

Subject 17. Summary control of the module “Basics of medical chemistry”.List of theory questions for the summary module control of knowledge in the subject

Thematical module 1. Homogeneous equilibriums in biological fluids.

Heterogeneous equilibriums in biological fluids

1. Electron structure of biogenic elements. Typical chemical properties of the elements and their compounds (reaction without change of the oxidation state, reactions with change of the oxidation state). Correlation of place of *s*-, *p*-, *d*-elements in the Periodic system and their content in the organism. Application of compounds of *s*-, *p*-, *d*-elements in dentistry practice.
2. Solutions in life. Enthalpy and entropy factors of dissolution and their relationship to the mechanism of dissolution.
3. Nitrogen forms several oxides. One of the oxides is produced in blood vessels for vasodilation, the other is used for narcosis. Name the oxides.
4. What halogens are found in the organisms as hydrated ions?
5. Which ion is the central nervous system the most sensitive to?
6. Solubility of gases in liquids and its dependence on various factors. The Henry-Dalton law. Effect of electrolytes on solubility of gases. Solubility of gases in the blood.
7. Solubility of solids and liquids. Distribution of substances between two immiscible liquids. The Nernst law of distribution and its importance for permeability of biomembranes.
8. Equilibrium in solution of electrolytes. The Ostwald's law of dilution.
9. Dissociation of water. The ionic product of water. pH of biological liquids.
10. The product of solubility. Conditions of formation and dissolution of precipitates.
11. Types of protolytic reactions. Neutralization, hydrolysis and ionization reactions.
12. Salt hydrolysis. Hydrolysis degree, its dependence on concentration and temperature. The hydrolysis constant.
13. Basics of titrimetric analysis. Methods of acid-base titration. Acid-base indicators and their selection.
14. Buffer systems, their classification. pH of buffer solutions.
15. Action mechanism of buffer solutions.
16. Buffer capacity and the factors that effect it. Buffer systems of blood.
17. Colligative properties of diluted solutions: depression of freezing temperature, elevation of boiling temperature. The Raoult's laws. Criometry and ebulliometry.

18. A colligative property of diluted solutions: osmosis. Osmotic pressure. The Van't Hoff's law. Plasmolysis and hemolysis.
19. Colligative properties of diluted solutions of electrolytes. The isotonic coefficient. Hypo-, hyper- and isotonic solutions in medical practice. Role of osmosis in biological systems.
20. Is it possible to calculate osmotic pressure of a solution with cryoscopy and ebullioscopy data? Write an example of calculation.
21. How can molar mass of a substance be calculated with cryoscopy data? Which of solvents, with bigger or smaller cryoscopy constant should be used for a more exact measurement of molar mass?
22. Macroergic compounds. ATP as a universal source of energy for biochemical reactions. Characteristics of macroergic bonds.
23. The First Law of Thermodynamics. Internal energy. Enthalpy. Heat of the isobaric and isochoric processes. Standard heats of formation and combustion of substances.
24. Thermochemistry. The Hess' law. Thermochemical transformations.
25. Thermochemical calculations and their application for evaluation of energy metabolism in biochemical processes.
26. The Second Law of Thermodynamics. Entropy. The Gibbs' energy.
27. Chemical equilibrium. Thermodynamic conditions of equilibrium. Prediction of direction of spontaneous processes. Exergonic and endergonic processes in the organism.
28. The Law of working masses. The constant of chemical equilibrium. The Le Chatellier's principle. Prediction of shifts of chemical equilibrium.
29. The rate of chemical reactions. The Law of working masses for rate of chemical reactions. The rate constant.
30. Simple and complex reactions (subsequent, parallel, conjugated, reversible, chain). Photochemical reactions and their role in the life.
31. The order of a reaction. Reactions of first and second order. Reactions of zero order. The period of half-life.
32. Effect of temperature on the reaction rate. The temperature coefficient. The Van't Hoff's rule. Characteristics of the temperature coefficient of biochemical processes.
33. The Arrhenius' equation. The energy of activation. The theory of active collisions and the theory of the transition state.
34. Homogeneous and heterogeneous catalysis. Mechanism of catalytic action. Role of catalysis in the metabolic processes.

35. Enzymes as catalysts of biochemical reactions. Effects of enzyme and substrate concentration, temperature and pH on enzymic reactions.
36. Solutions of coordination compounds. Modern theories of structure of coordination compounds.
37. Classification of coordination compounds (by the nature of ligands and the charge of the inner sphere).
38. Constants of unstability and stability of coordination ions. Intercoordination compounds. Coordination compounds in biological systems. Structure of hemoglobin.
39. Which coordination compounds belong to aquacomplexes?
40. What type of bonds is characteristic for coordination compounds?
41. Electrode processes and the mechanism of their formation. The Nernst equation. The standard electrode potential.
42. The standard hydrogen electrode.
43. Measurement of electrode potential. Measurement electrodes. Comparison electrodes.
44. Oxidation-reduction electrode potentials. Mechanism of formation, biological importance. The Nernst-Peters equations.
45. Oxidation-reduction reactions in the organism. Prediction of their direction with the standard values of Gibb's energy and values of redox potentials.
46. Galvanic cells. Electrode processes in the oral cavity.
47. Potentiometric titration, its application in medical and biological research.
48. Characteristics of solutions of high molecular compounds. Mechanism of turgescence and solubility of high molecular compounds. Effect of various factors on turgescence and solubility of high molecular compounds. Role of turgescence in physiology of organisms.
49. Isoelectric point of the protein (pI) and methods of its measurement.
50. Jellification of solutions of high molecular compounds. Properties of jellies.
51. Anomalous viscosity of solutions of high molecular compounds. Viscosity of blood and other biological fluids. Osmotic pressure of solutions of biopolymers. Oncotic pressure of blood plasma and blood serum.
52. Donnan's membrane equilibrium.
53. Surface activity. The Traube's rule. The Gibbs' equation. Orientation of molecules in the surface layer and structure of biological membranes.
54. The Langmure's equation.
55. Adsorption from solutions on the solid surface. The Freundlich's equation.
56. Physico-chemical principles of the adsorption therapy.

57. Adsorption of electrolytes (selective and ion-exchange). The Panet's rule.
58. Ionites and their application in medicine.
59. Classification of methods of chromatography by distribution of substances, aggregative phase and technique. Application of chromatography in medical and biological research.
60. Dispersion systems and their classification. Obtaining and purification of colloidal solutions. Dialysis and electrodialysis, ultrafiltration. "Artificial kidney".
61. Molecular-kinetic properties of colloidal systems (Brownian movement, diffusion, osmotic pressure).
62. Optical properties of colloidal systems. Ultramicroscopy. Structure of colloidal particles.
63. Electrokinetical potential of colloidal particles. Electrophoresis, its application in medicine and medical and biological research.
64. Kinetic and aggregative stability of liosols. Stability factors. Mechanism of coagulation action of electrolytes.
65. Coagulation threshold, its determination. Coagulation processes in purification of drinking water and waste waters. Colloidal protection, its biological role.
66. Coarse dispersion systems (aerosols, suspensions, emulsions). Obtaining and properties. Medical application. Semicolloids.

2. www.pdmu.edu.ua
<https://med-chemistry.pdmu.edu.ua/>

(Web page of Poltava State Medical University).