabolic. Which of the following pathways is considered as "amphibolic" in nature?
A. TCA cycle
B. Glycogenesis
C. Glycolytic pathway
D. Lipolysis
E. Pentosophosphate pathway

13. The TCA cycle is a pathway designed to burn away carboxylic acids as two moles of CO2.TCA cycle to be continuous requires the regeneration of:
A. Oxaloacetic acid
B. Pyruvic acid
C. a-oxoglutaric acid
D. Malic acid
E. Succinic acid

14. Malate dehydrogenase is an enzyme that reversibly catalyzes the oxidation of malate to oxaloacetate. Malate dehydrogenase is an enzyme dependent from the presence of which of the following cofactors:
A. NAD^+
B. TPP
C. Coenzyme A
D. NADP
E. FMN

15. Which from listed below substances is used as an inhibitor in studies of TCA cycle functioning?
A. Malonate
B. NAD
C. Aconitate
D. ATP
E. Isocitrate

16. Conversion of a-ketoglutarate to succinyl CoA occurs through oxidative decarboxylation is catalyzed by a-ketoglutarate dehydrogenase complex.a- Ketoglutarate dehydrogenase complex contains derivative which of the following vitamins:
A. Thiamine
B. Folic acid
C. Retinol
D. Pyridoxine
E. B12

17. How many moles of $NADH+H^+$ are produced in process of oxidation of 0,25 mole of acetyl-CoA in tricarboxylic acid cycle?
A. 0,75
B. 0,25
C. 0,1
D. 0,5
E. 1,0

18. This is the only citric acid cycle enzyme that is tightly bound to the inner mitochondrial membrane. It is an FAD dependent enzyme, which catalyzes the conversion of succinate to

fumarate. Which of the following is this enzyme:

A. Succinate dehydrogenase
B. Fumarase
C. Aconitase
D. Citrate synthase
E. Isocitrate dehydrogenase

19. Phosphorylated compounds with high $AG^{o'}$ values of hydrolysis have higher phosphate group transfer potentials than those compounds with lower values. Which of the following phosphorylated compounds would you expect to liberate the least free energy on hydrolysis?

A. AMP
B. ATP
C. ADP
D. Phosphoenolpyruvate
E. Phosphocreatine

20. Tricarboxylic acid cycle (TCA) generates so called reduced equivalents - reduced forms of NAD^+ and FAD which are used in:

A. Respiratory chain of enzymes in mitochondria
B. Synthesis of fatty acids
C. Biosynthesis of ATP by substrate phosphorylation
D. Biosynthesis of ATP by oxidative phosphorylation
E. Biosynthesis of purine nucleotides

21. TCA cycle enzymes are regulated by: substrate availability, product inhibition, allosteric inhibition or activation by other intermediates. Which of the following substances allosterically activate isocitrate dehydrogenase

A. ADP
B. FADH2
C. $NADH+H^+$
D. ATP
E. Mg^{2+}

22. In the TCA cycle one phosphorylated compounds with high $AG^{o'}$ value of hydrolysis is produced directly. Substrate level phosphorylation in TCA cycle is in step:

A. Succinate thiokinase
B. Isocitrate dehydrogenase
C. Malate dehydrogenase
D. Aconitase
E. Succinate dehydrogenase

23. Phosphorylated compounds with high $AG^{o'}$ values of hydrolysis have higher phosphate group transfer potentials than those compounds with lower values. Which of the following compounds would you expect to liberate the highest free energy on hydrolysis?

A. Phosphoenolpyruvate
B. ATP
C. ADP
D. AMP
E. Phosphocreatine

24. How many moles of FADH2 are produced in process of oxidation of 0,25 mole of acetyl-CoA in tricarboxylic acid cycle?

A. 0,25
B. 0,1

C. 0,5
D. 1,0
E. 1,5

25. Which of the following enzymes tricarboxylic acid cycle catalyze the reaction: Acetyl-CoA + oxaloacetate ^ citrate + CoASH:

A. Citrate synthase
B. Succinate dehydrogenase
C. Fumarase
D. Aconitase
E. Isocitrate dehydrogenase

26. TCA cycle (Krebs cycle, citric acid cycle) is the most important metabolic pathway for the energy supply to the body. What substance is the main fuel material for TCA cycle?

A. Acetyl-CoA
B. Succinyl-CoA.
C. Glucose
D. Amino acids
E. Fatty acids

27. The TCA cycle is a pathway designed to burn away carboxylic acids as two moles of CO2.Which of the following statements regarding TCA cycle is true?

A. It is amphibolic in nature
B. It is an anaerobic process
C. It occurs in cytosol
D. It contains no intermediates for gluconeogenesis
E. It occurs in nucleus

28. Three enzymes of TCA cycle, which are knows as allosteric and regulation cycle functioning. Which of the listed below is an allosteric one:

A. Isocitrate dehydrogenase
B. Malate dehydrogenase
C. Succinate dehydrogenase
D. Fumarase
E. Aconitase

29. Out of 12 mols of ATP formed in TCA cycle, 1 molecule of ATP can be formed at "substrate level" by which of the following reaction?

A. Succinyl-CoA^Succinic acid
B. Citric acid ^ Isocitric acid
C. Isocitrate^Oxaloacetate
D. Succinic acid^Fumarate
E. Fumarate^Malate

30. A central intermediate of protein, lipid, and carbohydrate metabolism, which delivers the acetyl group to the citric acid cycle to be oxidized for energy production is:

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

31. Succinyl coenzyme A synthetase also known as succinyl-CoA synthetase or succinate thiokinase or succinate-CoA ligase) is an enzyme that catalyzes the reversible reaction of succinyl-CoAto succinate. This reaction requires:

A. GDP
B. CDP
C. ADP
D. $NADP^+$
E. NAD^+

32. Anaplerotic reactions are chemical reactions that form intermediates of a metabolic pathway. An aneplerotic reaction which sustains the availability of oxaloacetate is the carboxylation of:
A. Pyruvate
B. Glutamate
C. Aconitate
D. Citrate
E. Succinate

33. There are three main stages of catabolism in the enzymatic degradation of complex bioorganic compounds in humans. In the first stage the reactions occur according to the mechanism:
A. Hydrolysis
B. Reduction
C. Phosphorylation
D. Oxidation
E. Carboxylation

34. Reactions, metabolites of which may be included both in catabolic and anabolic processes, belong to:
A. Amphibolic
B. Catabolic
C. Exergonic
D. Endergonic
E. Anabolic

35. Oxidation of acetyl-CoA in Krebs cycle plays an important role in the energy supply of each of these cells (tissues, organs), except:
A. Red blood cells
B. Muscle
C. Brain
D. Kidney
E. Liver

36. How many ATP molecules can be formed in the citric acid cycle without electron transport chain in the substrate phosphorylation reaction only?
A. 1
B. 12
C. 11
D. 2
E. 3

37. Anabolic pathways are involved in the synthesis of larger and more complex compounds from smaller precursors What the class of enzymes associated only with anabolic pathways, only:
A. Ligase
B. Transferase
C. Isomerase
D. Oxidoreductase
E. Lyase

38. In the 1^{st} stage of catabolic processes biomolecules such as, carbohydrates, fats, and proteins

are broken down into their individual monomer units: carbohydrates into simple sugars, fats into fatty acids and glycerol, and proteins into amino acids. Catabolic stage I reactions for organic compounds in human organism is located in in:

A. Digestive tract
B. Any place of human body
C. Rough EPR
D. Ribosome
E. Cellular membrane

39. The rat poison fluoroacetate reacts with oxaloacetate to form fluorocitrate. Fluorocitrate inhibits aconitase, leading to the accumulation of citrate. Ingestion may result in convulsions, cardiac arrhythmias, and eventually death. Fluroacetate is found as non-competitive inhibitor for:

A. Aconitase
B. Citrate synthetase
C. Succinate dehydrogenase
D. Alpha-ketoglutarate dehydrogenase
E. Malate dehydrogenase

Situational Tasks:

I. Oxaloacetate is a metabolite of CTC that can be used for the synthesis of glucose and aspartate. With its deficiency in the mitochondria, there is an accumulation of acetyl-CoA.
a) From which metabolites can oxaloacetate be formed?
b) What coenzymes are required for this?
c) Why deficiency of oxaloacetate accumulates acetyl-CoA?

2. Citric acid is used to improve energy metabolism in cells.
a) From what metabolites is citric acid formed in the mitochondria?
b) What is the name of the enzyme? What process is starting?
c) What are allosteric activators and inhibitors of this reaction?

3. In the process of oxidative decarboxylation of pyruvate, a central metabolite is formed, which is further oxidized to the final metabolites of CO2 and H2O.
a) Name this metabolite.
b) In what process does it oxidize to the final metabolites?
c) Calculate the energy balance of pyruvate oxidation to CO2 and H2O.

4. In the treatment of many diseases, the pharmaceutical preparation cocarboxylase (thiamine diphosphate) is used to provide cells with energy.
a) What process is being activated?
b) Specify the energy balance of the reaction?
c) List the components of this complex.

5. The patient entered to hospital with a diagnosis of diabetes mellitus. Among the metabolic disorders is a reduction of oxalacetate, citrate and ketoglutarate.
a) Activity metabolic process which decreases in these conditions?

b) What are the consequences for the organism have decreased activity of this metabolic process?
c) Which anaplerotic reaction replenishes reserves of oxaloacetate?

6. In patients with chronic alcoholism observed increase of pyruvate content in blood serum and increase its excretion in the urine due to thiamine deficiency.
a) The activity of what metabolic process is reduced in these patients?
b) Indicate enzymes and coenzymes of the process.
c) Using of which coenzyme enhance the metabolic activity of this pathway?

7. A chemical plant worker with signs of poisoning was hospitalized. An increased concentration of arsenate was found in the woman's hair, and an increased content of pyruvate was found in her blood.
a) Violation of which process caused the arsenate?
b) Which coenzyme is blocked by arsenate?
c) Which multi-enzyme complexes include this coenzyme?

8. Reduced equivalents are formed in the Krebs cycle, which are oxidized in the respiratory chain to form ATP.
a) What are the recovered equivalents and in what quantity are they generated in the Krebs cycle?
b) What is called the ATP synthesis process coupled with the oxidation of reduced equivalents in the respiratory chain.
c) How many ATP molecules are formed by oxidation in the respiratory chain of all recovered equivalents formed in the Krebs cycle?

9. The oxidative decarboxylation of pyruvate plays a large role in providing the body with energy.
a) Which multi-enzyme complex provides this process?
b) In the absence of which coenzymes it is broken?
c) What are the biochemical symptoms of pyruvate oxidative decarboxylation disorders?

I0. One reaction occurs in the Krebs cycle during which I molecule of GTP is formed, which is easily converted to ATP.
a) What is this reaction called?
b) Name the starting material, product and enzyme of this reaction
c) Which cell organelle does this reaction take place?

Chapter V. Biological oxidation.

List of the exam questions:

1. The principles of bioenergetics. Biological oxidation (the modern conceptions).
2. Oxidoreductases: reacrions, classification and coenzymes.
3. Mitochondrial oxidation (tissue respiration): scheme, complexes, biological role. The electron transport (respiratory) chain.
4. Oxidative phosphorylation: mechanism, chemiosmotic theory, synthesis of ATP, regulation. Substrate level phosphorylation.
5. Uncouplers and inhibitors of electron transport and oxidative phosphorylation.
6. Microsomal (oxygenase) oxidation: scheme, reactions, biological role.
7. Peroxisomal oxidation: reactions, biological role.
8. Free radical processes (reactive oxygen species and their elimination, lipid peroxidation), its bioligical role. Antioxidant system.

Multiple Choice Questions:

1. Cells gain energy required for their functions:
a. by anaerobic oxidation of carbohydrates, lipids and proteins
b. by all oxidation reduction reactions
c. by oxidation of ATP and ADP
d. by the processes called intermediary metabolism

2. Human organism:
a. takes as source of energy diretly energy rich compounds like AT
b. uses directly energy of glucose for all processes which require energy
c. energy of foodstuffs converts to energy in ATP by reduction of substrates
d. energy of foodstuffs converts to energy in ATP by oxidation of substrates

3. In cells of human organism:
a. ATP is formed only in presence of oxygen
b. ATP is formed mainly in lack of oxygen
c. ATP is formed by processes which are located in mitochondria and cytosol
d. ATP can be formed by process of substrate level phosphorylation

4. Cells can gain energy:
a. by oxidation of main sorces of energy for example ATP
b. by oxidation of carbohydrates, lipids and proteins
c. only in aerobic conditions
d. in cytosol by the process called oxidative phosphorylation

5. Glucose is compound which:
a. is universal source of energy
b. allows synthesis of ATP in pentose phosphate pathway
c. is oxidized to CO_2 and H_2O in all cells of human organism
d. requires oxygen for complete oxidation

6. Glucose:
a. allows synthesis of ATP by its reduction in glycolysis
b. allows synthesis of ATP mainly in cytosol
c. is source of energy for all cells of human body
d. allows synthesis of ATP in mitochondria and in cytosol

7. Oxidation of compounds in the cells can be performed by:
a. addition of electrons
b. reaction of compounds with NADH2
c. enzymes which use FAD, NAD and NADP as coenzymes
d. by reaction of compound with oxygen

8. Oxidation of compounds in vivo can proceed:
a. by removal of hydrogens in reactions catalyzed for example by succinate dehydrogenase
b. by removal of electrons
c. by reaction with oxygen for example in hydroxylation reactions
d. by dehydrogenation for example in conversion of lactate to pyruvate

9. Reduction of compounds in the cells:
a. can be made by hydrogenation
b. can proceed by reaction of compounds with oxygen
c. can be made by removal of electrons
d. can be made by addition of proton for example in reaction $HCO3^- + H^+$

10. Reduction of compounds is possible:
a. by uptake of electrons
b. by dehydrogenation
c. by hydrogenation for example in reaction of p-hydroxybutyrate synthesis from acetoacetate
d. by removal of electrons for example during terminal oxidation

11. Dehydrogenation is:
a. reaction by which comounds are oxidized
b. reaction by which compounds are reduced
c. mode of oxidation of compounds for example in Krebs cycle
d. for example conversion of pyruvate to lactate

12. Energy rich bonds:
a. can be formed also in anaerobic conditions
b. are synthesized only in mitochondria
c. are bonds by hydrolysis of which energy more than 3 kJ/mol is released
d. are totally four types

13. Compounds with energy rich bonds:
a. are formed mainly by the process of oxidative phosphorylation
b. all cen be used for synthesis of ATP by substrate level phosphorylation
c. all contains phosphate
d. may contain phosphoanhydride bond - for example ATP and ADP

14. Which of following bonds belong to energy rich:
a. phosphodiester in NAD
b. acylphosphate present in acyl-CoA

c. acylphosphate present in 1,3-bisphosphoglycerate
d. enolphosphate which is formed during glycolysis

15. Acylphosphate energy rich bond is bond which:
a. is present in 3-phosphoglycerate
b. can be formed by reaction of fatty acids with ATP
c. can be formed by enolase
d. is used for synthesis of ATP by oxidative phosphorylation

16. Enolphosphate energy rich bond:
a. is present in enolpyruvate
b. contains the highest amount of energy
c. is formed by reaction of pyruvate with ATP
d. can be used for synthesis of ATP in anaerobic conditions

17. Phosphoenolpyruvate:
a. contains acylphosphate energy rich bond
b. can be used for synthesis of ATP by substrate level phosphorylation in mitochondria
c. is formed by dehydrogenation reaction
d. is compound for synthesis of which in gluconeogenesis GTP is required

18. Compound with guanidiniumphosphate energy rich bond:
a. is creatine phosphate
b. is formed in mucles during work
c. is direct source of energy for muscle contraction
d. can be used for synthesis of ATP by substrate level phosphorylation

19. Guanidinium phosphate energy rich bond:
a. is present in GDP
b. is present in compound which is storage form of energy in muscles
c. is specific donor of energy for gluconeogenesis
d. is formed by creatine kinase

20. Energy released by spliting of energy rich bonds can be used for:
a. activation of substrate for example in synthesis of glucose-6-phosphate
b. active transport
c. transport of Na+ onto the cells
d. synthesis of ATP by oxidative phosphorylation

21. Energy of guanidiniumphosphate energy rich bond can be used for:
a. synthesis of ATP by substrate level phosphorylation
b. transport of compounds through membranes
c. regeneration of ATP in muscles during work
d. proteosynthesis

22. Which of following bonds belon to energy rich:
a. guanidiniumphosphate bond present in GTP
b. phosphoanhydride bond present in ADP
c. acylphosphate bond present in 1,3-bisphosphoglycerate
d. thioester bond present in CoA

23. Oxidoreductases are enzymes which:
a. catalyze oxidation of substrate
b. catalyze reduction of substrates
c. participate for example in synthesis of fatty acids
d. are also component of respiratory chain

24. Which of following enzymes belongs to oxidoreductases:
a. all enzymes of Krebs cycle
b. all enzymes of terminal oxidation
c. all enzymes of glycolysis
d. enzymes which allow synthesis of ATP by substrate level phosphorylation

25. FAD is coenzyme which:
a. is derived for riboflavine
b. contains adenine nucleotide
c. during reduction binds one hydrogen and one electron
d. transfers hydrogens to terminal oxidation directly to cytochrome a

26. FAD:
a. is coenzyme of oxidoreductases
b. is coenzyme of monooxygenases
c. allows synthesis of 3 ATP by oxidative phosphorylation
d. is coenzyme which during reduction binds two hydrogen atoms

27. Monooxygenases:
a. catalyze binding of one oxygen atom into the substrate
b. catalyze reduction of substrates
c. are components of respiratory chain
d. by hydroxylation of substrates they increase solubility of compounds in water

28. Oxidation-reduction reactions in the cells:
a. can be catalyzed by dehydrogenases with coenzymes for example NAD or FAD
b. can be catalyzed by peroxidase, which produces H2O2
c. can catalze binding of oxygen into substrate - for example monooxygenases and dioxygenases
d. all are important for synthesis of ATP

29. Which of components of terminal oxidation transfers hydrogens:
a. NAD+
b. FMN
c. Green complex IV
d. coenzyme Q

30. Which of components of terminal oxidation transfers only electrons:
a. FMN
b. CoQ
c. cytochromes for example cyt b5
d. FeS protein

31. NADH+H+ is coenzyme which:
a. is the coenzyme of monooxygenases
b. transfers hydrogens to FMN in respiratory chain

c. enables synthesis of 3 ATP by oxidative phosphorylation
d. when is oxidized 6 protons are transported into mitochondrial matrix

32. Green complex I:
a. is present in outer mitochondrial membrane
b. is NADH-ubiquinone reductase
c. transfers two hydrogens from NADH2 to FeS-protein
d. is important for reoxidation of FADH2 in terminal oxidation

33. FeS protein in terminal oxidation:
a. takes electrons from FMNH2
b. transfers electrons directly to oxygen
c. transfers electron and proton to coenzyme Q
d. during reduction changes from Fe2+ into Fe3+

34. Terminal oxidation is the process which:
a. is located in inner mitochondrial membrane
b. is used for reoxidation of coenzymes NAD and NADP2
c. produces gradient of protons which is used for synthesis of ATP
d. is inhibited by compounds called uncouplers

35. ATP/ADP translocase is system which:
a. is present in inner mitochondrial membrane
b. is responsible for synthesis of ATP by oxidative phosphorylation
c. is responsible for active transport of ATP and ADP
d. can be inhibited by compounds called uncouplers

36. Cytochrome c oxidase:
a. is located in mitochondrial matrix
b. contains ions of iron and copper
c. transfers electrons to oxygen
d. can be activated by CN- ions

37. When FADH2 is donor of hydrogens to respiratory chain, then:
a. FMN is the first acceptor of hydrogens
b. CoQ is the first acceptor of hydrogens
c. 6 protons are transported to outer side of mitochondrial membran
d. 2 ATP can be formed

38. Mitochondrial ATP-ase:
a. is present in mitochondrial matrix
b. is enzyme of terminal oxidation
c. contains F0 subunitwhich represents proton channel
d. contains F1 subunit which synthesizes ATP form ADP and phosphate

39. Mitochondrial ATP-ase is enzyme which:
a. consists of F1 and F0 subunits
b. is responsible for hydrolysis of ATP
c. uses energy of proton gradient for synthesis of aTP
d. is responsible for transport of ATP into cytosol

40. Uncouplers for example dinitrophenol:
a. inhibit process of terminal oxidation
b. increase synthesis of ATP
c. increase permeability of inner mitochondrial membrane for protons
d. increase production of proton gradient

41. Process of terminal oxidation:
a. is called also oxidative phosphorylation
b. is inhibited by lack of oxygen
c. is activated during hypoxia by lack of oxygen
d. is activated by increased ratio ADP/ATP in mitochondria

Situational tasks:

I. Oxaloacetate is a metabolite of CAC that can be used for the synthesis of glucose and aspartate. With its deficiency in the mitochondria, there is an accumulation of acetyl-CoA.
a) From which metabolites can oxaloacetate be formed?
b) What coenzymes are required for this?
c) Why deficiency of oxaloacetate accumulates acetyl-CoA?

2. Rotenone insecticide was introduced into the body of the laboratory animal, causing signs of poisoning.
a) What process is being disrupted?
b) Explain the mechanism of action of rotenone. What other substances have this effect?
c) Why is the P / O ratio under these conditions?

3. Reduced equivalents are formed in the Krebs cycle, which are oxidized in the respiratory chain to form ATP.
a) What are the recovered equivalents and in what quantity are they generated in the Krebs cycle?
b) What is called the ATP synthesis process coupled with the oxidation of reduced equivalents in the respiratory chain.
c) How many ATP molecules are formed by oxidation in the respiratory chain of all recovered equivalents formed in the Krebs cycle?

4. The oxidative decarboxylation of pyruvate plays a large role in providing the body with energy.
a) Which multi-enzyme complex provides this process?
b) In the absence of which coenzymes it is broken?
c) What are the biochemical symptoms of pyruvate oxidative decarboxylation disorders?

5. Antibiotic antimycin A was added to the mitochondrial culture while reducing the amount of ATP in the medium.
a) What process is being disrupted?
b) Explain the mechanism of action of antimycin A
c) Why is the P / O ratio under these conditions?

6. The ability of walruses to stay in cold water for a long time is explained by the fact that they enhance the synthesis of thyroid hormones (thyroxine).
a) What is the mechanism underlying the "warming" action of these hormones?
b) How does the electrochemical potential and its components in the mitochondria at high thyroxine concentrations change?
c) What are the substances with such effect on the components of the electrochemical potential?

7. One of the side effects of long-term administration of the antibiotic gramicidin is a rise in body temperature.
a) Explain the mechanism of pyrogenic action of this antibiotic.
b) How does the electrochemical potential and its components in mitochondria change in the presence of gramicidin?
c) What are the substances with such effect on the components of the electrochemical potential?

8. Gas poisoning, which has the smell of rotten eggs, is accompanied by impaired tissue respiration, disorders of consciousness and may cause instant death.
a) Name the unknown gas
b) Explain the mechanism of its toxic effect on tissue respiration
c) What substances have the mechanism of influence on the respiratory chain, similar to this gas?

9. One reaction occurs in the Krebs cycle during which I molecule of GTP is formed, which is easily converted to ATP.
a) What is this reaction called?
b) Name the starting material, product and enzyme of this reaction
c) In which cell organelle does this reaction take place?

I0. A forensic expert found the death of cyanide poisoning when she opened the body of a 20-year-old girl.
a) Violation of what process caused the death of the girl?
b) Explain the mechanism of cyanide toxic action
c) Could it be possible to save the child with ascorbic acid?

I I. In programmed cell death (apoptosis), caspase enzymes, which are activated when cytochrome C appears in the cytosol, play an important role.
a) Where is cytochrome C localized?
b) What function does cytochrome C perform in a normal cell?
c) Which prosthetic group is included in cytochrome C?

I2. In a 30-year-old man, a hypo-energetic condition associated with impaired mitochondrial respiratory chain cytochromes.
a) What is the chemical nature of cytochrome enzymes? Which IFF class do they belong to?

b) Name the cytochromes in order of their location in the respiratory chain.
c) What cellular poisons are inhibitors of cytochrome aa3?

I3. Sleeping pill class is assigned to a patient with insomnia.
a) Name the mitochondrial enzyme for which this drug is an inhibitor
b) Which coenzyme is a part of it?
c) By what principle are the coenzymes of the respiratory chain?

I4. Blocking of oxidative phosphorylation in mitochondria occurs under the action of some chemical compounds, but oxygen consumption occurs and the substrate is oxidized.
a) What are these compounds called? Give examples.
b) Explain the mechanism of their action.
c) How will the major metabolism and body temperature change with the introduction of such compounds?

I5. In patients with thyrotoxicosis there is hyperthermia, bulimia, weight loss, increase of the basic metabolism.
a) What are the reasons for these defections?
b) Explain the mechanism of thyroid hormone effects on tissue respiration and ATP synthesis
c) What other hormone has a similar effect on these processes?

I6. The antibiotic oligomycin has recently been used in the treatment of tuberculosis.
a) What process blocks this drug in the tuberculosis stick?
b) Which enzyme inhibitor is oligomycin?
c) Explain the peculiarities of the structure of this enzyme and its function.

I7. Citric acid is used to improve energy metabolism in cells.
a) From what metabolites is citric acid formed in the mitochondria?
b) What is the name of the enzyme? What process is starting?
c) What are allosteric activators and inhibitors of this reaction?

I8. In the process of oxidative decarboxylation of pyruvate, a central metabolite is formed, which is further oxidized to the final metabolites of CO2 and H2O.
a) Name this metabolite.
b) In what process does it oxidize to the final metabolites?
c) Calculate the energy balance of pyruvate oxidation to CO2 and H2O

I9. An insecticide poisoned patient is brought to the hospital. Inhibition of the activity of the mitochondrial enzyme NADH-dehydrogenase was revealed.
a) What insecticide poisoned the patient?
b) What process is being disrupted?
c) How will the P / O index change under these conditions?

20. In the treatment of many diseases, the pharmaceutical preparation cocarboxylase (thiamine diphosphate) is used to provide cells with energy.
a) What process is being activated?
b) Specify the energy balance of the reaction?
c) List the components of this complex.

Theoretical questions:

I. Explain, how endergonic processes are coupled with exergonic processes. Give examples of endergonic and exergonic metabolic pathways. Which of them are catabolic, and which are anabolic?
2. What high-energy compounds do you know? How these compounds are classified? Give examples of metabolic pathways where they are formed.
3. Explain difference between oxidative, substrate level and photosynthetic phosphorylation. What energy compound is formed by substrate level phosphorylation in Krebs cycle?
4. What subclasses of oxidoreductases do you know? Write the list of all coenzymes and corresponding vitamins of these enzymes.
5. Write full name and components of I and III respiratory chain complexes. What inhibitors of these complexes do you know?
6. Write full name and components of II and IV respiratory chain complexes. What inhibitors of these complexes do you know?
7. What vitamins derivatives are included in respiratory chain? What vitamin-like and non-vitamin compounds are used in electron transport? What complex incorporate Cu ion?
8. Explain oxidative phosphorylation process by modern conception. What ATP synthase inhibitors do you know?
9. Explain the mechanism of oxidative phosphorylation uncouplers' act. What ionophores and protonophores do you know?
I0. Why are the energy yields from NAD2H and FAD2H different? How many ATP are formed from each of them? Explain mechanism of respiratory control.
I I. Explain difference between peroxisomal and microsomal oxidation (by localization, enzymes, type of reactions, biological role).
I2. Role of free radical oxidation in normal and pathology conditions. What antioxidants do you know? How they are classified?

REFERENCES

1. Biochemistry: Manual for medical students or interns/ L.D. Popova, A.V. Polikarpova – Kharkiv: KNMU, 2011. – 539 p.
2. Biological and Bioorganic Chemistry in 2 books: national textbook for students and teachers of higher medical education establishments. Book I: Bioorganic Chemistry /B. S. Zimenkovsky, V. A. Muzychenko, I. V. Nizhenkovska, G. O. Syrova. – 3rd edition. – K.: AUS Medicine Publishing, 2020. – 288 p.
3. Biological and Bioorganic Chemistry in 2 books: national textbook for students and teachers of higher medical education establishments. Book 2: Biological Chemistry /Yu.I. Gubsky, I.V. Nizhenkovska, M.M. Korda [et al.] – K.: AUS Medicine Publishing, 2020. – 544 p.
4. Davydov V.V. Principles of medical biochemistry. Tutorial on biochemistry for foreign students of medical department of higher education institutions / V.V. Davydov, E.R. Grabovetskaya; Ryazan State Medical University. – Ryazan; Saint Petersburg: Eco-Vector LLC, 2016. – 552 p.
5. Vidya Sagar MCQ`s in Biochemistry – New Age International Publisher; Ist Ed. edition (2008) – 301 p.
6. GRE Biochemistry, Cell and Molecular Biology Test: The Best Test Preparation (Paperback) – Research & Education Association – 2007 – 347 p.
7. Harper's Biochemistry. 30th edition / R. K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 2015. – 927 p.
8. Janson L.W., Tischler M. Medical Biochemistry: The Big Picture / The McGraw-Hill Companies, 2012. – 431 p.
9. Lehninger A. Principles of Biochemistry. – Sixth Edition. David L. Nelson and Michael M. Cox. – 2013. – 1336 p.
10. Mardashko O.O., Yasinenko N.Y. Biochemistry. Texts of lectures. – Odessa. The Odessa State Medical University, 2003. – 416 p.
11. Nelson D.L., Cox M.M. Lehninger Principles of Biochemistry. Seventh edition – New York. – W.H. Freeman and Company. – 2017. – 1328 p.
12. Richard A Harvey, Ph. D.; Denise R Ferrier, Lippincott's Illustrated Reviews: Biochemistry, Fifth Edition. – 2011. – 531 p.
13. Rostoka L.M. «Medicine. Biological chemistry – Krok I» Self-Study guide for students for licensing examination Krok I (medical care) / L.M. Rostoka, A.D. Sitkar, Ya.Yu. Burmistrova, H.E. Reyti – Uzhhorod, 2019. – 172 p.
14. Rostoka L.M., Sitkar A.D. Burmistrova Ya.Yu. Medicine. Biological chemistry – Krok I. Self-Study manual for students for licensing examination Krok I (medicine) / L.M. Rostoka, A.D. Sitkar, Ya.Yu. Burmistrova. – Uzhhorod, 2021. – 174 p.
15. Satyanarayana U., Chakrapani U. "Biochemistry", Fourth Edition. – 2013. – 809 p.
16. USMLE™. Step 1 Biochemistry and Medical Genetics Lecture Notes – 2013 Kaplan, Inc. – 430 p.

CONTENTS

Foreword.....3
Chapter I. Amino acids. Peptides. Proteins.....4
Chapter II. Nucleotides. Nucleic acids.....28
Chapter III. Enzymes.....47
Chapter IV. Introduction to metabolism.....95
Chapter V. Biological oxidation.....I03
References.....I I2