The list of questions to the control test
in sections "Introduction to biochemistry",
"Enzymology" and "Biological oxidation"
for 2022/2023 acad. year

The first and the second questions:

1. Subject and tasks of biochemistry. Objects and methods of biochemical research in clinic and experiment, their characteristics (chromatography, electrophoresis, salting out). A brief history of biochemistry. Biochemistry importance for doctor.
2. Protein structure. Levels of structural organization of protein. Characteristics of bonds. Oligomeric proteins. Species specificity of proteins. Polymorphism of proteins. Methods of qualitative detection and quantitative determination of protein.
3. Protein folding, the role of chaperones. Formation of the native conformation and active site of the protein as a result of folding. Protein biological functions. Pathology of folding (examples).
4. Denaturation: mechanisms, using in medical and laboratory practice. Protein renaturation. Methods for protein separation and purification.
5. History of enzymology. Properties of enzymes. The similarity and difference between enzymatic and non-enzymatic catalysis. Evidence of protein nature of the enzyme. Separation and purification of enzymes.
6. The structure of enzymes. Simple and complex enzymes. Cofactors, coenzymes. The role of vitamins in enzyme structure: structure and mechanism of action of FAD, FMN, $NAD(P)^+$, TPP, pyridoxal phosphate (PLP). The value of enzymes in the life processes.
7. Stages and mechanism of substrate and enzyme interaction (E. Fisher hypothesis, D. Koshland and modern concepts). Theory of intermediates. Thermodynamics of enzymatic catalysis: Gibbs energy, activation energy, energy barrier).
8. The kinetics of enzymatic reactions. Factors influencing the rate of enzymatic reactions (graphs). Km – definition and physiological significance.
9. The enzyme activity. Regulation of enzyme activity (the role of hormones, cAMP, Ca^{2+}, IP_3). Chemical modification of enzymes (limited proteolysis, phosphorylation-dephosphorylation cycle, etc.). Units of enzyme activity.
10. Inhibition of the enzymes: competitive, noncompetitive and uncompetitive inhibitors. Mechanism of action and examples of inhibitors.
11. Allosteric enzymes. Features of the structure and functioning, properties and biological role. Allosteric regulation of TCA cycle enzymes activity.
12. Nomenclature and classification of enzymes. Examples.
13. Localization of enzymes in the cell. Marker and organ-specific enzymes (examples of enzymes and the reactions they catalyze). Isozymes: origin, biological role, use in diagnostics, and examples of reactions they catalyze.
14. The main directions of medical enzymology. Enzymodiagnostics: objects (blood, urea, saliva, liquor, sweat, etc.), goals and objectives. Examples of enzymes used the enzymodiagnostics in myocardial infarction, liver and kidney disease, et al.
15. Enzymopathies. Causes, mechanisms of primary and secondary metabolic blocks examples thereof, the degree of clinical symptoms, diagnosis and treatment principles.
16. Enzyme therapy. Using of enzymes for the replacement therapy, treatment of cardiovascular, surgery, and oncological diseases. The concept of liposomes and viral vectors. The use of enzymes in laboratory practice.

17. Metabolism as a condition of life. The concept of anabolism, catabolism, and metabolism. Substrates of biological oxidation (BO), stages of thereof formation. The history of the development of the theory of biological oxidation. Bakh-Engler and Palladin-Wieland hypotheses.
18. Conversion and transfer of energy in cells. Redox reactions, redox potential. Enzymes and coenzymes of BO, their structure and role in the energy metabolism.
19. Macroergic compounds, structure and biological role of ATP, the causes of macroergity. ATP-cycle – the ways of ATP formation and utilization.
20. The main ways of oxygen consumption in organism (mitochondrial, microsomal, and peroxomal). General characteristics of mitochondria (Mt). The concept of tissue respiration.
21. Krebs tricarboxylic acid cycle (TCA): reactions, enzymes, coenzymes, localization, regulation, biological role, and energy balance of the TCA cycle. Substrate phosphorylation reaction of TCA cycle.
22. Mitochondrial oxidation. The structure and functions of mitochondrial electron transporting chain (Mt ETC). Mt ETC complexes. Basic principles and mechanisms of functioning of Mt ETC. The link between Mt ETC and TCA cycle.
23. Oxidative phosphorylation (OP): the mechanisms of coupling, OP points, P/O ratio. P. Mitchell chemiosmotic hypothesis. Uncoupling of oxidation and phosphorylation. Types, mechanism of action and biological role of uncouplers. Low-energy state: characteristics, causes.
24. Microsomal oxidation. Microsomal electron transporting chain (ETC): localization, structure, biological role, and major electron carriers. The role of microsomal ETC in xenobiotics metabolism. Comparative characteristics of mitochondrial and microsomal ETC.
25. Peroxide oxidation. Features of the oxygen atom structure and the mechanisms of the reactive oxygen species (ROS) formation. Neutralization of ROS with help of enzymatic and non-enzymatic antioxidant defense (AOD): mechanisms of action and biological role. Peroxide oxidation in norm and pathology.

<u>The third question:</u>

- Structure of pentapeptide, its name, and all possible charges by interval method (revise the formulas of 20 amino acids, pKa of amino acids).
- Structure of NAD^+, $NADH+H^+$, $NADP^+$, $NADPH+H^+$, FAD, $FADH_2$, FMN, $FMNH_2$, ATP.
- The reactions catalyzed by AST, ALT, CK, LDH. Isozymes: CK, LDH.
- Clinical and diagnostical value of amylase and creatinekinase activity and total protein concentration determining in blood plasma.

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