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BIOCHEMISTRY

Test assignments
for the faculty of foreign students (in the English Medium)

Under the general editorship of professor V.V. Lelevich

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БИОЛОГИЧЕСКАЯ ХИМИЯ

Тесты
для студентов по Биологической химии
(на английском языке)

Под общей редакцией профессора В.В. Лелевича

CONTENTS

PREFACE

Computer testing is one of important steps in the assessment of students' knowledge levels on the studied discipline.

The present test assignments include questions on all major parts of biological chemistry: biochemistry of proteins, nucleic acids, enzymes, introduction into metabolism, biomembranes, energy metabolism, hormones, vitamins, metabolism of carbohydrates, lipids, and amino acids, biochemistry of the liver, kidney, blood, muscles, as well as connective and nervous tissues. Questions on the laboratory practical part are also represented in the book.

Assessment of students' knowledge is done according to the criteria as follows:

Less than 24% of correct answers – **1** point – failed**;**
25 – 34% of correct answers – **2** points – failed**;**
35 – 44% of correct answers – **3** points – failed**;**
45 – 54% of correct answers – **4** points – passed;
55 – 64% of correct answers – **5** points – passed;
65 – 74% of correct answers – **6** points – passed;
75 – 82% of correct answers – **7** points – passed;
83 – 89% of correct answers – **8** points – passed;
90 – 95% of correct answers – **9** points – passed;
96 – 100% of correct answers – **10** points – passed.

One or two correct answers are provided for each question.

Test assignments are useful for the formation and development of biochemical mind of students, as well as for better understanding of practical significance of biochemical analyses in diagnosis.

PROTEINS, ENZYMES

1. **Which of the following amino acids are sulfur-containing?**
   1) serine
   2) alanine
   3) methionine
   4) cysteine

2. **Which of the following amino acids are essential?**
   1) alanine
   2) glycine
   3) lysine
   4) serine

3. **Which of the following amino acids are negatively charged?**
   1) tyrosine
   2) aspartate
   3) glutamine
   4) histidine

4. **In the molecule of a protein, amino acids are joined by:**
   1) hydrogen bond
   2) ionic bond
   3) disulfide bond
   4) peptide bond

5. **The molecule of a peptide is composed of:**
   1) fatty acids
   2) glucose
   3) nucleotides
   4) amino acids

6. **Which of the following amino acids contains hydroxyl group?**

1) tyrosine

2) tryptophan

3) threonine

4) arginine

7. Molecular mass of proteins varies (ranges):

1) 500-1200 Da

2) 1000-2500 Da

3) 2000-50000 Da

4) 6000-1000000 Da

8. Which of the following amino acids are positively charged?

1) leucine

2) histidine

3) tryptophan

4) asparagine

9. In denaturation of proteins, which phenomenon is observed?

1) loss of biological activity

2) cleavage of peptide bonds

3) destruction of primary structure

4) decrease of molecular mass of protein

10. Which type of bond is characteristic of primary structure of proteins?

1) hydrogen bond

2) disulfide bond

3) hydrophobic bond

4) peptide bond

11. Types of secondary structure of proteins:

1) globular

2) spiral

3) subunit

4) pleated sheet

12. Which of the following is the driving force in the formation

of secondary structure of proteins?

1) electrostatic repulsion

2) interaction of side-chain radicals with water

3) ability for the formation of hydrogen bonds

4) thermolability of the protein molecule

13. Which of the following proteins have the highest degree of α-spiralization of polypeptide chain?

1) keratin

2) myoglobin

3) insulin

4) collagen

14. Which of the following are fibrous proteins?

1) insulin

2) hemoglobin

3) albumin

4) collagen

15. Which of the following are globular proteins?

1) elastin

2) myoglobin

3) histidine

4) keratin

16. Which of the following bonds stabilize tertiary structure in globular proteins?

1) electrostatic bond

2) peptide bond

3) hydrophobic interactions

4) phosphodiester bond

17. Which of the following proteins have quaternary structure?

1) myoglobin

2) albumin

3) hemoglobin

4) lactate dehydrogenase

18. Which of the following amino acids are present in histones at increased amounts?

1) leucine

2) lysine

3) serine

4) arginine

19. Which of the following proteins are scleroproteins?

1) albumin

2) collagen

3) casein

4) ceruloplasmin

20. Which of the following are conjugated proteins?

1) scleroproteins

2) casein

3) histones

4) myoglobin

21. Which properties are characteristic of histones?

1) are components of lipoproteins

2) isoelectric point is within acidic pH

3) contain many residues of arginine and lysine

4) are present in the cytoplasm

22. Which of the foolowing are characteristic of proteins?

1) amphoteric property

2) ability of passing through membrane

3) low oncotic pressure

4) light absorption at 450 nm

23. Immunoglobulins are classified as:

1) lipoproteins

2) glycoproteins

3) nucleoproteins

4) phosphoproteins

24. In sickle-cell anemia, the structure of which protein is impaired?

1) albumins

2) globulins

3) hemoglobin

4) immunoglobulins

25. Hyperproteinemia is observed in:

1) hepatitis
2) nephrosis

3) myeloma disease
4) liver cirrhosis

26. Which of the following compounds are peptides?

1) trypsin

2) ceruloplasmin
3) angiotensin

4) glutathione

27. Which of the following is the driving force in the formation of tertiary structure of proteins?

1) electrostatic repulsion

2) interaction of side-chain radicals with water
3) ability for the formation of hydrogen bonds

4) thermolability of the protein molecule

28. Which of the following compounds are classified as metalloproteins?

1) glucagon

2) transferrin

3) hemoglobin

4) methionine

29. Which of the following reactions are classified as universal colour reactions on proteins and amino acids?

1) xanthoproteic reaction

2) ninhydrin reaction

3) Fohl reaction
4) biuret reaction

30. Biuret reaction is positive if the molecule contains minimum number of peptide bonds equal to:

1) one

2) two

3) three
4) five

31. Principle of the method of xanthoproteic reaction is:

1) formation of Ruhemann's complex

2) formation of the sulfide lead sediment

3) nitrification of aromatic amino acids
4) formation of complex with copper ions

32. Normal content of the total serum protein is:

1) 20 – 30 g/L
2) 40 – 50 g/L
3) 65 – 85 g/L
4) 90 – 100 g/L

33. Hypoproteinemia is observed in:

1) myeloma disease
2) chronic nephritis
3) dehydration of the organism
4) liver cirrhosis

34. Which of the following phenomenon takes place in salting-out?

1) increase of charge
2) neutralization of charge
3) dehydration of protein
4) splitting of peptide bonds

35. For elimination of low-molecular components from protein solution, which of the following may be used?

1) salting-out
2) ultracentrifugation
3) electrophoresis
4) dialysis

36. Which properties are characteristic of histones?

1) contain many residues of asparagine and glutamine
2) are components of chromatin
3) isoelectric point is within alkaline pH
4) are components of the total serum protein

37. Hydrolysis of proteins may be caused by:

1) heavy metal salts
2) strong acids
3) ammonium sulfate
4) trypsin

38. In the half saturation solution of ammonium sulfate, which of the following proteins will precipitate?

1) albumins
2) globulins
3) protamines
4) histones

39. A component of quaternary structure of protein is called:

1) monomer
2) domen
3) protomer
4) oligomer

40. What is characteristic of the denatured protein?

1) availability of hydrogen bonds
2) availability of peptide bonds
3) loss of primary, secondary and tertiary structures
4) availability of quaternary structure

41. Which of the following are peptides?

1) bradikinin
2) pepsin
3) glutamine
4) gastrin

42. At which temperature will enzymes denature?

1) 10 – 20ºC
2) 80 – 100ºC
3) 20 – 30ºC
4) 30 – 40ºC

43. Which temperature is optimal for the action of most enzymes?

1) 50 – 60ºC

2) 15 – 20ºC
3) 80 – 100ºC
4) 35 – 40ºC

44. Principle of the method of biuret reaction is:

1) formation of Ruhemann's complex
2) formation of the sulfide lead sediment
3) nitrification of aromatic amino acids
4) formation of complex with copper ions

45. The activity of amylase in the urine is increased in:

1) atherosclerosis
2) diabetes mellitus
3) pancreatitis
4) myocardial infarction 5)

46. Principle of the method of Fohl's reaction is:

1) formation of Ruhemann's complex
2) formation of the sulfide lead sediment
3) nitrification of aromatic amino acids
4) formation of complex with copper ions

47. Which of the following bonds is covalent?

1) disulfide bond
2) electrostatic bond
3) hydrophobic bond
4) peptide bond

48. At full saturation solution of sodium chloride, which of the following proteins will precipitate?

1) albumins
2) globulins
3) protamines
4) histones

49. Ninhydrin reaction detects:

1) peptide bonds
2) aromatic amino acids
3) α-amino group
4) sulfur-containing amino acid

50. Availability of which amino acids in proteins is detected by xanthoproteic reaction?

1) serine
2) threonine
3) tryptophan
4) phenylalanine

51. Globulins precipitate at:

1) full saturation solution of ammonium sulphate
2) half saturation solution of ammonium sulphate

3) full saturation solution of sodium chloride
4) half saturation solution of sodium chloride

52. Albumins precipitate at:

1) full saturation solution of ammonium sulphate
2) half saturation solution of ammonium sulphate
3) full saturation solution of sodium chloride
4) half saturation solution of sodium chloride

53. Principle of the method of ninhydrin reaction is:

1) formation of Ruhemann's complex
2) formation of the sulfide lead sediment
3) nitrification of aromatic amino acids
4) formation of complex with copper ions

54. Synthesis of which protein will be impaired in the vitamin C deficiency?

1) myoglobin
2) insulin
3) collagen
4) hemoglobin

55. What is the name of additional component firmly bound with the protein part in the enzyme molecule?

1) coenzyme
2) holoenzyme
3) apoenzyme
4) prosthetic group

56. On what property of ions is based their position at Hoffmeister's row?

1) solubility in water
2) dehydration ability

3) electrophoretic mobility

4) denaturation ability

57. What common properties are characteristic of both enzymes and inorganic catalysts?

1) do not shift equilibrium of the reaction

2) have high specificity

3) do not expend at the course of reaction
4) activity does not depend on temperature

58. At which pH value do most proteins exhibit their maximum activity?

1) acidic, pH = 1.5 – 2.0
2) alkaline, pH = 8.0 – 9.0
3) close to neutral
4) only at pH = 7.0

59. Which of the following statements concerning enzymes is true?

1) they consist of amino acids
2) they are thermostable
3) they denature under extreme conditions
4) their molecular mass is low

60. Which of the following amino acids may be detected by Fohl's reaction?

1) serine
2) methionine
3) cysteine
4) phenylalanine

61. Enzymes of oxidoreductase class catalyze:

1) loss or gain of electrons or hydrogen atoms
2) reactions of intermolecular transfer of atoms, groups of atoms
3) break of chemical bonds with the use of water
4) generating double bonds or joining atom groups on them

62. Enzymes of tranferase class catalyze:

1) loss or gain of electrons or hydrogen atoms
2) reactions of intermolecular transfer of atoms, groups of

atoms

3) break of chemical bonds with the use of water

4) generating double bonds or joining atom groups on them

63. Enzymes of hydrolase class catalyze:

1) loss or gain of electrons or hydrogen atoms

2) reactions of intermolecular transfer of atoms, groups of atoms
3) break of chemical bonds with the use of water
4) generating double bonds or joining atom groups on them

64. Enzymes of lyase class catalyze:

1) loss or gain of electrons or hydrogen atoms
2) reactions of intermolecular transfer of atoms, groups of atoms
3) break of chemical bonds with the use of water
4) generating double bonds or joining atom groups on them

65. Which of the following enzymes are classified as isomerases?

1) esterase
2) mutase
3) catalase
4) epimerase

66. Enzymes of ligase class catalyze:

1) transfer of atom groups (without participation of H_2O)
2) break of chemical bonds with the use of water
3) generating double bonds or joining groups on them
4) formation of new bonds, coupled with the use of ATP

67. Xanthoproteic reaction detects:

1) peptide bond
2) aromatic amino acids
3) α-amino groups
4) sulfur-containing amino acid

68. For simple enzymes, the velocity of enzymatic reaction depends on:

1) concentration of substrate

2) concentration of enzyme

3) molecular mass of enzyme

4) molecular mass of substrate

69. For estimation of the functional state of the liver (diagnosis of liver disorders), activity of which enzyme is determined in the blood serum?

1) acid phosphatase
2) alanine aminotransferase
3) aspartate aminotransferase
4) histidase

70. In the structure of a conjugated enzyme, the non-protein component is called:

1) domen
2) apoenzyme
3) cofactor
4) protomer

71. Isoenzymes are multiple forms of enzymes which:

1) catalyze different reactions
2) catalyze the same reaction
3) differ by their physicochemical properties
4) do not differ by their physicochemical properties

72. Allosteric enzymes differ from simple enzymes by:

1) kinetics of reactions
2) availability of regulatory center
3) availability of one polypeptide chain
4) availability of native properties only in tertiary structure

73. In regulation of the enzyme activity, covalent modification includes:

1) induction and repression
2) partial proteolysis
3) phosphorylation and dephosphorylation of an enzyme

4) feed-back inhibition

74. The largest activity of lactate dehydrogenase is observed in:

1) prostate gland
2) liver
3) myocardium
4) bone

75. In myocardial infarction, the activity of which enzyme is increased?

1) aspartate aminotransferase
2) creatine kinase
3) alkaline phosphatase
4) LDH_5

76. Which of the following enzymes exhibit relative (group) specificity?

1) lipase
2) urease
3) histidase
4) trypsin

77. The higher is Michaelis constant, the affinity of the enzyme for the substrate:

1) is higher
2) is lower
3) remains unaltered

78. Which of the following statements concerning enzymes is true?

1) enzymes increase Michaelis constant
2) enzymes decrease Michaelis constant
3) enzymes decrease activation energy
4) enzymes increase activation energy

79. Lineweaver-Burk plot helps in the exact determination of:

1) concentration of enzyme
2) concentration of substrate
3) optimum pH
4) Michaelis constant

80. Allosteric regulation of the enzyme activity includes:

1) feed-back inhibition

2) phosphorylation and dephosphorylation of enzymes

3) partial proteolysis
4) induction and repression

81. Which of the following takes place in competitive inhibition?

1) V_{max} (maximal velocity) is decreased

2) K_M (Michaelis constant) is increased

3) V_{max} (maximal velocity) stays the same

4) K_M (Michaelis constant) stays the same

82. Which of the following takes place in non-competitive inhibition?

1) V_{max} (maximal velocity) is decreased

2) K_M (Michaelis constant) is increased

3) V_{max} (maximal velocity) stays the same

4) K_M (Michaelis constant) stays the same

NUCLEIC ACIDS, BIOSYNTHESIS OF PROTEINS

83. Which of the following components is monomeric unit of nucleic acids?

1) amino acid

2) monosaccharide

3) nucleotide

4) nitrogenous base

84. Which of the following nucleotides is a component of DNA ?

1) dTDP

2) dGMP

3) dUMP

4) dCTP

85. Which of the following nucleotides is a component of RNA?

1) dUMP
2) TMP
3) CMP
4) UTP

86. Primary structure of DNA and RNA is formed by which of the following chemical bonds?

1) glycoside bond
2) phosphodiester bond
3) peptide bond
4) hydrogen bond

87. Which of the following signs of secondary structure of DNA are true?

1) right-handed double helix
2) left-handed double helix
3) one turn of the helix includes 12 base pairs
4) one turn of the helix is 3.4 nm of vertical size

88. Which of the following are functions of tRNA?

1) transfer of amino acids to ribosomes
2) transfer of genetic information from DNA to ribosomes
3) transport of mRNA from the nucleus to the cytoplasm
4) transport of ribosomal subunits

89. Which one of the following transfers genetic information from DNA to the place of protein synthesis?

1) DNA-polymerase
2) mRNA
3) tRNA
4) rRNA

90. The cloverleaf structure is characteristic of:

1) tertiary structure of DNA
2) 40 S subunit of ribosome
3) tRNA
4) mRNA

91. Which sequence of nucleotides is present on the 3′-end of the acceptor stem of tRNA?

1) UAG

2) CAA

3) CCA

4) AUG

92. Denaturation of DNA is accompanied by:

1) hyperchromic effect

2) breakdown of primary structure

3) increase of viscosity of the DNA solution

4) separation of complementary polynucleotide strands

93. Which of the following are components of chromatin?

1) histones

2) cytochromes

3) DNA

4) heme

94. Compact packing of DNA in the nucleus is possible due to formation of:

1) microsomes

2) nucleosomes

3) chromatin filaments

4) ribosomes

95. Which of the following enzymes participate in biosynthesis of DNA in eukaryotes?

1) topoisomerase

2) DNA polymerase α (alpha)

3) translocase

4) polynucleotide phosphorylase

96. Which of the following components are substrates for the DNA synthesis in eukaryotes?

1) nucleotide triphosphates

2) deoxyribonucleoside triphosphates

4) Okazaki fragments

5) deoxyribonucleotide triphosphates

97. Which of the following concerning tRNA is true?

1) contains 60S and 40S subunits
2) contains modified nitrogenous bases
3) contains codon loop
4) has the cloverleaf structure

98. Which of the following concerning tRNA is true?

1) contains anticodon loop
2) contains “cap” on its 5'-end
3) binds with histones
4) contains thymine

99. Which of the following are representatives of nucleoproteins?

1) ribosomes
2) microsomes
3) cytochromes
4) chromosomes

100. Full hydrolysis of deoxyribonucleoproteins results in the formation of:

1) nucleosides
2) purine bases
3) ribose
4) amino acids

101. **In full hydrolysis, RNA decomposes to**:

1) phosphate
2) amino acids
3) ribose
4) nucleotides

102. Uric acid is the end product of which type of catabolism?

1) pyrimidine bases
2) purine bases
3) heme
4) urea

103. Which of the following are designations of ribosomal subunits in eukaryotes?

1) 40 S

2) 30 S

3) 60 S

4) 70 S

104. Which of the following enzymes participate in biosynthesis of DNA in the nucleus of eukaryotes?

1) revertase
2) DNA-ligase
3) DNA-polymerase γ (gamma)
4) helicase

105. Determination of uric acid in the urine is used in diagnosis of:

1) kidney diseases
2) gout
3) hepatitis
4) phenylketonuria

106. Hyperuricemia (hyperuricacidemia) is observed in:

1) renal failure
2) gout
3) parenchymal jaundice
4) obesity

107. What is the name of oligoribonucleotide required for initiation of the DNA synthesis?

1) promoter
2) protomer
3) primer
4) Okazaki fragment

108. Activation of amino acids for the protein synthesis is the binding of an amino acid with:

1) tRNA
2) mRNA
3) large ribosomal subunit
4) small ribosomal subunit

109. Which of the following enzymes catalyzes activation of amino acids?

1) transaminase

2) acyl CoA synthetase

3) aminoacyl-tRNA-synthetase

4) peptidyltransferase

110. Which of the following amino acids initiates protein synthesis?

1) alanine
2) glutamate
3) cysteine
4) methionine

111. Post-transcriptional modification of hnRNA includes:

1) polyadenylation
2) replication
3) reparation
4) capping

112. Splicing is:

1) separation of the DNA strands
2) removal of introns and connection of exons
3) polyadenylation of 3'-end
4) removal of exons and connection of introns

BIOLOGICAL OXIDATION. ENERGY METABOLISM

113. Entropy is:

1) heat content of the system
2) energy content of the system
3) measure of the disorder of the system
4) heat loss of the system

114. Exergonic reactions proceed with:

1) decrease of the standard free energy
2) increase of the standard free energy

3) absorbance of heat

4) release of water

115. Which of the following are macroergic substrates?

1) glucose 6-phosphate
2) ATP
3) fatty acids
4) creatine phosphate

116. Uncoupling of the electron transport chain and oxidative phosphorylation results in:

1) hypoxia
2) decrease of body temperature
3) rise of body temperature
4) muscle weakness

117. How many high-energy bonds does ATP contain?

1) one
2) two
3) three
4) four

118. Which of the following is universal high-energy compound in humans?

1) glucose
2) glycogen
3) triacylglycerols
4) ATP

119. What percentage of ATP is formed in the organism by the way of oxidative phosphorylation?

1) 100 %
2) 90 %
3) 75 %
4) 50 %

120. Which of the following substances are formed as a result of functioning of the electron transport chain?

1) H_2O

2) O_2

3) ATP

4) H_2O_2

121. At what compartment of the cell is the electron transport chain located?

1) in microsomes
2) on the external mitochondrial membrane
3) on the internal mitochondrial membrane
4) in the mitochondrial matrix

122. Which of the following enzymes participate in the transport of electrons from substrates to oxygen?

1) hydrolases
2) pyridine dehydrogenases
3) isomerases
4) cytochromes

123. The sequence of components in the ETC is:

1) NAD – FMN – CoA – cytochromes
2) FAD – NAD – CoA – cytochromes
3) NAD – FMN – CoQ – cytochromes
4) NAD – NADP – CoQ – cytochromes

124. How many molecules of ATP are formed in the ETC per one pair of electrons transferred from $NADH_2$ to oxygen?

1) 12
2) 2
3) 38
4) 3

125. NAD is a derivative of vitamin:

1) B_1
2) B_2
3) B_6
4) PP

126. FAD is a derivative of vitamin:

1) B_1
2) B_2
3) B_6
4) PP

127. Which of the following are components of the electron transport chain?

1) cytochromes
2) $NADPH_2$
3) CoQ
4) CoA

128. According to the structure, cytochromes are:

1) lipoproteins
2) glycolipids
3) nucleoproteins
4) hemoproteins

129. With which metabolic process is synthesis of ATP coupled by the way of oxidative phosphorylation?

1) gluconeogenesis
2) synthesis of triacylglycerols
3) deamination of amino acids
4) electron transport chain

130. Which of cytochromes contains copper?

1) c_1
2) c
3) aa_3
4) b

131. How many molecules of ATP are formed in the ETC per one pair of electrons transferred from $FADH_2$ to oxygen?

1) 38
2) 12
3) 2
4) 3

132. At what compartment of the cell is the major amount of ATP synthesized?

1) endoplasmic reticulum
2) nucleus
3) mitochondria
4) cytoplasm

133. In transport of electrons along the ETC, at what compartment of the cell is the proton gradient generating?

1) mitochondrial matrix
2) intermembrane space
3) cytoplasm
4) cell membrane

134. Which metabolic pathway is the major extra-mitochondrial source of $NADH_2$ for the electron transport chain (ETC)?

1) gluconeogenesis
2) pentose phosphate pathway
3) tricarboxylic acid cycle
4) glycolysis

135. Which of the following compounds are uncouplers of the electron transport chain (ETC) and oxidative phosphorylation?

1) thyroxine
2) insulin
3) 2,4-dinitrophenol
4) cholesterol

136. Which of the following compounds are inhibitors of the ETC?

1) amytal
2) ADP
3) CO_2
4) cyanide

137. Which of the following compounds are activators of the ETC?

1) oxidized substrates
2) ADP
3) oxygen

4) ATP

138. Which enzyme is involved in the transfer of electrons directly to oxygen?

1) superoxide dismutase

2) catalase

3) cytochrome oxidase
4) peroxidase

139. Which of the following are the ways of ATP formation?

1) microsomal oxidation
2) lipid peroxidation
3) substrate-level phosphorylation
4) oxidative phosphorylation

140. Which components of the ETC are inhibited by cyanides?

1) cytochrome oxidase
2) CoQ
3) cytochrome b
4) NADH-dehydrogenases

141. Active part of NAD is:

1) adenine
2) pentose
3) nicotinamide
4) isoalloxazine ring

142. Active part of FAD is:

1) adenine
2) nicotinamide
3) iron
4) isoalloxazine ring

143. In which metabolic pathways does cytochrome oxidase participate?

1) glycolysis
2) tricarboxylic acid cycle

3) electron transport chain

4) pentose phosphate pathway

144. What is transferred by cytochrome oxidase?

1) protons H^+

2) hydrogen atoms

3) electrons

4) oxygen

145. Which of the following substrates are macroergic compounds?

1) glucose 1-phosphate
2) phosphoenolpyruvate
3) glucose 6-phosphate
4) 1,3-bisphosphoglycerate

146. Which of the following structural features are specific to cytochrome oxidase?

1) simple enzyme
2) contains heme
3) contains copper
4) contains NAD

147. Which of the following is transferred by cytochromes in the electron transport chain (ETC)?

1) protons
2) electrons
3) hydrogen atoms
4) oxygen

148. Which of the following is the active part of cytochromes?

1) adenine
2) nicotinamide
3) iron
4) isoalloxazine ring

149. Who discovered the tricarboxylic acid cycle?

1) Sanger
2) Watson and Crick
3) Mitchell
4) Crebs

150. At what compartment of the cell is the tricarboxylic acid cycle located?

1) in the cytoplasm
2) in mitochondria
3) in the nucleus
4) in ribosomes

151. Which of the following metabolites is utilized in the TCA cycle?

1) ammonia
2) glucose
3) acetyl CoA
4) ATP

152. Which of the following is the substrate of citrate synthase?

1) pyruvate
2) citrate
3) acetyl CoA
4) oxaloacetate

153. Which of the following is coenzyme of isocitrate dehydrogenase?

1) FAD
2) NAD^+
3) TDP
4) HSCoA

154. Which enzyme of the TCA cycle catalyzes reaction of substrate-level phosphorylation?

1) citrate synthase
2) isocitrate dehydrogenase
3) succinate dehydrogenase
4) succinyl CoA synthase

155. Which of the following enzymes regulate flow velocity of the TCA cycle?

1) citrate synthase
2) succinate dehydrogenase
3) isocitrate dehydrogenase
4) malate dehydrogenase

156. How many molecules of ATP are generated in utilization of 1 molecule acetyl CoA in the TCA cycle?

1) 2

2) 3

3) 12

4) 38

157. Activity of which enzymes of the TCA cycle will be impaired in the vitamin PP deficiency?

1) citrate synthase
2) isocitrate dehydrogenase
3) succinate dehydrogenase
4) fumarase

158. Which enzymes of the TCA cycle will be impaired in the vitamin B_2 deficiency?

1) malate dehydrogenase
2) isocitrate dehydrogenase
3) succinate dehydrogenase
4) aconitase

159. In which reactions of the TCA cycle is $NADH_2$ generated?

1) isocitrate dehydrogenase
2) succinyl CoA synthase
3) succinate dehydrogenase
4) malate dehydrogenase

160. In which reactions of the TCA cycle is $FADH_2$ generated?

1) isocitrate dehydrogenase
2) succinyl CoA synthase
3) succinate dehydrogenase
4) malate dehydrogenase

161. Of how many enzymes is α-ketoglutarate dehydrogenase complex composed?

1) two
2) three
3) four
4) six

162. Which of the following compounds is coenzyme of succinate dehydrogenase?

1) TDP
2) NAD
3) HSCoA
4) FAD

163. Microsomal oxidation is classified as which type of oxidation?

1) dioxygenase type
2) monooxygenase type
3) oxidase type
4) peroxidase type

164. Which of the following enzymes participate in microsomal oxidation?

1) cytochrome oxidase
2) NADPH-cytochrome P_{450}-reductase
3) peroxidase
4) glutathione reductase

165. What is the biological role of microsomal oxidation?

1) transport of oxygen to tissues
2) detoxification of xenobiotics
3) energy production
4) hydroxylation of hydrophobic substrates

166. Reactive oxygen species are represented by:

1) superoxide anion
2) peroxide radical
3) oxidized glutathione
4) malonic dialdehyde

167. Antioxidant factors are represented by:

1) ascorbic acids
2) glucuronic acid
3) vitamin PP
4) selenium

168. Enzymes of the antioxidant defence are represented by:

1) glucose oxidase
2) glutathione peroxidase
3) catalase
4) NADPH-cytochrome P_{450}-reductase

169. Glutathione participates in the antioxidant defence due to availability in its structure:

1) methyl group
2) hydroxyl group
3) amino group
4) sulfhydryl group

170. Catalase destroys:

1) peroxide radical
2) superoxide anion
3) glutathione
4) hydrogen peroxide

171. Anabolism implies:

1) degradation of organic substances
2) hydrolysis of biopolymers
3) biosynthesis of compounds from precursor molecules
4) transport of molecules across membranes

172. Catabolism implies:

1) degradation of complex molecules to simpler ones
2) hydrolysis of biopolymers in the body
3) biosynthesis of complex molecules
4) transport of molecules across membranes

173. Which of the following processes are classified as catabolic pathways?

1) gluconeogenesis
2) glycolysis
3) β-oxidation of fatty acids
4) transamination

174. Which of the following processes are classified as anabolic

pathways?

1) glycogenolysis
2) decarboxylation of amino acids
3) biosynthesis of fatty acids
4) gluconeogenesis

175. End products of metabolism in humans are:

1) glucose
2) CO_2
3) glycerol
4) urea

176. Which representatives of lipids are never included into biological membranes?

1) phospholipids
2) triacylglycerols
3) sphingolipids
4) glycolipids

177. Which of the following properties are characteristic of biological membranes?

1) symmetry
2) low electric resistance
3) selective permeability
4) liquid-crystal state

178. In facilitated diffusion, substrates are transported across membrane:

1) against concentration gradient
2) with help of protein transporter
3) without help of protein transporter
4) with use of ATP

179. In primary active transport, substrates are transported across membrane:

1) against concentration gradient
2) down concentration gradient
3) without use of ATP
4) with use of ATP

180. Which of the following properties are characteristic of cell membranes?

1) high permeability for ions

2) low permeability for water

3) high electric resistance

4) asymmetry

HORMONES

181. Which of the following hormones regulate metabolism of Ca and phosphate?

1) mineralocorticoids

2) aldosterone

3) parathyroid hormone

4) vasopressin

182. Which of the following hormones regulate water and salt balance?

1) oxitocin

2) vasopressin

3) calcitonin

4) aldosterone

183. Which of the following are peptide hormones?

1) insulin
2) thyroxine

3) adrenaline

4) cortisol

184. Which of the following are peptide hormones?

1) testosterone

2) glucagon

3) growth hormone
4) thyroxine

185. Which of the following hormones are derivatives of amino acids?

1) thyroxine

2) vasopressin

3) adrenaline

4) glucagon

186. Which of the following are steroid hormones?

1) glucagon
2) cortisol

3) corticotropin
4) adrenaline

187. Which of the following are steroid hormones?

1) hydrocortisone
2) glucagon
3) thyroxine
4) estradiol

188. Target tissues are:

1) tissues which produce the hormone
2) tissues on which the hormone acts
3) tissues at which receptors to the hormone are available

189. Receptors for peptide hormones are located:

1) in the cytoplasm of the cell
2) on the outer surface of the cell membrane
3) in ribosomes
4) in microsomes

190. Receptors for the steroid hormones are located:

1) in the cytoplasm
2) in ribosomes
3) on the outer surface of the cell membrane

191. In the action of peptide hormones on the cell, the second messenger is:

1) Ca^{++}
2) protein kinase
3) cyclic AMP
4) phosphatidylinositol

192. In the action of peptide hormones on the cell, the second

messenger is:

1) inositol triphosphate

2) phosphatidylinositol

3) adenylate cyclase

4) diacylglycerol

193. Role of adenylate cyclase:

1) synthesis of cyclic AMP
2) destruction of cyclic AMP
3) activation of protein kinase
4) phosphorylation of enzymes

194. Which of the following hormones are formed in the thyroid gland?

1) thyroid stimulating hormone
2) adrenaline
3) thyroxine
4) insulin

195. Hormone thyroxine is synthesized in:

1) pancreas
2) thyroid gland
3) parathyroid glands
4) adrenal medulla

196. Which of the following are structural characteristic features of thyroxine?

1) is derivative of amino acid tryptophan
2) contains iodine
3) is derivative of amino acid tyrosine
4) has polypeptide structure

197. Thyroxine deficiency in a child causes the disease:

1) myxedema
2) Graves' disease
3) cretinism
4) acromegaly

198. Thyroxine deficiency in adults causes the disease:

1) Graves' disease
2) cretinism
3) myxedema
4) pheochromocytoma

199. Action of physiological concentrations of thyroxine:

1) increase synthesis of nucleic acids and proteins
2) increase deposition of calcium and phosphate in bones
3) uncouple the ETC and oxidative phosphorylation
4) maintain energy balance

200. Action of high concentrations of thyroxine:

1) activate anabolism
2) activate catabolism
3) decrease body temperature
4) uncouple the ETC and oxidative phosphorylation

201. Symptoms of hyperthyroidism:

1) rise of the body temperature
2) decrease of the body temperature
3) obesity
4) body weight loss

202. Hyperproduction of thyroxine is accompanied by:

1) excitement, nervousness
2) muscle weakness
3) skeletal deformity
4) increase of cholesterol levels in the blood

203. Symptoms of myxedema:

1) tachycardia
2) decrease of the body temperature
3) mucous-like swelling of tissues
4) increase of the body temperature

204. Which symptoms are observed in cretinism?

1) protruded eyes

2) goitre

3) mental and physical retardation
4) disorder of twilight vision

205. Biological action of parathyroid hormone:

1) increases concentration of Ca^{++} and phosphate in the blood

2) decreases concentration of Ca^{++} and phosphate in the blood
3) increases concentration of Ca^{++} but decreases concentration of phosphate in the blood
4) decreases concentration of Ca^{++} but increases concentration of phosphate in the blood

206. Which of the following are target tissues for parathyroid hormone?

1) muscle
2) kidney
3) thyroid gland
4) bone

207. Biological action of calcitonin:

1) decreases concentration of Ca^{2+} and phosphate in the blood
2) increases concentration of Ca^{2+} and phosphate in the blood
3) increases concentration of Ca^{2+} but deceases concentration of phosphate in the blood
4) decreases concentration of Ca^{2+} but increases concentration of phosphate in the blood

208. Hormone calcitonin is formed in:

1) pancreas
2) adrenal cortex
3) adrenal medulla
4) thyroid gland

209. Major target tissues for insulin (tissues absolutely dependent on insulin):

1) erythrocytes
2) muscle
3) adipose tissue
4) brain

210. Tissues absolutely independent on insulin:

1) erythrocytes
2) muscle
3) adipose tissue
4) brain

211. Biological action of insulin:

1) increases concentration of glucose in the blood
2) exerts anabolic effect
3) exerts catabolic effect
4) stimulates synthesis of protein, fat, and glycogen

212. Effect of insulin on carbohydrate metabolism:

1) activates glycolysis
2) activates gluconeogenesis
3) activates synthesis of glycogen
4) activates degradation of glycogen

213. Which of the following hormones increase membrane permeability for glucose to enter the cell?

1) insulin
2) glucagon
3) glucocorticoids
4) thyroxine

214. Which of the following hormones decrease membrane permeability for glucose to enter the cell?

1) insulin
2) glucagon
3) glucocorticoids
4) thyroxine

215. Biological action of glucagon:

1) increases synthesis of glycogen
2) increases degradation of glycogen
3) activates glycolysis
4) activates gluconeogenesis

216. Glucagon is synthesized in:

1) adrenal cortex
2) adrenal medulla
3) α-cells of Langerhans islets
4) β-cells of Langerhans islets

217. Which of the following are representatives of glucocorticoids?

1) glucagon
2) hydrocortisone
3) aldosterone
4) deoxycorticosterone

218. Which of the following are representatives of mineralocorticoids?

1) adrenaline
2) vasopressin
3) aldosterone
4) deoxycorticosterone

219. Which of the following are target tissues for glucocorticoids?

1) erythrocytes
2) liver
3) adipose tissue
4) adrenals

220. Which of the following are target tissues for glucocorticoids?

1) adrenal cortex
2) adrenal medulla
3) lymphoid tissue
4) muscle

221. Which of the following effects do glucocorticoids exert in the liver?

1) activate gluconeogenesis
2) inhibit glycolysis
3) inhibit gluconeogenesis

4) activate glycolysis

222. Which of the following effects do glucocorticoids exert in muscle?

1) activate glycolysis

2) activate gluconeogenesis

3) inhibit glycolysis
4) increase membrane permeability for glucose to enter the cell

223. In excess of glucocorticoids, which of the following symptoms are observed?

1) increased deposition of fat on the extremities
2) decreased deposition of fat on the extremities
3) increased deposition of fat on the truck and face
4) decreased deposition of fat on the trunk and face

224. In excess of glucocorticoids, which of the following symptoms are observed?

1) muscle weakness and atrophy
2) increased degradation of protein in peripheral tissues
3) increased resistance to infections
4) diabetes insipidus

225. Mineralocorticoids regulate metabolism of:

1) proteins, fat, and carbohydrates
2) calcium and phosphate
3) sodium, potassium, and water
4) sodium, calcium, and water

226. Biological action of aldosterone in kidney:

1) increases reabsorption of potassium
2) increases reabsorption of sodium
3) decreases reabsorption of sodium
4) decreases reabsorption of potassium

227. Aldosterone causes:

1) increase of sodium concentration in the blood
2) increase of potassium concentration in the blood

3) increase of potassium excretion in the urine
4) decrease of the blood pressure

228. Excess of glucocorticoids in the organism occurs in:

1) Cushing's disease

2) Kohn's disease

3) Addison's disease
4) Graves' disease

229. Excess of mineralocorticoids in the organism occurs in:

1) Cushing's syndrome
2) Kohn's disease
3) adrenogenital syndrome
4) Addison's disease

230. Which of the following are representatives of female sex hormones?

1) estradiol
2) prostaglandins
3) corticosterone
4) progesterone

231. Biological action of estrogens:

1) increase secretory activity of sebaceous glands of the skin
2) decrease synthesis of VLDL
3) increase synthesis of angiotensinogen
4) decrease synthesis of HDL

232. In excess of estrogens, which of the following is observed?

1) liability to thrombosis
2) spider-like obesity
3) increased blood pressure
4) subconscious preference of salt meals

233. Action of estrogens on metabolism of lipoproteins:

1) decrease synthesis of VLDL

2) increase synthesis of VLDL

3) increase synthesis of HDL

4) decrease synthesis of HDL

234. Which of the following symptoms are observed in Addison's disease?

1) hypoglycemia

2) hyperglycemia

3) spider-like obesity
4) increased blood pressure

235. Which of the following symptoms are observed in Addison's disease?

1) pigmentation of the skin

2) mental deficiency

3) decreased blood pressure

4) hyperglycemia

236. Addison's disease is caused by the damage of:

1) thyroid gland
2) hypophysis

3) adrenal medulla

4) adrenal cortex

237. Which of the following are representatives of androgens?

1) testosterone
3) antiduiretic hormone

4) aldosterone

5) progesterone

238. Biological action of androgens:

1) decrease ossification of epiphysial growth zones of the bone
2) increase ossification of epiphysial growth zones of the bone

3) increase secretory activity of sebaceous glands of the skin

4) increases synthesis and deposition of fats

239. In excess of androgens, which of the following symptoms are observed?

1) aggressiveness

2) subconscious preference of salt meals

3) short height
4) tall height

240. Role of cyclic AMP in the cell:

1) is converted to ATP

2) activates adenylate cyclase

3) is source of energy
4) activates protein kinase A

241. At what part of the body is adrenaline synthesized?

1) parathyroid glands

2) adrenal medulla

3) α-cells of Langerhans islets

4) adrenal cortex

242. What is the chemical structure of adrenaline?

1) derivative of amino acid tyrosine

2) protein

3) derivative of amino acid tryptophan

4) steroid hormone

243. Which of the following are target tissues for adrenaline?

1) adrenal medulla

2) adipose tissue

3) adrenal cortex

4) liver

244. Influence of adrenalin on metabolism:

1) increases synthesis of triacylglycerols

2) increases degradation of glycogen in the liver to form glucose

3) increases degradation of triacylglycerols

4) increases degradation of glycogen in muscles to form glucose

245. Hyperproduction of adrenalin in the body is observed in:

1) adrenogenital syndrome

2) pheochromocytoma
3) Cushing's syndrome
4) Addison's disease

246. In pheochromocytoma, which of the following symptoms are observed?

1) increased concentration of fatty acids in the blood
2) decreased blood pressure

3) hypoglycemia
4) increased blood pressure

247. In pheochromocytoma, which of the following components are present in the urine?

1) glucose
2) increased concentration of adrenaline
3) blood
4) increased concentration of homogentisic acid

248. The notion 17-ketosteroids includes:

1) hormones of adrenal cortex
2) hormones of testicles
3) products of degradation of glucocorticoids, mineralocorticoids, and male sex hormones
4) products of degradation of female and sex hormones

249. At what part of the body are 17-ketosteroids formed?

1) testicles
2) adrenal glands
3) liver
4) ovaries

250. Increased concentration of 17-ketosteroids in the urine is observed in:

1) Cushing's syndrome
2) Addison's disease
3) Kohn's disease
4) pheochromocytoma

251. What is the biological action of growth hormone?

1) calorigenic action (increases body temperature)
2) lipolytic action (increases degradation o

triacylglycerols in adipose tissue)
3) anabolic action (increases synthesis of nucleic acids and protein)
4) hypoglycemic action

BIOCHEMISTRY OF NUTRITION. VITAMINS

252. **How many kilocalories is produced in oxidation of 1 g carbohydrates**?

1) 9.5 kcal/g

2) 7.3 kcal/g

3) 4.2 kcal/g

4) 2.1 kcal/g

253. How many kilocalories is produced in oxidation of 1 g fats?

1) 9.5 kcal/g

2) 7.3 kcal/g
3) 4.2 kcal/g

4) 2.1 kcal/g

254. How many kilocalories is produced in oxidation of 1 g proteins?

1) 9.5 kcal/g

2) 7.3 kcal/g

3) 4.3 kcal/g

4) 2.1 kcal/g

255. Which of the following are essential components of food?

1) fructose

2) linoleic acids

3) amino acid alanine
4) amino acid valine

256. What is the approximate daily requirement in dietary fats for a normal human?

1) 100 g

2) 200 g

3) 300 g

4) 500 g

257. What is the approximate daily requirement in dietary carbohydrates for a normal human?

1) 100 – 200 g

2) 400 – 500 g
3) 200 – 300 g
4) 700 – 800 g

258. Proteins of high biological (nutritional) value are present in:

1) milk
2) vegetables
3) beef
4) fruit

259. Kwashiorkor is caused by the deficient intake by a child:

1) carbohydrates
2) fats
3) proteins
4) vitamins

260. Macrominerals of the organism are represented by:

1) calcium
2) selenium
3) iodine
4) sodium

261. Microminerals essential for the organism are represented by:

1) zinc
2) iron
3) chloride
4) magnesium

262. Balanced diet contains nutritional components (protein-fat-carbohydrate) at a ratio:

1) 1: 2: 4
2) 1: 2: 3

3) 4: 1: 1
4) 1: 1: 4

263. Vitamin PP is synthesized in tissues from:

1) glucuronic acid

2) tryptophan

3) tyrosine
4) arachidonic acid

264. Which of the following is coenzymatic form of vitamin B_1?

1) NAD

2) TDP
3) pyridoxal phosphate

4) FAD

265. Thiamine diphosphate is coenzyme of :

1) transaminase

2) transaldolase

3) transketolase
4) translocase

266. In vitamin B_1 deficiency, which of the following symptoms are observed?

1) megaloblastic anemia

2) vascularization of the cornea

3) gingival hemorrhages

4) polyneuritis

267. Avitaminosis of vitamin B_1 (thiamine) results in the disease:

1) kwashiorkor

2) pellagra
3) beri-beri

4) rickets

268. Which of the following is coenzymatic form of vitamin B_2?

1) TDP
2) FAD

3) NAD

4) HSCoA

269. Vitamin B_2 (riboflavin) is a component of enzymes catalyzing reactions:

1) transfer of groups

2) synthesis of new molecules

3) hydrolysis

4) oxidative reduction reactions

270. In vitamin B_2 deficiency, which of the following symptoms are observed?

1) vascularization of the cornea
2) softening and distortions of bones
3) painful fissures at the corners of the mouth
4) xerophthalmia

271. Which of the following is coenzymatic form of vitamin PP?

1) TDP
2) FAD
3) NAD
4) HSCoA

272. In vitamin A deficiency, which of the following symptoms are observed?

1) xerophthalmia
2) seborrheic dermatitis
3) dementia
4) follicular hyperkeratosis

273. In vitamin PP deficiency, which of the following symptoms are observed?

1) diarrhea
2) dementia
4) capillary hemorrhages
5) hemeralopia

274. Which of the following is coenzymatic form of vitamin B_6?

1) FAD, FMN
2) NAD, NADP
3) pyridoxal phosphate
4) HSCoA

275. Vitamin B_6 is a component of enzymes catalyzing reactions:

1) phosphorylation of glucose
2) transamination of amino acids
3) oxidation of biogenic amines
4) decarboxylation of amino acids

276. Deficiency of folic acid in the organism results in:

1) abnormalities of developing fetus
2) megaloblastic anemia
3) polyneuritis
4) night blindness

277. Vitamin B_1 is called:

1) thymine
2) thymidine
3) thioredoxin
4) thiamine

278. Hypervitaminosis of which vitamin is dangerous for the organism?

1) vitamin C
2) vitamin A
3) vitamin E
4) vitamin D

279. Vitamin B_2 is called:

1) biotin
2) pyridoxine
3) riboflavin
4) thiamine

280. What is the daily requirement of the organism in ascorbic acid (vitamin C)?

1) 10 – 15 mg/day
2) 60 – 100 mg/day
3) 1 – 2 g/day
4) 30 – 40 mg/day

281. Vitamin PP is called:

1) nicotinic acid
2) riboflavin

3) nicotinamide
4) pyridoxine

282. Vitamin B_6 is called:

1) pyridoxine
2) nicotinic acid

3) pyrimidine
4) riboflavin

283. In vitamin C deficiency, which of the following diseases is observed?

1) pellagra

2) rickets

3) scurvy

4) beri-beri

284. Which are the major functions of vitamin C in the body?

1) acts as antioxidant
2) is necessary for hydroxylation of proline in collagen synthesis
3) is a factor of blood coagulation system

4) produces reactive oxygen species

CARBOHYDRATE METABOLISM

285. Which of the following homopolysaccharides is present in human tissues?

1) amylose

2) starch

3) glycogen
4) cellulose

286. Which of the following carbohydrates are absorbed in the intestine?

1) glucose

2) sucrose

3) lactose

4) glycogen

287. The content of glycogen in the liver amounts to:

1) 1 %

2) 6 %

3) 10 %

4) 20 %

288. Which of the following carbohydrates are absorbed in the intestine?

1) starch

2) maltose

3) galactose

4) fructose

289. Which of the following carbohydrates are normally present in the peripheral blood?

1) fructose

2) glucose

3) galactose

4) glycogen

290. Which of the following are the major dietary disaccharides for humans?

1) starch

2) sucrose

3) cellulose

4) lactose

291. In what tissue is glucokinase present?

1) in all tissues of the body

2) muscles and adipose tissue

3) liver

4) brain

292. At what part of the GIT does the digestion of carbohydrates start?

1) in the oral cavity
2) in the stomach
3) in the duodenum
4) in the intestine

293. Which of the following enzymes participate in the digestion of carbohydrates?

1) amylase
2) pepsin
3) glucose 6-phosphatase
4) amylo 1,6-glycosidase

294. Which of the following are the major sources of glucose in the body?

1) glycolysis
2) degradation of glycogen
3) gluconeogenesis
4) pentose phosphate pathway

295. Phosphorylation of glucose is catalyzed by:

1) glucose 6-phoshpatase
2) hexokinase
3) phosphorylase
4) glucokinase

296. Which of the following substrates may be directly formed from pyruvate?

1) phosphoenolpyruvate
2) oxaloacetate
3) lactose
4) malate

297. Galactosemia is caused by the deficient activity of:

1) lactase
2) hexose 1-phosphate uridyltransferase
3) phosphorylase
4) glucose 6-phosphatase

298. Essential fructosuria is caused by the deficient activity of:

1) hexose 1-phosphate uridyltransferase
2) fructokinase
3) phosphofructokinase
4) fructose 1-phosphate aldolase

299. Hereditary fructose intolerance is caused by the deficient activity of:

1) fructokinase
2) phosphofructokinase
3) fructose 1-phosphate aldolase
4) hexose 1-phosphate uridyltransferase

300. Which of the following carbohydrates are components of lactose?

1) fructose
2) galactose
3) glucose
4) maltose

301. At what compartment of the cell does glycolysis occur?

1) lysosomes
2) mitochondria
3) cytoplasm
4) ribosomes

302. Which of the following are irreversible reactions of glycolysis?

1) hexokinase
2) aldolase
3) phosphofructokinase
4) lactate dehydrogenase

303. Substrate-level phosphorylation reactions in glycolysis are catalyzed by:

1) hexokinase
2) phosphoglycerate kinase
3) phosphofructokinase
4) pyruvate kinase

304. Which of the following is the end product of anaerobic glycolysis?

1) pyruvate

2) phosphoenolpyruvate

3) lactate

4) acetyl CoA

305. Which of the following are activators of pyruvate dehydrogenase complex?

1) insulin

2) glucagon

3) NAD^+

4) $NADH_2$

306. How many molecules of ATP are generated in the course of anaerobic glycolysis per one molecule of glucose?

1) 2

2) 3

3) 12

4) 38

307. How many molecules of ATP are generated in the course of aerobic glycolysis per one molecule of glucose?

1) 2

2) 3

3) 12

4) 38

308. The major pathway for utilization of pyruvate in tissues is its conversion to:

1) lactate

2) acetyl CoA

3) lyceraldehydes ate

4) oxaloacetate

309. At what tissue does gluconeogenesis occur?

1) brain

2) muscles

3) liver

4) adrenal cortex

310. Which of the following bonds are hydrolyzed by amylase?

1) peptide bond

2) phosphodiester bond

3) α-1,4-glycoside bond

4) α-1,6-glycoside bond

311. Which of the following are enzymes of the oxidative part of the pentose phosphate pathway?

1) glucose 6-phosphate dehydrogenase
2) transketolase
3) malate dehydrogenase
4) transaldolase

312. Which of the following is coenzyme of transketolase?

1) pyridoxal phosphate
2) thiamine diphosphate
3) NAD
4) NADP

313. Which of the following are functions of the pentose phosphate pathway?

1) energy production
2) production of $NADH_2$
3) production of ribose 5-phosphate
4) production of $NADPH_2$

314. Which of the following is precursor for the glycogen synthesis?

1) glucose
2) fructose
3) galactose
4) sucrose

315. Which of the following enzymes catalyzes degradation of glycogen?

1) phosphatase
2) phosphorylase
3) protease
4) glucuronyltransferase

316. Which of the following factors activates breakdown of glycogen?

1) insulin
2) adrenalin
3) glucagon
4) intake of food

317. In glycogenoses, which of the following processes is impaired?

1) glucose synthesis
2) gluconeogenesis
3) degradation of glycogen
4) glucose absorption

318. Which of the following diseases are classified as glycogenoses?

1) Von Gierke's disease
2) Niemann-Pick's disease
3) Addison's disease
4) McArdle's disease

319. Which of the following effects are specific of insulin?

1) increases transport of glucose into the cell
2) activates gluconeogenesis
3) activates glycolysis
4) activates degradation of glycogen

320. Which of the following effects are specific of glucagon?

1) activates glycolysis
2) activates glycogenolysis
3) activates gluconeogenesis
4) increases transport of glucose into the cell

321. Which of the following are specific (key) enzymes of gluconeogenesis?

1) glucose 6-phosphatase
2) phosphofructokinase
3) fructose 1,6-bisphosphataldolase
4) phosphoenolpyruvate carboxykinase

322. Which of the following are regulatory enzymes of glycolysis?

1) hexokinase

2) glucose 6-phosphatase

3) fructose 1,6-bisphosphatase

4) phosphofructokinase

323. Which of the following enzymes participate in the formation of glucose 6-phosphate?

1) hexokinase
2) glucokinase
3) glucose 6-phosphatase
4) phosphorylase

324. Which of the following enzymes catalyze conversion of phosphoenolpyruvate to pyruvate?

1) pyruvate carboxylase
2) pyruvate kinase
3) pyruvate dehydrogenase
4) phosphoenolpyruvate carboxykinase

325. Which of the following products is formed in oxidative decarboxylation of pyruvate?

1) oxaloacetate
2) lactate
3) phosphoenolpyruvate
4) acetyl CoA

326. Which of the following compounds is coenzyme of glucose 6-phosphate dehydrogenase?

1) thiamine diphosphate
2) pyridoxal phosphate
3) FAD
4) NADP

327. Which of the following are substrates of hexokinase?

1) glucose 6-phosphate
2) glucose
3) hexosaminoglycans
4) fructose

328. In type I glycogenosis, which of the following enzymes is deficient?

1) phosphorylase of the liver
2) glucose 6-phosphatase
3) glycogen synthase
4) phosphorylase of muscles

329. Gluconeogenesis is defined as:

1) synthesis of glycogen from glucose
2) degradation of glycogen
3) conversion of glucose to lactate
4) synthesis of glucose from non-carbohydrate precursors

330. Which of the following are enzymes of the non-oxidative part of the pentose phosphate pathway?

1) glucose 6-phosphate dehydrogenase
2) transketolase
3) 6-phosphogluconate dehydrogenase
4) transaldolase

331. GLUT-1 is the major transporter of glucose into cells of:

1) liver
2) muscles
3) adipocytes
4) brain

332. GLUT-4 is the major transporter of glucose into cells of:

1) brain
2) liver
3) muscles
4) adipocytes

333. Which of the following enzymes catalyzes conversion of pyruvate to oxaloacetate?

1) pyruvate dehydrogenase complex
2) pyruvate kinase
3) pyruvate carboxylase
4) pyruvate decarboxylase

334. Which of the following enzymes are activated by insulin?

1) hexokinase
2) glucose 6-phosphatase
3) phosphofructokinase
4) phosphorylase

335. Which of the following processes are activated in diabetes mellitus?

1) glycolysis
2) gluconeogenesis
3) synthesis of glycogen
4) degradation of glycogen

336. Which of the following are symptoms of galactosemia?

1) obesity
2) mental deficiency
3) cataract
4) diabetes mellitus

337. Which of the following substances are components of maltose?

1) glucose
2) fructose
3) galactose
4) lactose

338. Which of the following substances are components of sucrose?

1) galactose
2) glucose
3) lactose
4) fructose

339. Which of the following is the rate-limiting enzyme of glycolysis?

1) hexokinase
2) phosphofructokinase
3) aldolase
4) lactate dehydrogenase

340. Which of the following are inhibitors of pyruvate dehydrogenase complex?

1) insulin

2) acetyl CoA

3) ADP

4) $NADH_2$

341. In type V (Mac Ardle's disease) glycogenosis, which of the following enzyme is deficient?

1) phosphorylase of the liver
2) glucose 6-phosphatase
3) glycogen synthase
4) phosphorylase of muscles

342. Which types of bonds are present in the molecule of glycogen?

1) N-glycoside bond
2) α-1,4-glycoside bond
3) β-1,4-glycoside bond
4) α-1,6-glycoside bond

343. The product of phosphorylase reaction is:

1) glucose
2) glucose 6-phosphate
3) glucose 1-phosphate
4) UDP-glucose

344. Which of the following enzymes are used in the enzymatic method for determination of glucose in the blood serum?

1) hexokinase
2) glucokinase
3) glucose oxidase
4) peroxidase

345. Normal concentration of glucose in the blood serum of adults is:

1) 1.5 – 2.5 mmol/L
2) 3.3 – 6.4 mmol/L
3) 7.5 – 12.5 g/L

4) 8.55 – 20.52 μmol/L

346. Hyperglycemia is observed in:

1) Von Gierke’s disease
2) Addison’s disease
3) diabetes mellitus
4) pheochromocytoma

347. Hypoglycemia is observed in:

1) obesity
2) insulinoma
3) hypofunction of thyroid gland
4) diabetes mellitus

348. Glucose tolerance test allows diagnosing of:

1) hepatitis
2) nephritis
3) diabetes mellitus
4) lactose intolerance

349. Which of the following are specific (key) enzymes of gluconeogenesis?

1) hexokinase
2) fructose 1,6-bisphosphatase
3) pyruvate kinase
4) pyruvate dehydrogenase

350. In performing the glucose tolerance test, hyperglycemia is normally observed after the intake of glucose (glucose load) in:

1) 10 min
2) 1 hour
3) 2 hours
4) 3 hours

351. In performing the glucose tolerance test, normalization of glycemia is normally observed after the glucose load in:

1) 30 min
2) 1 hours
3) 2 hours
4) 3 hours

352. In performing the glucose tolerance test, hyperglycemic type of curve is observed in:

1) hyperinsulinism
2) hyperthyroidism
3) hypothyroidism
4) Addison's disease

353. In performing the glucose tolerance test, the flat type of glycemic curve is observed in:

1) Addison's disease
2) hyperthyroidism
3) Cushing's disease
4) hypothyroidism

354. Which of the following compounds are classified as homopolysaccharides?

1) starch
2) hyaluronic acid
3) heparin
4) cellulose

355. Which of the following hormones decrease concentration of glucose in the blood?

1) adrenaline
2) glucagon
3) thyroxine
4) insulin

356. Which of the following compounds function as depot of glucose in animals?

1) lactose
2) starch
3) proteoglycans
4) glycogen

357. What standard quantity of glucose is given to a patient in performing the glucose tolerance test?

1) 500 mg/kg
2) 1 g/kg
3) 100 mg/kg

4) 5 g/kg

358. Functioning of which metabolic pathways leads to hyperglycemia?

1) glycolysis

2) synthesis of glycogen

3) degradation of glycogen
4) gluconeogenesis

359. Which of the following hormones activate glycolysis?

1) adrenaline
2) glucagon
3) insulin
4) cortisol

360. What is the biological role of glycogen?

1) is component of membrane glycoproteins (glycocalyx)
2) is a hormone produced by α-cells of Langerhans islets
3) is depot of glucose
4) is a structural component of intercellular matrix of connective tissue

361. In phosphorylase deficiency in the liver, which disease is developed?

1) Mc Ardle's disease
2) aglycogenosis
3) Von Gierke's disease
4) Hers' disease

362. In type VI glycogenosis (Hers' disease), which of the following enzymes is deficient?

1) phosphorylase of the liver
2) glucose 6-phosphatase
3) glycogen synthase
4) phosphorylase of muscles

363. Which of the following conversions are the substrate-level phosphorylation reactions?

1) fructose 6-phosphate to fructose 1,6-bisphoaphate
2) lyceraldehydes phosphate to 1,3-bisphosphoglycerate

3) 1,3-bisphosphoglycerate to 3-phosphoglycerate

4) phosphoenolpyruvate to pyruvate

364. Which of the following compounds are classified as heteropolysaccharides?

1) heparin

2) glucuronic acid

3) chondroitin sulphate
4) dextrins

365. Which of the following enzymes catalyzes the oxidation-reduction reaction in glycolysis?

1) lyceraldehydes phosphate dehydrogenase
2) phosphoglycerate kinase
3) phosphofructokinase
4) aldolase

LIPID METABOLISM

366. Which of the following compounds are classified as tissue lipids?

1) triacylglycerols
2) waxes
3) glycolipids
4) carotenoids

367. Which of the following compounds are classified as lipids of human tissues?

1) sphingolipids
2) terpenoids
3) waxes
4) phospholipids

368. Which of the following properties are characteristic of reserve lipids?

1) are components of cell membranes

2) are present in adipose tissue
3) are not used to meet energy requirements of the body
4) are used to meet energy requirements of the body

369. Which of the following properties are characteristic of protoplasmic lipids?

1) their quantity does not vary depending on individual's nutrition
2) their quantity varies depending on individual's nutrition
3) are components of cell membranes
4) are present in adipose tissue

370. Which of the following hormones are synthesized from cholesterol?

1) prostaglandins
2) glucocorticoids
3) sex hormones
4) calcitonin

371. Which of the following compounds are classified as reserve lipids?

1) phospholipids
2) cholesterol
3) triacylglycerols
4) glycolipids

372. Which of the following compounds are classified as protoplasmic lipids?

1) phospholipids
2) waxes
3) triacylglycerols
4) cholesterol

373. Which of the following enzymes participate in the digestion of triacylglycerols in the GIT?

1) triglyceride lipase
2) lipoprotein lipase

3) intestinal lipase

4) pancreatic lipase

374. Which of the following compounds participates in emulsification of fats?

1) unsaturated fatty acids

2) pancreatic lipase

3) bile acids
4) triacylglycerols

375. Which of the following are components of triacylglycerols?

1) fatty acids
2) sphingosine
3) phosphate
4) glycerol

376. Which of the following are components of glycolipids?

1) fatty acids
2) sphingosine
3) phosphate
4) glycerol

377. Which of the following are components of phospholipids?

1) fatty acids
2) bile acids
3) phosphate
4) carbohydrate

378. Which of the following are components of phospholipids?

1) cholesterol
2) nitrogenous base
3) glycerol
4) carbohydrate

379. Which of the following is activator of pancreatic lipase?

1) HCl
2) bile acids
3) fatty acids

4) monoacylglycerols

380. In absorption of products of dietary lipid digestion, which of the following components are included into micella?

1) monoacylglycerols

2) triacylglycerols

3) apoproteins

4) fatty acids with less than 10 carbon atoms

381. In absorption of products of dietary lipid digestion, which of the following components are included into micella?

1) glycerol
2) cholesterol
3) cholesterol esters
4) bile acids

382. Which of the following are components of chylomicrons?

1) cholesterol
2) triacylglycerols
3) monoacylglycerols
4) bile acids

383. Which of the following are components of chylomicrons?

1) phospholipids
2) free fatty acids
3) proteins
4) glycolipids

384. At what part of the organism are chylomicrons formed?

1) in the liver
2) in the blood
3) in enterocytes
4) in the bile

385. Chylomicrons are the transport form of:

1) cholesterol to cells
2) endogenous triacylglycerols
3) exogenous triacylglycerols
4) cholesterol from cells

386. VLDL are the transport form of:

1) cholesterol to cells

2) endogenous triacylglycerols

3) exogenous triacylglycerols
4) cholesterol from cells

387. LDL are the transport form of:

1) cholesterol to cells

2) endogenous triacylglycerols

3) exogenous triacylglycerols
4) cholesterol from cells

388. HDL are the transport form of:

1) cholesterol to cells
2) endogenous triacylglycerols
3) exogenous triacylglycerols
4) cholesterol from cells

389. Which of the following enzymes participates in degradation of chylomicrons?

1) triglyceride lipase
2) lipoprotein lipase
3) phospholipase
4) phosphodiesterase

390. Which of compounds present in chylomicrons is degraded by lipoprotein lipase?

1) phospholipids
2) triacylglycerols
3) apoproteins
4) cholesterol esters

391. Degradation of chylomicrons takes place:

1) in muscles
2) in the brain
3) in adipose tissue
4) in enterocytes

392. Which of the following enzymes participate in degradation of VLDL?

1) phospholipase

2) cholesterol esterase

3) triglyceride lipase

4) lipoprotein lipase

393. LDL are formed as a result of degradation of:

1) chylomicrons

2) high density lipoproteins

3) very low density lipoproteins
4) micella

394. In degradation of VLDL, which of the following products is formed?

1) chylomicrons
2) high density lipoproteins
3) micella
4) low density lipoproteins

395. Enzyme triglyceride lipase participates in:

1) digestion of dietary triacylglycerols in the GIT
2) fat mobilization from depot
3) degradation of triacylglycerols present in lipoproteins
4) intracellular lipolysis

396. Which of the following hormones are stimulators of lipolysis?

1) insulin
2) glucagon
3) estrogens
4) adrenaline

397. Which of the following are classified as unsaturated fatty acids?

1) arachidic acid
2) lipoic acid
3) linoleic acid
4) stearic acid

398. Which of the following are classified as unsaturated fatty acids?

1) oleic acid

2) palmitic acid

3) arachidonic acid
4) lignoceric acid

399. Linoleic, linolenic and arachidonic acids are called:

1) vitamin E

2) vitamin P

3) vitamin F
4) vitamin B_3

400. Which of the following enzymes participates in the activation of fatty acids?

1) lipase
2) thiokinase
3) thiolase
4) transacylase

401. Which of the following is the active form of a fatty acid?

1) acetyl CoA
2) acyl CoA
3) acylcarnitine
4) HSCoA

402. At what compartment of the cell does β-oxidation of fatty acids take place?

1) microsomes
2) cytoplasm
3) nucleus
4) mitochondria

403. Which of the following substances participates in the transport of fatty acids into mitochondria?

1) keratin
2) carotene
3) carnitine
4) creatine

404. Which of the following are representatives of ketone bodies?

1) acetyl CoA

2) acetone
3) acetoacetate
4) acetoacetyl CoA

405. Which of the following are representatives of ketone bodies?

1) β-hydroxybutyrate
2) β-hydroxy-β-methylglutaryl CoA
3) β-alanine
4) β-hydroxybutyric acid

406. At what part of the organism are ketone bodies synthesized?

1) in the liver
2) in muscles
3) in adipose tissue
4) in enterocytes

407. At what compartment of the cell does the synthesis of fatty acids take place?

1) mitochondria
2) cytoplasm
3) lysosomes
4) ribosomes

408. Which of the following participates in the synthesis of fatty acids?

1) acetyl CoA
2) acetoacetyl CoA
3) chylomicrons
4) $NADPH_2$

409. Which of the following participate in the synthesis of fatty acids?

1) acyl CoA
2) malonyl CoA
3) thiokinase

4) $NADH_2$

410. Which of the following is the end product of the action of fatty acid synthetase?

1) butyric acid

2) oleic acid

3) stearic acid
4) palmitic acid

411. Which of the following is classified as glycolipids?

1) cerebrosides
2) sulphatides
3) glycerophospholipids
4) glycosaminoglycans

412. Which of the following are intermediates in the synthesis of cholesterol?

1) acetoacetyl CoA
2) acetoacetate
3) β-hydroxy-β-methylglutaryl CoA
4) phosphatidic acid

413. Cholesterol is a precursor of:

1) vitamin A
2) vitamin D_3
3) stearic acids
4) bile acids

414. Which of the following are functions of bile acids?

1) participate in the formation of ketone bodies
2) stimulate peristalsis of the intestine
3) are components of chylomicrons
4) activate pancreatic lipase

415. Which of the following are functions of bile acids?

1) represent the pathway for elimination of cholesterol from the body
2) are components of micella
3) activate triglyceride lipase

4) participate in the transport of fatty acids in the blood

416. Which of the following lipoproteins are atherogenic?

1) chylomicrons
2) VLDL
3) LDL
4) HDL

417. Which of the following lipoproteins are anti-atherogenic?

1) chylomicrons
2) VLDL
3) LDL
4) HDL

418. Which of the following are considered to be the major reasons of atherosclerosis?

1) increased levels of ketone bodies in the blood
2) hypercholesterolemia
3) damage to the endothelium of the arterial wall
4) steatorrhea

419. Which are the major factors facilitating development of atherosclerosis?

1) increased levels of HDL and low levels of LDL in the blood
2) increased levels of LDL and low levels of HDL in the blood
3) increases levels of chylomicrons in the blood
4) presence of modified lipoproteins

420. Which are the major reasons for the formation of cholesterol stones?

1) hypercholesterolemia
2) increased levels of chylomicrons in the blood
3) congestion and inspissation of bile
4) excess of bile acids in the gall bladder

421. Steatorrhea means:

1) formation of stones in the gall bladder
2) excess of triacylglycerols in feces
3) increased concentration of lipoproteins in the blood
4) accumulation of stearic acid in the urine

422. Which of the following are saturated fatty acids?

1) butyric acid

2) oleic acid

3) stearic acid

4) nervonic acid

423. Which of the following are monounsaturated fatty acids?

1) oleic acid
2) linoleic acid
3) stearic acid
4) nervonic acid

424. The number of double bonds in linoleic acid is:

1) one
2) two
3) three
4) four

425. The number of double bonds in linolenic acid is:

1) one
2) two
3) three
4) four

426. The number of double bonds in arachidonic acid is:

1) one
2) two
3) three
4) four

427. Role of carnitine in the organism:

1) transports fatty acids from mitochondrion into cytoplasm
2) transports fatty acids in the blood
3) transports fatty acids from cytoplasm into mitochondrion
4) is precursor of vitamin A

428. Which of the following substances are classified as phospholipids?

1) sphingosine

2) phosphatidic acid

3) phosphocholine

4) phosphatidyl serine

429. Which of the following substances are classified as phospholipids?

1) phosphatidyl ethanolamine

2) inositol triphosphate

3) glycerol phosphate
4) plasmalogens

430. Which of the following substances are classified as phospholipids?

1) phosphatidyl inositol
2) pyridoxal phosphate
3) phosphoethanol amine
4) cerebrosides

431. Phosphatidic acid is:

1) intermediate in the synthesis of triacylglycerols
2) intermediate in the synthesis of cholesterol
3) representative of phospholipids
4) component of sphingomyelin

432. The increase of which lipoproteins is accompanied by hypertriacylglycerolemia?

1) VLDL
2) LDL
3) HDL
4) chylomicrons

433. What is the reason of type II hyperlipoproteinemia?

1) deficient lipoprotein lipase
2) decreased activity of phospholipase
3) deficient triglyceride lipase
4) absence of LDL-receptors

434. What is the reason of type I hyperlipoproteinemia?

1) deficient lipoprotein lipase
2) decreased activity of phospholipase
3) deficient triglyceride lipase

4) absence of LDL-receptors

435. Normal concentration of cholesterol in the blood serum is:

1) 2.0 – 3.6 mmol/L
2) 3.6 – 5.2 mmol/L
3) 2.5 – 8.33 mmol/L
4) 2.0 – 20.5 μmol/L

436. Concentration of which lipoproteins is increased in the blood serum in type IV hyperlipoproteinemia?

1) chylomicrons
2) VLDL
3) LDL
4) HDL

437. Concentration of which lipoproteins is increased in the blood serum in type V hyperlipoproteinemia?

1) chylomicrons
2) VLDL
3) LDL
4) HDL

438. What amount of cholesterol is synthesized daily in the organism?

1) 0.4 – 0.6 g
2) 0.8 – 1.0 g
3) 3 – 5 g
4) 6 – 8 g

439. What amount of cholesterol is ingested daily with foodstuffs?

1) 0.3 – 0.5 g
2) 1 – 2 g
3) 2 – 4 g
4) less than 0.1 g

440. Which pathology is accompanied by hypercholesterolemia?

1) atherosclerosis
2) hyperthyroidism
3) diabetes mellitus

4) liver cirrhosis

441. Which pathology is accompanied by hypocholesterolemia?

1) hyperthyroidism

2) liver cirrhosis

3) diabetes mellitus

4) hypothyroidism

442. Which are the major sites of cholesterol synthesis in adults?

1) kidney

2) liver

3) brain

4) enterocytes

443. Which of the following are intermediates in the synthesis of cholesterol?

1) scatole

2) geranylpyrophosphate

3) phosphatidate

4) malonate

444. Which of the following enzymes participate in β-oxidation of fatty acids?

1) thiolase

2) deacylase

3) β-hydroxyacyl CoA dehydrogenase

4) β-hydroxybutyrate dehydrogenase

445. Which of the following are intermediates in the synthesis of cholesterol?

1) malate

2) malonate

3) mevalonate

4) malonyl CoA

446. Concentration of which lipoproteins is increased in the blood serum in type I hyperlipoproteinemia?

1) LDL

2) VLDL

3) HDL

4) chylomicrons

447. Apoproteins are:

1) protein part of conjugated proteins

2) non-protein part of conjugated proteins

3) proteins present in lipoproteins

4) peripheral proteins of cell membranes

448. Which are intermediary products in the synthesis of glycerophospholipids?

1) ceramide
2) UDP-galactose
3) UDP-choline
4) CDP-ethanolamine

449. Concentration of which lipoproteins is increased in the blood serum in type IIa hyperlipoproteinemia?

1) chylomicrons
2) LDL
3) VLDL
4) HDL

450. At what part in the organism are VLDL formed?

1) muscles
2) liver
3) adipose tissue
4) blood plasma

451. At what part in the organism are LDL formed?

1) enterocytes
2) adipose tissue
3) blood plasma
4) muscles

452. What pathology is accompanied by the increased levels of LDL in the blood serum?

1) atherosclerosis
2) type I hyperlipoproteinemia
3) hyperthyroidism
4) type II hyperlipoproteinemia

453. Which of the following is regulatory enzyme in the synthesis of cholesterol?

1) β-hydroxy-β-methylglutaryl CoA lyase
2) β-hydroxy-β-methylglutaryl CoA synthetase
3) β-hydroxy-β-methylglutaryl CoA reductase
4) acetyl CoA acetyltransferase

454. For the dissolution of cholesterol stones, which of the following compounds is used?

1) deoxycholic acid
2) linolenic acid
3) chenodeoxycholic acid
4) linoleic acid

455. Which of the following substances are intermediary products in the synthesis of triacylglycerols?

1) acetoacetyl CoA
2) glycerol phosphate
3) phosphatidic acid
4) glyceraldehyde phosphate

456. Which of the following molecules is formed in the reaction catalyzed by acetyl CoA carboxylase?

1) malonyl CoA
2) acetoacetyl CoA
3) acetone
4) CO_2

AMINO ACID AND NUCLEOTIDE METABOLISM

457. Non-essential amino acids are compounds which:

1) are not synthesized in the organism and have to be ingested with food
2) in the course of metabolism, may be replaced by the other compounds
3) are synthesized in humans from other amino acids

458. Which of the following are essential amino acids?

1) isoleucine

2) cysteine

3) glutamine

4) methionine

459. Which of the following are non-essential amino acids?

1) isoleucine
2) cysteine
3) methionine
4) tyrosine

460. Negative nitrogen balance is observed in:

1) aged persons
2) children
3) the absence of essential amino acids in food
4) the absence of non-essential amino acids in food

461. Which of the following hormones stimulate synthesis of protein?

1) adrenaline
2) insulin
3) glucagon
4) androgens

462. Proteins are degraded in the stomach by:

1) pepsin
2) trypsin
3) amylase
4) gastrin

463. Which of the following enzymes is produced in the pancreas to digest proteins?

1) pepsin
2) trypsin
3) amylase
4) collagenase

464. Which of the following biogenic amines causes vasodilatation?

1) tryptamine
2) serotonin
3) histamine
4) GABA

465. Deficiency of which enzyme will cause citrullinuria?

1) carbamoylphosphate synthetase
2) ornithine carbamoyltransferase
3) argininosuccinate synthetase
4) argininosuccinate lyase

466. Which of the following is cofactor of glutamate dehydrogenase?

1) FAD
2) pyridoxamine phosphate
3) NAD
4) pyridoxal phosphate

467. Which of the following substrates are formed as a result of transmethylation?

1) creatine
2) methionine
3) S-adenosylmethionine
4) adrenaline

468. Which of the following is the predominant type of deamination of amino acids in human tissues?

1) reductive deamination
2) hydrolytic deamination
3) oxidative deamination
4) intramolecular deamination

469. Which of the following are essential amino acids?

1) serine
2) tryptophan
3) tyrosine
4) threonine

470. The major amino acid which undergoes oxidative deamination in humans is:

1) glutamic acid
2) aspartic acid
3) glutamine
4) asparagine

471. Which of the following amino acids participate in the synthesis of urea?

1) aspartate
2) ornithine
3) asparagine
4) glutamate

472. Which of the following are non-essential amino acids?

1) arginine
2) cysteine
3) lysine
4) asparagine

473. Which of the following enzymes require vitamin B_6 as cofactor?

1) glutamate decarboxylase
2) glutamate dehydrogenase
3) transaminase
4) monoamine oxidase

474. Which of the following coenzymes is required for decarboxylation of amino acids?

1) FAD
2) NADP
3) NAD
4) pyridoxal phosphate

475. Which of the following biogenic amines causes vasoconstriction?

1) tryptamine
2) serotonin
3) histamine

4) GABA

476. Which of the following are biogenic amines?

1) serotonin

2) histidine

3) glutamine

4) thiamine

477. Reductive amination is a process in which:

1) ammonia is formed

2) biogenic amines are formed

3) participates glutamate dehydrogenase

4) detoxification of ammonia takes place

478. Derivative of which vitamin is coenzyme of decarboxylases of amino acids?

1) B_1

2) PP

3) B_6

4) B_2

479. What is the biological role of decarboxylation of amino acids in humans?

1) energy production

2) synthesis of essential amino acids

3) biosynthesis of biogenic amines

4) synthesis of $NADPH_2$

480. Which of the following is characteristic of γ-aminobutyric acid?

1) is the major inhibitory neurotransmitter in the CNS

2) is the major stimulatory neurotransmitter in the CNS

3) is formed from butyric acid

4) is formed in decarboxylation of glutamate

481. The ornithine cycle is:

1) the major pathway for detoxification of ammonia in the body

2) the pathway for urea formation

3) mechanism for transport amino acids through membrane

4) the pathway for ATP formation

482. The first reaction of the ornithine cycle is synthesis of:

1) citrate
2) carbamoylphosphate
3) ornithine
4) citrulline

483. Which of the following is the major form of nitrogen excretion in humans?

1) ammonia
2) urea
3) uric acid
4) ammonium salts

484. Which of the following amino acids participate in the synthesis of creatine?

1) lysine
2) arginine
3) methionine
4) glutamate

485. Which of the following are genetic disorders of metabolism of phenylalanine and tyrosine?

1) phenylketonuria
2) albinism
3) citrullinuria
4) gout

486. Which of the following enzymes is deficient in phenylketonuria?

1) homogentisate oxidase
2) tyrosinase
3) fumarylacetoacetase
4) phenylalanine hydroxylase

487. Which of the following conversions is impaired in phenylketonuria?

1) phenylalanine to tyrosine
2) tyrosine to phenylalanine
3) phenylalanine to tryptophan
4) tryptophan to phenylalanine

488. Which of the following substances is formed in putrefaction of amino acids in the intestine?

1) cresol
2) indican
3) ornithine
4) scatol

489. Which of the following conversions is impaired in alkaptonuria?

1) phenylalanine to tyrosine
2) *n*-hydroxyphenylpyruvate to homogentisic acid
3) homogentisic acid to maleylacetoacetate
4) tyrosine to *n*-hydroxyphenylpyruvate

490. Biogenic amines are synthesized in:

1) α-decarboxylation of amino acids
2) reductive amination
3) deamination of amides
4) transamination

491. Which of the following are ways for the formation of ammonia in the organism?

1) deamination of amino acids
2) oxidation of biogenic amines
3) transamination
4) reductive amination

492. Which of the following is the pathway for synthesis of urea?

1) reductive amination
2) degradation of purines
3) degradation of pyrimidines
4) ornithine cycle

493. Which of the following is the pathway for detoxification of ammonia in the brain?

1) synthesis of asparagine
2) synthesis of urea
3) formation of ammonium salts
4) synthesis of glutamine

494. Which intermediates are normally synthesized in oxidative catabolism of phenylalanine and tyrosine?

1) phenylpyruvate
2) fumarylacetoacetate
3) glucuronic acid
4) homogentisic acid

495. Which of the following is characteristic of albinism?

1) tyrosinase is absent in the cells
2) albumins are absent in the blood serum
3) melanin is not synthesized
4) mental development is impaired

496. Of which amino acid is pigment melanin synthesized?

1) tryptophan
2) phenylalanine
3) tyrosine
4) threonine

497. Which of the following diseases is caused by the deficiency of homogentisate oxidase?

1) alkaptonuria
2) albinism
3) phenylketonuria
4) hemophilia

498. Which of the following diseases is caused by the impairment of conversion of phenylalanine to tyrosine?

1) alkaptonuria
2) phenylketonuria
3) albinism
4) cretinism

499. Which of the following substances is universal donor of methyl groups?

1) isoleucine
2) methionine
3) S-adenosylmethionine

4) serine

500. Which of the following enzymes catalyze reactions of transamination?

1) glycine amidinotransferase

2) γ-glutamyltranspeptidase

3) alanine aminotransferase

4) phosphoribosyl amidotransferase

501. Which of the following are dicarboxylic amino acids?

1) glutamine
2) lysine
3) aspartate
4) asparagine

502. Transamination is:

1) removal of NH_2 group from amino acids to form NH_3
2) transfer of NH_2 group from amino acid to keto acid
3) transfer of NH_2 group to amino acid with formation of amides
4) removal of NH_2 group from biogenic amines

503. Which of the following substrates is formed in the transamination reaction catalyzed by alanine aminotransferase?

1) glutamine
2) acetoacetate
3) oxaloacetate
4) pyruvate

504. Which of the following is the coenzyme of transaminases?

1) thiamine diphosphate
2) pyridoxal phosphate
3) FAD
4) NAD

505. Derivative of which vitamin is the cofactor of transaminases?

1) B_1
2) PP
3) B_2
4) B_6

506. What is the biological role of transamination in the body?

1) synthesis of non-essential amino acids
2) formation of ammonia
3) synthesis of biogenic amines
4) formation of amides

507. Which of the following substrates is formed in the transamination reaction catalyzed by aspartate aminotransferase?

1) glutamine
2) acetoacetate
3) oxaloacetate
4) pyruvate

508. Increased activity of alanine aminotransferase (AlAT) in the blood serum is observed in:

1) hepatitis
2) acute pancreatitis
3) diabetes mellitus
4) myocardial infarction

509. Alanine aminotransferase catalyzes transfer of amino group from alanine to:

1) glutamate
2) α-ketoglutarate
3) pyruvate
4) acetoacetate

510. Activity of AlAT in the blood serum is normally:

1) 0.10 – 0.45 mmol/L·h
2) 0.25 – 0.90 mmol/L·h
3) 0.10 – 0.68 mmol/L·h
4) 0.50 – 1.20 mmol/L·h

511. Activity of AsAT in the blood serum of adults is normally:

1) 0.10 – 0.68 mmol/L·h

2) 0.10 – 0.45 mmol/L·h

3) 0.75 – 1.30 mmol/L·h

4) 0.60 – 1.50 mmol/L·h

512. Which of the following tissues have the highest activity of AlAT?

1) kidney

2) intestine

3) heart

4) liver

513. Urea is synthesized in:

1) kidney
2) small intestine
3) liver
4) brain

514. Urea is:

1) product of degradation of purine nitrogenous bases
2) product of detoxification of ammonia
3) pathological component of the urine
4) major end product of protein catabolism

515. Decreased concentration of urea in the blood serum is observed in:

1) degradation of protein in tissues
2) cirrhosis of the liver
3) kidney diseases
4) genetic disorder of urea cycle

516. Increased concentration of urea in the blood serum is observed in:

1) genetic disorder of urea cycle
2) liver diseases
3) kidney diseases
4) increased degradation of protein in tissues

517. Normal concentration of urea in the blood serum is:

1) 2.5 – 5.0 mmol/ L
2) 2.5 – 8.33 mmol/L
3) 0.1 – 0.68 mmol/L
4) 65 – 85 g/L

518. Normally, excretion of urea in the urine is:

1) 120 – 300 mmol/day
2) 400 – 800 mmol/day
3) 65 – 85 mmol/day
4) 333 – 583 mmol/day

519. Increased activity of aspartate aminotransferase in the blood serum is observed in:

1) hepatitis
2) acute pancreatitis
3) diabetes mellitus
4) myocardial infarction

520. Which of the following are pyrimidine nitrogenous bases?

1) guanine
2) cytosine
3) adenine
4) thymine

521. Which of the following nitrogenous bases are purines?

1) guanine
2) cytosine
3) uracil
4) adenine

522. Inosinic acid is intermediate for synthesis of:

1) GMP
2) urea
3) UMP
4) adenylic acid

523. Which of the following substrates is intermediate in synthesis of guanylic acid?

1) IMP
2) hypoxanthine
3) xathylic acid
4) argininosuccinate

524. Which of the following substrates is intermediate in

synthesis of AMP?

1) xanthine

2) inosinic acid

3) orotate

4) adenylosuccinate

525. Which of the following are intermediates in the synthesis of UMP?

1) carbamoylaspartate

2) argininosuccinate

3) IMP

4) orotate

526. Which of the following are symptoms of orotaciduria?

1) megaloblastic anemia

2) growth retardation

3) deposition of the sodium urate crystals in and around joints

4) black colour of urine on standing

BIOCHEMISTRY OF TISSUES

527. Which of the following properties is characteristic of direct bilirubin?

1) is not soluble in water

2) is readily soluble in water

3) is complex with glucuronic acid

4) is toxic

528. As a result of heme degradation in the spleen and bone marrow, which of the following compounds is formed?

1) stercobilinogen

2) urobilinogen

3) indirect bilirubin

4) direct bilirubin

529. Heme is degraded to form indirect bilirubin mainly in which

of the following organs?

1) kidney
2) spleen
3) bone marrow
4) brain

530. Which of the following substances are synthesized in the liver?

1) albumins
2) steroid hormones
3) insulin
4) ketone bodies

531. Which of the following substances are synthesized in the liver only?

1) prothrombin
2) glycogen
3) urea
4) globulins

532. Which of the following substances are intermediates in conversion of bilirubin in the small and large intestine?

1) di-and tripyrrhols
2) uroporphyrinogen
3) stercobilinogen
4) biliverdin

533. Which of the following substrates are precursors for the synthesis of heme?

1) serine
2) glycine
3) palmitoyl CoA
4) succinyl CoA

534. Detoxification of indirect bilirubin in the liver occurs due to its conjugation with:

1) sulfuric acid
2) glucuronic acid
3) taurine

4) glycine

535. What is the reason of hepatocellular (parenchymal) jaundice?

1) increased hemolysis

2) obstruction of the common bile duct

3) viral hepatitis
4) cancer of the head of pancreas

536. Hepatic failure is accompanied by:

1) hyperbilirubinemia

2) hyperalbuminemia
3) hypercholesterolemia

4) hyperammoniemia

537. Bilirubin is the product of degradation of:

1) nucleic acids

2) amino acids

3) hemoglobin
4) steroids

538. Which of the following are intermediates in the synthesis of heme?

1) urobilinogen
2) protoporphyrin

3) carbamoylphosphate

4) aminolevulinate

539. Normal concentration of bilirubin in the blood serum is:

1) 5.0 – 20.5 μmol/L

2) 2.0 – 4.0 g/L
3) 3.5 – 6.4 mmol/L

4) 0.1 – 0.45 mmol/L

540. In which type of jaundice is indirect bilirubin detected in the urine?

1) obstructive jaundice

2) hemolytic jaundice

3) parenchymal (hepatocellular) jaundice

4) never present in the urine

541. Hemolytic jaundice is characterized by:

1) presence of bilirubin in the urine
2) increased levels of indirect bilirubin in the blood serum
3) increased levels of direct bilirubin in the blood serum
4) increased levels of stercobilinogen in the blood serum

542. Hepatocellular jaundice is characterized by:

1) presence of bilirubin in the urine
2) increased levels of stercobilinogen in the blood serum
3) decreased levels of direct bilirubin in the blood serum
4) increased levels of both direct and indirect bilirubin in the blood serum

543. Obstructive jaundice is characterized by:

1) presence of bilirubin in the urine
2) increased levels of stercobilinogen in the blood serum
3) increased levels of direct bilirubin in the blood serum
4) decreased levels of indirect bilirubin in the blood serum

544. In which type of jaundice is direct bilirubin detected in the urine?

1) obstructive jaundice
2) hemolytic jaundice
3) parenchymal jaundice
4) never present in the urine

545. In which type of jaundice is stercobilinogen absent in the urine?

1) obstructive jaundice
2) hemolytic jaundice
3) parenchymal jaundice
4) never present in the urine

546. Which of the following properties is characteristic of indirect bilirubin?

1) is filtered into the urine
2) is not toxic
3) is transported on the bloodstream bound with albumin
4) is conjugated with glucuronic acids

547. At what part of the body is normally stercobilinogen present?

1) bile

2) urine

3) blood

4) hepatocytes

548. Which of the following cell does not contain mitochondria?

1) leucocytes
2) lymphocytes
3) erythrocytes
4) granulocytes

549. Normal content of albumins in the blood serum is:

1) 20 - 30 g/L
2) 30 - 40 g/L
3) 40 - 50 g/L
4) 50 - 60 g/L

550. In erythrocytes of adults, which variant of hemoglobin is predominant?

1) Hb P
2) Hb F
3) Hb A
4) Hb A_2

551. Major variant of hemoglobin in adults, Hb A, consists of which types of subunits?

1) α_2 β_2
2) α_2 γ_2
3) α_2 δ_2
4) α_2 ε_2

552. Proteinuria is observed in:

1) chronic nephritis
2) diabetes mellitus
3) arterial hypertension
4) diabetes insipidus

553. What is the normal content of sodium in the blood serum?

1) 20 - 30 g/L
2) 3.2 - 5.6 mmol/L
3) 2.25 - 2.75 mmol/L
4) 130 - 155 mmol/L

554. At what part of the organism is iron deposited and stored?

1) kidney
2) muscles
3) spleen
4) bone marrow

555. Which of the following are factors of the blood coagulation system?

1) plasminogen
2) fibrinogen
3) proaccelerin
4) heparin

556. What is the normal content of calcium in the blood serum?

1) 130 - 155 mmol/L
2) 2.25 - 2.75 mmol/L
3) 3.2 - 5.6 mmol/L
4) 3.5 - 8.33 mmol/L

557. Which of the following are the major ions of intracellular fluid?

1) Na^+
2) K^+
3) Cl^-
4) HPO_4^{2-} and $H_2PO_4^-$

558. Which of the following proteins contain iron?

1) cytochromes
2) ceruloplasmin
3) interferon
4) myoglobin

559. Which of the following hormones participate in regulation of water and salt balance?

1) cortisol
2) aldosterone
3) vasopressin
4) oxitocin

560. Which of the following are target tissues for aldosterone?

1) adrenal glands
2) liver
3) kidney
4) hypothalamus

561. Which of the following are effects of atrial natriuretic peptide?

1) decreases diuresis
2) decreases reabsorption of Na^+ in the kidney
3) causes vasoconstriction
4) causes vasodilatation

562. Which of the following are major ions of extracellular fluid?

1) Na^+
2) K^+
3) HCO^-
4) HPO_4^{2-} and $H_2PO_4^-$

563. Which of the following are functions of angiotensin II?

1) increases reabsorption of Na^+ in kidney
2) decreases reabsorption of Na^+ in kidney
3) causes vasoconstriction
4) causes vasodilatation

564. Which of the following components are normally present in the urine?

1) glucose
2) urea
3) creatinine
4) bilirubin

565. Which of the following are pathological components of the urine?

1) uric acid
2) bilirubin
3) urea
4) phenylpyruvate

566. Which of the following are the functions of Ca^{2+} ions in the organism?

1) regulation of the acid-base balance
2) participation in the transmission of nerve impulses
3) participation in the process of blood coagulation
4) formation of electrochemical potential on cell membranes

567. What is the normal K^+ content in the blood serum?

1) 3.2 - 5.6 mmol/L
2) 3.5 - 8.33 mmol/L
3) 2.25 - 2.75 mmol/L
4) 130 - 155 mmol/L

568. Which of the following compounds contain copper?

1) cytochrome c
2) myoglobin
3) ceruloplasmin
4) cytochrome oxidase

569. Normal daily diuresis in adults makes up:

1) 1500 ml both in men and women
2) 1200 ml in men and 1500 ml in women
3) 1200 ml in women and 1500 ml in men
4) 500 ml in women and 2000 ml in men

570. Polyuria is observed in:

1) chronic nephritis
2) acute nephritis
3) poisoning with nephritic toxicants
4) diabetes insipidus

571. Oliguria is observed in:

1) chronic nephritis
2) acute nephritis
3) diabetes insipidus
4) urolithiasis

572. Urine may change its colour due to presence of:

1) urea
2) glucose
3) ketone bodies
4) bilirubin

573. Reaction (pH) of the urine under ordinary dietary condition (in mixed food diet) is normally:

1) neutral
2) weakly alkaline
3) distinctly acidic
4) weakly acidic

574. Decrease of pH of the urine is observed in:

1) starvation
2) vegetarian (vegetable) diet
3) diabetes mellitus
4) cystitis

575. Alkaline reaction (pH) of the urine is observed in:

1) starvation
2) vegetarian (vegetable) diet
3) diabetes mellitus
4) cystitis

576. Red or pinky-red colour of the urine may be caused by:

1) ketone bodies
2) hematuria
3) taking meat as a meal
4) taking beetroot as a meal

577. Cloudy appearance of the urine may be caused by:

1) cell elements

2) protein
3) glucose
4) ketone bodies

578. Which of the following are pathological components of the urine?

1) creatinine
2) protein
3) uric acid
4) bilirubin

579. Proteinuria is observed in:

1) increased blood pressure
2) diabetes mellitus
3) nephrosis
4) diabetes insipidus

580. Which of the following reagents is used for the qualitative determination of protein in the urine?

1) sulphasalicylic acid
2) solution of iodine
3) concentrated nitric acid
4) diazo reagent

581. In detection of protein in the urine with use of sulphasalicylic acid, which of the following signs is observed if protein is present?

1) blue-violet colour
2) red-pink colour
3) white precipitate or cloudiness
4) white cloudy ring on the border of two liquids

582. In detection of protein in the urine with use of concentrated nitric acid, which of the following signs is observed if protein is present?

1) cloudy appearance in the test-tube
2) red-pink colour
3) blue-violet colour

4) white cloudy ring on the border of two liquids

583. Increased content of ketone bodies in the urine is observed in:

1) low-carbohydrate diet

2) diabetes mellitus

3) nephritis, nephrosis
4) phenylketonuria

584. Renal hematuria is observed in:

1) chronic nephritis
2) urolithiasis
3) cancer of bladder
4) acute nephritis

585. Extrarenal hematuria is observed in:

1) meat-rich diet
2) hemolysis
3) cancer of bladder
4) acute nephritis

586. Extrarenal hematuria is observed in:

1) increased blood pressure
2) urolithiasis
3) acute nephritis
4) chronic nephritis

587. Glucosuria is observed in:

1) glycogenoses
2) diabetes mellitus
3) phenylketonuria
4) pheochromocytoma

588. Accumulation of ketone bodies in the blood is observed in:

1) obesity
2) starvation
3) diabetes insipidus

4) myxedema

589. Which of the following are pathological components of the urine?

1) indican
2) blood
3) 17-ketosteroids
4) stercobilinogen

590. Which of the following are myofibrillar proteins of muscle tissue?

1) myoglobin
2) troponin
3) hemoglobin
4) myosin

591. Which of the following are the energy sources for muscle contraction?

1) phosphoenolpyruvate
2) creatine phosphate
3) 1,3-bisphosphoglycerate
4) adenosine triphosphate

592. Which of the following ions participate in regulation of muscle contraction?

1) magnesium
2) iron
3) calcium
4) sodium

593. Which of the following are the most abundant amino acids in collagen?

1) glycine
2) tryptophan
3) proline
4) serine

594. Which of the following are components of the ground substance (extracellular matrix) of connective tissue?

1) proteoglycans
2) collagen
3) troponin

4) fibroin

595. Which of the following statements characterizing collagen is true?

1) is globular protein

2) is nucleoprotein

3) is structural component of extracellular matrix of connective tissue
4) contains many residues of hydroxyproline

596. In acute meningitis, what is specific in analysis of cerebrospinal fluid?

1) concentration of glucose is decreased
2) concentration of glucose is increased
3) concentration of protein is decreased
4) concentration of protein is increased

597. The major metabolic fuel for neurons is:

1) fatty acids
2) glucose
3) amino acids
4) triacylglycerols

598. Which of the following are specific to carbohydrate metabolism of nervous tissue?

1) mainly aerobic metabolism of glucose
2) high concentration of glycogen
3) high activity of enzymes of the pentose phosphate pathway
4) utilization of glucose is proportional to the blood insulin levels

599. Which of the following are specific to energy metabolism of nervous tissue?

1) high intensity of energy metabolism
2) low intensity of energy metabolism
3) major mechanism of the ATP synthesis is oxidative phosphorylation
4) major mechanism of the ATP synthesis is substrate-level phosphorylation

600. Which of the following compounds are classified

as glycosaminoglycans?

1) heparin
2) chondroitin sulphates
3) glucuronic acid
4) glutamic acid

ANSWERS

1.	3, 4	27.	2	53.	1	79.	4
2.	3	28.	2	54.	3	80.	1
3.	2	29.	2, 4	55.	4	81.	2, 3
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596. 1, 4
597. 2

599. 1, 3
600. 1, 2

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