Exam questions

1. The first law of thermodynamics. Enthalpy. Standard enthalpy of formation. Hess law. Calculations as a consequence of the law of Hess. Thermochemical processes. Application of the first law of thermodynamics to biosystems.

2. The main thermodynamic functions of the state. Enthalpy. Entropy. Gibbs energy. Calculation of the change in Gibbs energy under various conditions. Endergonic and exergonic reactions, the principle of energy conjugation in biological systems.

3. Features of the thermodynamics of biochemical processes in equilibrium and stationary states. The concept of homeostasis.

4. The subject and basic concepts of chemical kinetics. Speed, rate constant of chemical reactions; their dependence on the nature of the reacting substances, concentration (the law of masses), temperature (Vant Hoff rule, Arrhenius equation). Application of chemical kinetics methods in medicine, biology, pharmacology, physiology.

5. The concept of the theory of active collisions, activation energy. The energy profile of exo-and endothermic reactions taking place without a catalyst and in the presence of a catalyst. Features of the catalytic activity of enzymes.

6. Kinetic and thermodynamic conditions of chemical equilibrium. The equilibrium constant, its dependence on various factors. Shift of equilibrium. The Le Chatelier principle is the principle of adaptive realignment for living systems.

7. Electrolytic dissociation. The relationship between the degree of dissociation and the dissociation constant of weak electrolyte and their dependence on various factors. Calculation of the concentration of ions of strong and weak electrolyte. Physico-chemical basis of the water-electrolyte balance in the body.

8. Colligative properties of dilute electrolyte solutions. Raul's law and its consequences: lowering the crystallization temperature, increasing the boiling point of solutions. Osmolality. Occurrence in biomedical practice.

9. Osmotic properties of electrolyte solutions. Osmolarity. Hypo-, hyper- and isotonic solutions. Isotonic coefficient. The role of osmosis in biological systems. Plasmolysis and cytolysis.

10. Ionic product of water. Hydrogen indicator. Determination of pH of aqueous solutions of acids, bases and salts. Examples of pH values of various biological environments.

11. Buffer solutions and systems. The mechanism of the buffer action on the example of acetate, bicarbonate, hydrophosphate, ammonia buffer.

12. Calculation of pH of protolytic (buffer) systems, pH dependence on various factors. Buffer zone.

13. Buffer capacity for acid and base. The dependence of the buffer capacity on dilution. Calculation and analysis of the buffer capacity. Comparison of acid buffer capacity and base buffer capacity.

14. Concepts about blood buffer systems: bicarbonate, phosphate, hemoglobin, oxyhemoglobin, protein. The concept of the acid-base state of the body. Acidosis. Alkalosis.

15. The relationship between the buffer systems of the body at the level of plasma and red blood cells. The processes occurring in the red blood cell in the lungs (during inhalation, exhalation), in the tissues. The essence of the hydrocarbon-chloride shift.

16. Limited and unlimited solubility; unsaturated, saturated, supersaturated solutions. Heterogeneous equilibria and processes. The solubility constant, its dependence on various factors. The relationship between the solubility constant and molar solubility. Conditions for the formation and dissolution of precipitation.

17. Competition for a cation or anion: an isolated and combined heterogeneous equilibrium in electrolyte solutions.

18. Reactions underlying the formation of inorganic substance of bone tissue - hydroxyapatite. The mechanism of calcium buffer functioning. Phenomenon of isomorphism: substitution of hydroxide ions in fluoride ions for hydroxyapatite, calcium ions for strontium ions, beryllium ions. Features of the process of stone formation.

19. The structure and nomenclature of complex compounds. Features of chemical bonds in complex compounds. The dependence of the strength of complex compounds on various factors. Chelate complex compounds. Physicochemical principles of chelation therapy.

20. Dissociation of complex electrolyte. Instability constant of a complex ion. Competition for a ligand or for a complexing agent: isolated and combined ligand-exchange equilibria. Inert and labile complexes.

21. The role of complex compounds in the body. Representations of the structure of metalloenzymes, metallocenes, polynuclear, macrocyclic biocomplex compounds by the example

of hemoglobin, cytochromes, ionophores, cobalamins. Physicochemical principles of oxygen transport by hemoglobin.

22. Redox reactions. Factors affecting the course of redox reactions. Redox systems of various types. Redox potential. Nernst-Peters equations.

23. Prediction of the direction of redox processes by the magnitude of the redox potential. Standard EMF (Δφoreactions), its connection with the change in Gibbs energy of the redox process.

24. The effect of the ligand environment of the central atom on the value of the redox potential. Electrochemical processes. Physico-chemical principles of electron transport in the electron transport chain of mitochondria. Toxic effect.
oxidizing agents (nitrates, nitrites, nitrogen oxides). The neutralization of oxygen, hydrogen peroxide and superoxide ion. The use of redox reactions for detoxification.
25. Galvanic cell. Processes at the anode and cathode. Calculation of EMF.
26. Corrosion chemical and electrochemical. Mechanism of action. The occurrence of EMF in the oral cavity during metal prosthetics.
27. Classification of dispersed systems by degree of dispersion; according to the state of aggregation of phases; by the strength of the intermolecular interaction between the dispersed phase and the dispersion medium. Body tissues as dispersed systems of various types (examples).
28. Obtaining dispersed systems. Micella is a structural unit of a sol, its structure.
29. Properties of lyophobic colloidal solutions: molecular kinetic, optical. Dialysis, electrodialysis, ultrafiltration. Physico-chemical principles of the functioning of the artificial kidney.
30. Stability of colloidal solutions. Sedimentation, aggregative and condensation stability of lyosols. Factors affecting the stability of lyosols. Coagulation. The coagulation threshold and its definition, the Schulze-Hardy rule, the phenomenon of addiction. Mutual coagulation. Colloidal protection and peptization. The physiological significance of the coagulation process for living systems. Electrophoresis, electroosmosis: use in medicine.
31. The concept of adsorption. Physical adsorption and chemisorption. The Langmuir and Freindlich equations. Adsorption isotherm.
32. Adsorption of ions from solutions: ion adsorption and ion exchange adsorption. Characteristics. The rule of Panet-Faience-Peskov. The value of adsorption processes for life.
33. Absorption. Gas absorption, the laws of Henry and Sechenov, methods of preventing decompression sickness.
34.Surface-active and surface-inactive substances. Change in surface activity in homologous series (Traube rule). Adsorption isotherm.

35.Dependence of adsorption on various factors. Selective Adsorption The value of adsorption processes for life. Physicochemical fundamentals of adsorption therapy, hemosorption, and the use of ion exchangers in medicine.

36. Chemistry of *s*-metal ions in the body: sodium and potassium; magnesium and calcium

37. Chemistry of *p*-element ions in the body.

38. Chemistry of *d*-metal ions in the body: manganese; iron and cobalt; copper; zinc, molybdenum.

EXAMINATION TICKET SAMPLE

discipline "Chemistry"

EXAMINATION TICKET № 0

1. Colligative properties of dilute solutions of non-electrolytes. Raul's law and its consequences: lowering the crystallization temperature, increasing the boiling point of solutions.

2. The solubility constant (Ks) of lead chloride at 250 C is $1.6\ 10^{-5}$. Determine the concentration of lead ions (Pb^{2+}) in a saturated solution of $PbCl_2$.

3. Arrange the substances in decreasing pH. The concentration of solutions is 0.1 mol / l).

a) $Fe(NO_3)_3$ b) $HClO_4$ c) $Zn(OH)_2$ d) NaOH g) K_2SO_3.

For each of the salts, write the ion-molecular equation of hydrolysis in the first step, indicate the type of hydrolysis, the acidity of the medium.

4. Is it possible in the standard state to replace the ligand in the hexafluoroferrate (III) -ion with a thiocyanate ion. For a reasoned answer, use the table values of the instability constants.

5. Calculate the change in Gibbs energy for the redox reaction between the solution of iron (III) chloride and potassium iodide. The reaction proceeds under standard conditions.