Spesiality: General Medicine

EXAMINATION QUESTIONS FOR INTERNATIONAL MEDICAL STUDENTS

CHEMISTRY OF PROTEINS

1. Amino acids. Classification, properties and structure.
2. Bonds between amino acid residues in protein molecules. Properties of peptide bond.
3. Physical and chemical properties of proteins. Solubility of proteins, factors of protein solution stability. Salt fractionation.
4. Functions of proteins.
5. An application of blot-analysis for protein resolution.
6. Primary, secondary and super-secondary structures of proteins. Kinds of bonds between amino acid residues, specific for those structures. Protein domains.
7. Tertiary structure of protein molecule. Kinds of bonds between amino acid residues, which are specific for tertiary structure. Denaturation of proteins. Denaturing agents.
8. Quaternary structure of protein molecule. Examples of functioning of proteins with quaternary structure.
9. Principles of protein classification. Simple proteins and their role in organism.
10. Compound proteins. The structure of prosthetic groups in compound proteins. Functions of compound proteins.

ENZYMES

11. The biological role of enzymes. Enzyme nomenclature and classification.
12. The origin and common properties of enzymes.
13. Structure of enzymes. An enzyme active site.
14. Coenzymes. Their classification and role.
15. The mechanism of enzymatic action. Enzyme kinetics.
16. Isoenzymes, their molecular forms and biological role.
17. Common principles of regulating catalytic activity.
18. The mechanism of isosteric regulation of enzyme activity.
19. The mechanism of allosteric regulation of enzyme activity.
20. Covalent modification of enzyme structure as a mechanism for regulating catalytic activity.
21. Enzyme inhibitors, classification and characteristics.
22. An application of enzymes in medicine.

BIOENERGETICS

23. The term “metabolism”. Interrelationship between catabolism and anabolism. Central metabolic pathways.
24. Biological oxidation. Pathways of oxygen utilization.
25. Adenilate system and its biological relevance. Mechanisms of ATP synthesis and utilization.
26. Tissue respiration. The mitochondrial respiratory chain and its components. $NADH{\cdot}H^{+}$ dehydrogenase and flavoproteins. Ubiquinone (coenzyme Q), cytochromes. Their chemical structure and role in biological oxidation.
27. Oxidative phosphorylation. Chemiosmotic theory of coupling between oxidative phosphorylation and tissue respiration.
28. Causes of cell hypoenergetic states. Inhibitors and uncouplers of the tissue respiration and oxidative phosphorylation, mechanisms of their action.

CARBOHYDRATE METABOLISM

29. Carbohydrates. Classification. Physiologic significance.
30. Nutritive value of carbohydrates. Digestion and absorption of carbohydrates. Biological role of cellulose.
31. Glycogenesis and glycogenolysis. Mechanisms of their regulation. The difference of glycogenolysis in liver and muscle.
32. Anaerobic conversion of glucose. Energetic balance and mechanisms of ATP formation.
33. Aerobic conversion of glucose. Stages, end products. Energetic balance and mechanisms of ATP formation.

34. The fate of glycolysis products – pyruvate and lactate. Gluconeogenesis, enzymes and regulation of the process.
35. Oxidative decarboxylation of pyruvate and other α-ketoacids, enzymes, coenzymes, biological significance.
36. The citric acid cycle, its intermediate stages, enzymes, biological significance. Connection with oxidative phosphorylation.
37. The pentose phosphate pathway of glucose oxidation and its biological significance.
38. Uronic acid pathway of glucose metabolism, its biological role.
39. Regulation of blood glucose. Hormonal mechanisms which regulate the concentration of blood glucose (insulin, glucagon, epinephrine, glucocorticoids).

LIPID METABOLISM

40. Lipids, their basic properties. Biological role. Lipid classification.
41. Classification of fatty acids. Polyunsaturated fatty acids. Arachidonic acid derivatives – eicosanoids (prostaglandins, prostacyclins, tromboxanes, leukotriens) and their biological role.
42. Glycerophospholipids. Chemical structure, properties and biological role.
43. Cholesterol, its biosynthesis and biological role. Disorders of cholesterol metabolism (atherosclerosis, cholelithiasis).
44. Digestion of lipids in gastrointestinal tract: emulsification, enzymes, products of hydrolysis, micelle formation. Significance of bile acids in lipid digestion.
45. Resynthesis of triacylglycerols and phospholipids in enterocytes. Formation of chylomicrons, their composition and structure.
46. Serum lipoproteins, their classification, composition, the place of formation, interconversion. The role of lipoproteinlipase, lecithin:cholesterol acyltransferase (LCAT).
47. Synthesis and degradation of triacylglycerols in adipocytes. Hormone-sensitive lipase.
48. Synthesis and secretion of lipids in the liver. The role of lipotropic factors.
49. The central role of acetyl-CoA in cell metabolism.
50. Cell localization and reactions of β-oxidation of fatty acids. The role of CoA-SH and ATP. Connection with oxidative phosphorylation. Energetic balance.
51. Ketone bodies, their biological role. The mechanism of ketogenesis. Ketosis in diabetes mellitus and starvation. Determination of ketone bodies in urine.
52. Fatty acid synthesis. Connection with glycolysis, pentose phosphate pathway of glucose metabolism, Krebs cycle. The importance of CO_2, ATP, $NADPH{\cdot}H^+$, biotin. The multienzyme complex for fatty acid synthesis. Activators and inhibitors of fatty acid synthesis.
53. Hormonal regulation of lipid metabolism.

METABOLISM OF PROTEINS AND AMINO ACIDS

54. The nitrogen balance. Protein requirement. Nutritional value of proteins.
55. Characteristics of proteases (peptidases). Biological role of selective proteolysis.
56. Digestion of proteins. The role of HCl. The analysis of gastric juice.
57. Proteases and peptidases of pancreatic juice, the mechanism of their action. Inhibitors of peptidases and their usage for treatment of pancreatitis.
58. Amino acid pool of the cell. Its utilization and sources of replenishment.
59. Transamination. Enzymes, coenzymes. Biological role of the process. Diagnostic value of the determination of serum transaminase activity.
60. Kinds of amino acid deamination. Enzymes and coenzymes of oxidative deamination. Biological importance of the L-glutamate dehydrogenase reaction.
61. Fate of carbon skeletons of amino acids. Glucogenic and ketogenic amino acids.
62. Ways of ammonia detoxification. Formation of glutamine and asparagine, their role in ammonia transfer.
63. Urea production. The role of liver in urea production. Medical importance of the determination of urea and nonprotein nitrogen in blood.
64. Decarboxylation of amino acids. Formation of biogenic amines and their biological role.

CHEMISTRY AND METABOLISM OF NUCLEIC ACIDS

65. Nucleic acids. DNA and RNA, their structure, cell localization and functions.

66. Primary and secondary structure of DNA and RNA. Binding of nucleic acids to proteins. Structure of nucleoproteins.
67. End products of purine and pyrimidine nucleotides catabolism. The medical importance of the determination of uric acid in serum and urine.
68. Purine nucleotide biosynthesis. Substrates and regulation of the process.
69. Pyrimidine nucleotide biosynthesis. Substrates and regulation of the process.
70. Nominate deoxyribonucleotides which are used for DNA synthesis, and specify the ways of their formation.
71. DNA replication. Enzymes and substrates. Characteristic of the process in eukaryotes.
72. RNA synthesis. Enzymes and substrates. Characteristic of the process in eukaryotes.
73. Genetic code and its properties.
74. The role of tRNA in protein biosynthesis. Aminoacyl-tRNA synthetase specificity. The adapter function of tRNA.
75. Modern conception of protein biosynthesis.

HORMONES

76. Hormones. Their chemical structure and classification. Connection of the hormone structure and its mechanism of action.
77. Mechanisms of hormonal action on cells. Role of G-proteins, second messengers, protein kinases.
78. Hormones of hypophysis, chemical structure. Hormones of adenohypophysis Their role in regulation of peripheral gland functions. Growth hormone, molecular mechanism of signal transmission in target cells, the influence on metabolism.
79. Hormones of neurohypophysis. Vasopressin, the mechanism of signal transmission in target cells, the influence on metabolism.
80. Hormones of thyroid gland. Their structure, the mechanism of action, the influence on metabolism. Hypo- and hyperthyroidism.
81. Hormones which regulate calcium and phosphorus metabolism. Their chemical structure, receptors. The mechanism of signal transmission in target cells, the influence on metabolism.
82. Insulin. Chemical structure, receptors. The mechanism of signal transmission in target cells, the influence on metabolism. Diabetes mellitus.
83. Glucagon. Chemical structure, receptors. The mechanism of signal transmission in target cells, the influence on metabolism.
84. Glucocorticosteroids. Their chemical structure, receptors. The mechanism of signal transmission in target cells, the influence on metabolism.
85. Mineralocorticosteroids. Their chemical structure, receptors. The mechanism of signal transmission in target cells, the influence on metabolism.
86. Hormones of adrenal medulla. Catecholamines: dopamine, epinephrine, norepinephrine. Their structure, receptors. The mechanism of signal transmission in target cells, the influence on metabolism.
87. Male and female sex hormones. Their chemical structure, receptors. The mechanism of signal transmission in target cells, the influence on metabolism.

BIOCHEMISTRY OF NUTRITION AND INTEGRATION OF METABOLISM

Water-soluble vitamins

88. General characteristic and classification of vitamins. Evaluation of the body vitamin saturation.
89. Biotin. Coenzyme form. Biological role. Specific symptoms of deficiency. Food resources, daily requirement.
90. Vitamin B_1. Participation in coenzyme arrangement. The role in metabolism. Specific syndromes of deficiency. Food resources, daily requirement.
91. Vitamin B_2. Structure, participation in flavin coenzymes arrangement. Biological role. Specific symptoms of deficiency. Food resources, daily requirement.
92. Vitamin B_6. Its participation in coenzyme arrangement. The role in metabolism. Specific symptoms of deficiency. Food resources, daily requirement.
93. Vitamin B_{12}. Cobalamins. The role in metabolism. Specific symptoms of deficiency. Food resources, daily requirement.
94. Vitamin C. Biological importance. Specific symptoms of deficiency. Food resources, daily requirement.

95. Pantothenic acid. Coenzymes which contain pantothenic acid. Biological importance. Specific symptoms of deficiency. Food resources, daily requirement.
96. Vitamin PP. Structure, participation in nicotinamide coenzymes arrangement. Biological role. Specific symptoms of deficiency. Food resources, daily requirement.
97. Folic acid. Structure, participation in coenzymes arrangement. Biological role. Specific symptoms of deficiency. Food resources, daily requirement.
98. Vitamin-like substances: bioflavonoids (vitamin P), para-aminobenzoic acid, inositol, pangamic acid, lipoic acid, choline, vitamin U. Biological role.

Lipid-soluble vitamins

99. Forms of vitamin A. Biological role. Vitamin A deficiency and toxicity. Food resources, daily requirement.
100. Vitamin E. Biological role. Vitamin E deficiency. Food resources, daily requirement.
101. Vitamin D. Its structure, biological role. Vitamin D deficiency and toxicity. Food resources, daily requirement.
102. Vitamin K. Biological role. Vitamin K deficiency. Food resources, daily requirement.

Water and minerals

103. Water, its biological significance. The biological role of sodium, potassium, chlorine. Regulation of the water and salt balance, mechanisms.
104. Macroelements (calcium, phosphorus, magnesium). The biological role.
105. Microelements, their significance. The biological role of manganese, copper, zinc, selenium, iodine, cobalt, fluoride.
106. The biological role of sulfur. The role of thiol and disulfide groups in the formation of specific structure and properties of proteins and hormones. Glutathione, sulfolipids, thiamine, biotin, participation in detoxification.
107. Mechanisms of iron absorption, transport and storage. The role of iron in metabolism.

The integration of metabolism and malnutrition

108. Interorgan metabolism and fuel supply in the well fed state.
109. Interorgan metabolism and fuel supply between meals and in fasting.
110. Clinical forms of malnutrition. Their origin and typical abnormalities.

BLOOD BIOCHEMISTRY

111. Chemical content of blood plasma. Plasma proteins and their role. Clinical importance of the total plasma protein and its fractions determination.
112. The origin of plasma enzymes. Clinical importance of the determination of enzyme activity in plasma.
113. Mechanisms of oxygen and carbon dioxide transport in blood. Development of hypoxic states.
114. Blood clotting. Phases of hemostasis. Factors and mechanisms involved in blood coagulation.
115. The role of Ca^{2+} and vitamin K in blood clotting.
116. Anticoagulant system.
117. Fibrinolysis. Its biological value. Plasmin system.

LIVER BIOCHEMISTRY

118. The role of liver in metabolic processes. Antitoxic function of liver. Biochemical methods of the diagnosis of liver damage.
119. Synthesis and breakdown of blood pigments. Metabolism of bile pigments.

BIOCHEMISTRY OF URINE

120. Normal characteristics of the urine.
121. Pathological urine components and their determination.