QUESTIONS FOR ORAL PART OF EXAM FROM "MEDICAL CHEMISTRY FOR DENTISTRY" academic year 2020-2021

1. Chemical bond - definition of coordination bond, explanation of the terms central atom, ligand and coordination number. Explanation of the term chelating ligand (two examples of biologically important chelating ligands). Characteristics of hydrogen bond, the importance of hydrogen bond in biological systems (two examples).
2. Natrium, potassium and sulfur - physiological function of sodium and potassium, biologically important molecules containing sulfur (at least 4), application of sodium thiosulphate in medicine.
3. Calcium and magnesium and phosphorus - physiological function of calcium, compounds in which calcium is found in bones and teeth. Physiological function of magnesium. Biologically important compounds containing phosphorus (examples).
4. Iron - deficiency and excess of iron (causes and consequences). Functions of transferrin and ferritin. Description of heme, functions of hemoglobin and 2 examples of pathological derivatives of hemoglobin. Function of catalase (including corresponding reaction).
5. Copper and zinc - Wilson's disease, therapy of Wilson's disease (the name and formula of the compound used in the Wilson's disease treatment). Functions of ceruloplasmin and Cu/Zn-SOD (including the summary reaction catalyzed by the enzyme and 2 steps in which it runs). Functions of carbonic anhydrase and alcohol dehydrogenase (including corresponding reactions).
6. Toxic elements - the factors influencing the toxicity of metal ions and the reasons of their toxicity (what is the metal ions toxicity based on). Chelation therapy – what are chelating agents from the chemical point of view, basic principles that define efficiency of chelating agents. 3 examples of therapeutic chelating agents.
7. Dispersed systems - classification and properties, physiological solution, isotonic, hypotonic and hypertonic environment and behavior of erythrocytes in these environments
8. Dispersed systems - true solutions, characteristics, properties, colligative properties of solutions - diffusion, osmosis, dialysis, osmolarity, osmotic pressure, ionic strength
9. Dispersed systems - colloidal solutions, their properties and types, sols, gels, foam, emulsions, emulsification process, biologically important emulsifiers and their role in the organism.
10. Dispersed systems - classification of colloids according to the affinity of dispersed molecules with dispersion medium, properties of individual groups, oncotic pressure, formation of edema, examples of colloids in the organism
11. Mechanism of redox processes, significance of redox potential. Biological oxidations and their importance in metabolic processes. Factors influencing the rate of chemical and biochemical reactions, mechanism of catalysis, biocatalysis.

12. Concept of equilibrium of chemical and biochemical reactions. Equilibrium constant and its meaning. Disturbing of a chemical equilibrium, Le Chatelier´s principle and its application in physiology.
13. Acid-base equilibrium in organism - theories of acids and bases, ion product of water and its meaning, strength of acids and bases. pH scale and calculation of pH.
14. Effects of pH changes on organism, Buffer solutions - their composition, function and mechanism of effect, buffer capacity. Henderson-Hasselbalch equation. The main buffers in biological systems, their composition. and mechanism of their effect.
15. Organism as thermodynamic system - characteristics of a biological system from thermodynamic point of view. Energy conversion and energy utilization in living systems. The 1st law of thermodynamics, internal energy, Hess law. Exothermic and endothermic reactions.
16. The 2nd law of thermodynamics, entropy and biological system, relationship between information and entropy. Gibbs free energy, standard Gibbs free energy, spontaneity of reactions. Coupling of exergonic and endergonic reactions. Importance of ATP and its hydrolysis.
17. Reactivity of organic compounds – reactive site in a molecule, the factors influencing reactivity (inductive and mesomeric effects).
18. Halogen- and hydroxyderivatives of hydrocarbons – biochemically and toxicologically significant structures and reactions.
19. Oxo compounds and carboxylic acids – biochemically and toxicologically important structures and reactions.
20. Functional and substitutional derivatives of carboxylic acids – significant structures and their chemical properties. Urea and its biochemically important derivatives.
21. Organic compounds containing nitrogen and sulfur (biological important amines, thiols) – structure and biochemically significant properties (reactions). Biologically significant heterocyclic structures and their derivatives.
22. Biological properties of monosaccharides, isomeric forms and their biochemically important reactions. Derivatives of monosaccharides (phosphate esters).
23. Reduction and oxidation of monosaccharides. Glucuronic acid – its formation, structure and properties.
24. Glycosides – disaccharides, polysaccharides (homo – and heteropolysaccharides). Explanation of their structure and biological importance.
25. Heteropolysaccharides – basic structure, glycoconjugates – proteoglycans and glycoproteins.
26. Lipids - functions and classification. Simple lipids - non-hydrolyzable and hydrolyzable. Structure, properties and importance.
27. Complex lipids - classification according to the basic alcohol and the nature of the non-lipid component, structure and biological function.
28. Derived lipids - classification, basic structure, biological function and relationship with the lipid-soluble vitamins and steroids.
29. Lipoproteins - basic characteristics of the structure of a lipoprotein particle, classes of lipoproteins according to their density and their biological functions.

30. Arachidonic acid, scheme of eicosanoids formation, their biological significance.
31. Biochemically important reactions of amino acids. Peptides – characteristics of individual structures, biological function. Peptide hormones. Glutathione – structure, biological function.
32. Proteins, basic characteristics, classification, structure and biological function.
33. Heteroproteins - classification, characteristics and biological function of individual groups of proteins.
34. Haemoproteins – the structure of prosthetic group, biological function. Hemoglobin, myoglobin, cytochromes. Proteins of blood plasma – characteristics, biological function. Immunoglobulins – basic structure and biological function.
35. Nucleic acids – characteristics, the structure of basic structural units, tautomeric forms and complementarity of purine and pyrimidine bases, minority bases.
36. DNA – characteristics, structure, Chargaff´s rules, DNA types, biological function.
37. RNA – structure, types (m-RNA, r-RNA, t-RNA), biological functions.
38. Classification of vitamins according to their solubility - individual names of vitamins, and the most important biological functions of individual vitamins. Antivitamins
39. Vitamin A - retinol, mechanism of vision. Vitamins D, their activation and functions.
40. Vitamin E, vitamin K - biochemical and physiological significance (vitamin K cycle).
41. B vitamins (B_1, B_2, B_6, B_7, B_{12}). Biochemical and physiological significance and their functions.
42. Niacin, pantothenic acid, folic acid - biochemical and physiological significance.
43. Biochemical and physiological significance of vitamin C. Oxidation-reduction function in cells, cooperation with vitamin E.
44. Coenzymes NAD^+/ NADH, $NADP^+$/NADPH, their structure, mechanism of action. Coenzyme Q.
45. Coenzymes transferring groups of atoms - adenosine phosphates as coenzymes not derived from vitamins (ATP, ADP, AMP, cAMP). Biochemical and physiological significance.
46. Simple enzymes and holoenzymes. Mechanism of enzyme reaction. Kinetics of enzyme reactions - Michaelis - Menten equation and graphical evaluation of the K_M constant (according to Michaelis - Menten and Lineweaver -Burke).
47. Catalytic (active) site of the enzyme - the theory of substrate-enzyme binding. Influence of apoenzyme and coenzyme structure on enzyme activity - specificity of enzymes. Isoenzymes - biological significance, write examples.
48. Physicochemical factors influencing the activity of enzymes. Characteristics, graphs of the dependence of the reaction rate on a given factor.
49. Inhibition of enzymes – irreversible inhibition, competitive, non-competitive, un-competitive. Characteristics of individual types, graphs of the dependence of the reaction rate on the substrate concentration.
50. Covalent modifications of enzyme activity (e.g. phosphorylation and dephosphorylation). Limited proteolysis, mechanism of activation of some proteolytic

enzymes (pepsinogen and chymotrypsinogen) and their importance for protein metabolism.

51. Types of regulation of enzyme activity with changing the number of enzyme molecules. Inductive and constitutive enzymes, induction, repression, organelles of protein degradation in the cell
52. Allosteric regulation of enzyme activity. Cooperative and sequential model of allosteric activation. Conversion of isocitrate to α-ketoglutarate - enzyme activators and inhibitors. Feed-forward activation, feed-back inhibition.
53. Classification and nomenclature of enzymes, examples of reactions catalyzed by individual classes of enzymes.
54. Importance of enzymes in biochemistry and medicine (use of allopurinol, aspirin, ethanol), enzyme disorders (lactose and sucrose intolerance).