

**THE LIST OF QUESTIONS SUBMITTED FOR EXAMINATION
FOR STUDENTS OF FACULTY OF MEDICINE(2023 year)**

1. The first principle of thermodynamics and peculiarities of its application to living systems.
2. Body energy consumption. Basal metabolic rate.
3. Temperature homeostasis. Thermoregulation in a living organism. Chemical and physical thermoregulation. Heat exchange, its types. Heat treatment. Use of low temperatures in medicine.
4. Methods of direct and indirect calorimetry.
5. Work types in the living organism.
6. The organism as an open system. Prigogine theorem. The comparison of thermodynamic equilibrium and stationary state.
7. Concept of entropy. Statistical meaning of entropy.
8. The second law of thermodynamics and its application for biosystems.
9. Thermodynamic potentials. Entropy, enthalpy, free energy, electrochemical potential.
10. The rate of entropy increase and a dissipative function.
11. Intermolecular interaction in biopolymers.
12. Basic biophysical methods of studying biopolymers.
13. The structure and functions of biological membranes.
14. Physical methods of studying of structure of biological membranes.
15. Physical properties of biological membranes. Phase transitions.
16. Basic types of a passive transport of substances through the membrane.
17. Fick's equation for a passive transport of substances through the membrane.
18. Simple and facilitated diffusion.
19. Passive transport of charged particles through the membrane. Nernst-Planck electrodiffusion equation.
20. Electrochemical potential. Theorell equation.
21. Osmosis. Water balance in cells. Filtration.
22. Active transport of substances through the membrane.
23. Electrogenic ion pumps.
24. Secondary active transport of ions.
25. Biomembrane potentials and their ionic nature. Resting membrane potential.
26. Nernst equation for resting membrane potential.
27. Main properties of an action potential.
28. The mechanism of generation and propagation of action potential in nerve cells
29. Donnan potential. Donnan equilibrium.
30. Electrodiffusion equation of ions through a membrane. Stationary Goldman-Hodgkin potential.
31. The propagation of excitation along nerve fibers.
32. General principles of functioning of ion channels. Channelopathies.
33. Mechanical properties of a living tissues.
34. Hooke's law. Young's modulus and Poisson's ratio.
35. Stretch diagrams for biological tissues.
36. Biophysical properties of muscle contraction.
37. Hill equation. The power of contraction of skeletal muscle.

38. Internal friction (viscosity of fluids). A Newtonian and a non-Newtonian fluids. Rheological properties of blood and fluids.
39. Laminar and turbulent fluid flow. Reynolds number. The flow of a viscous fluids. Hagen-Poiseuille equation. Hydraulic resistance.
40. Methods for determination of viscosity of fluids (viscometric method and Stokes method). The clinical method used for determination of blood viscosity.
41. Surface tension. Surface phenomena in the human body. Gas embolism.
42. General physical regularities of blood motion in vessels.
43. Stationary flow of fluids. Continuity equation. Linear and volume flow rate. Bernoulli's law.
44. Basic hemodynamic parameters.
45. The physical bases of the clinical method of measurement of blood pressure.
46. Work and power of the heart.
47. A pulse waves, the dependence of propagation velocity on the vessel parameters.
48. Biophysics of respiration. Biomechanics of inhalation and exhalation. Distension of the lungs. Breathing resistance. The work of breathing.
49. Gas exchange. Spirometry. Pneumotachography.
50. Basic biophysical properties of sensory systems and receptors.
51. Acoustics. Physical characteristics of sound. The acoustic impedance.
52. Characteristics of the auditory sensation (physiological characteristics) and their relationship with the physical characteristics of sound. Weber-Fechner law.
53. Physics of hearing. The concept of the sound conductive and the sound perceptive systems.
54. The physical bases of a sound methods of research used in the clinics. Reflection and absorption of sound waves. Reverberation.
55. Hearing threshold and pain threshold. Sound intensity scale and loudness scale, units. Audiometry.
56. Coding of information in the auditory analyzer. Mechanotransduction in hair cells.
57. The optical system of the eye. Optical power of the eye. Refractive surfaces of the eye.
58. Aberration. Resolution of the eye. Angle of view. Day and twilight vision. Sensitivity of the eye.
59. Anomalies of optical system of the eye and their correction.
60. Biophysical bases of visual reception. Transduction processes in retinal photoreceptors.
61. Noise and its impact on a living organism. Sound boom.
62. Infrasound, peculiarities of its propagation. Infrasound effects on biological objects. Vibration, their physical characteristics and impact on the living organism.
63. Ultrasound and its characteristics. Sources and receivers of ultrasound.
64. Peculiarities of propagation of ultrasonic waves. Effects of ultrasound on the matter.
65. The Doppler effect, its application for medical and biological research.
66. Biophysical bases of ultrasound effects on cells and tissues. The application of ultrasound in diagnostics and treatment.
67. Lead. Integral electric vector of the heart.
68. Einthoven's concept of ECG.
69. Components of normal electrocardiogram.
70. Vectorcardiography.
71. The mechanism of the electrical activity of organs and tissues. Electrical phenomena in cardiac muscle.
72. The electrical properties of cells and tissues. Conduction current and displacement currents.

73. Electrical conductivity of cells and tissues at direct current.
74. Application of direct electric current in medicine. Galvanization. Electrophoresis.
75. Application of the constant electric field of high voltage in medicine. Franklinization. Aeroionotherapy.
76. Effects of electric current on the living organism.
77. Passing of alternating current through biological objects. The impedance of tissues and organs.
78. Dispersion of impedance. Polarization coefficient of tissue. Reography.
79. The physical characteristics of pulsed current. Effects of pulsed electric current on the living organism. Cranial electrotherapy stimulation. Electrical stimulators. Defibrillators.
80. Effects of electromagnetic fields on biological objects. Primary mechanisms, currents and thermal effects, specific action.
81. Therapeutic factors and their application in medical techniques (UHF- and SHF-therapy, microwave resonance therapy).
82. The magnetic field of the human body. Biomagnetism.
83. Effects of magnetic fields on the living organism. Induction currents, thermal effects. Healing factors and their application in medical methods (magnetotherapy, inductothermy, etc.).
84. Resonance methods of quantum mechanics. Electron magnetic resonance.
85. Resonance methods of quantum mechanics. Nuclear magnetic resonance, its application in medicine (magnetic resonance tomography).
86. The nature of light. Optical refractometry. Endoscopy.
87. Optical microscope and its main characteristics. Some special methods of optical microscopy.
88. The mechanism of light absorption. Main characteristics of light absorption (intensity, absorption coefficient, optical density of medium, transmittance, extinction).
89. The principle of concentration colorimetry. The Beer-Lambert-Bouguer law.
90. The mechanism of light scattering. Rayleigh law. Nephelometry.
91. Light polarization. Ways to obtain polarized light. Birefringence. Nicolas prism.
92. Application of light polarization in medicine. Polarimeters.
93. Optically active substances. Biot's law.
94. The main types and stages of photobiological processes. Electronic transitions in atoms and molecules. Photochemical reactions.
95. The mechanism of biological effect of electromagnetic radiation of ultraviolet, visible and infrared ranges on a living organism. Application of non-ionizing radiation in medicine. Photomedicine.
96. Methods of spectral analysis and their use in medicine.
97. Spontaneous and induced radiation. The main structural components of a laser and their functions.
98. The main properties of laser radiation.
99. Effects of laser radiation on living tissue.
100. The main areas of a laser radiation application in medicine.
101. The mechanism and main characteristics of thermal radiation.
102. Laws of thermal radiation.
103. Peculiarities of thermal radiation of the human body. Temperature topography of the human body. The principles of thermal imaging.
104. Luminescence. Types of luminescence.
105. Basic regularities of fluorescent radiation, its properties. Stokes' law. Application of luminescence in medicine. Fluorescent microscope.

106. The phenomenon of the photoelectric effect. External and internal photoelectric effects and their application in medicine.
107. Properties of X-rays.
108. The mechanism of production of Bremsstrahlung (“braking radiation”). The boundary wavelength.
109. Nature of the characteristic radiation. Moseley’s law.
110. X-ray interaction with matter (coherent radiation, photoelectric effect, Compton effect).
111. The principles of X-ray diagnostics (radiography) and X-ray therapy.
112. Radioactivity. Main types of radioactive decay.
113. Law of radioactive decay. Activity of radioactive source. Lifetime.
114. The doses of ionizing radiation and their units. Detectors of ionizing radiation.
115. Biological effects of ionizing radiation. Basic quantitative characteristics of the interaction of ionizing radiation with biological objects.
116. Direct and indirect action of ionizing radiation. Modification of radiobiological effects.
117. The main physical and chemical methods of protection from ionizing radiation. Radioprotectors and radiosensitizers.
118. Methods of radioisotope medicine. Radionuclide diagnostics.
119. Positron emission tomography.
120. Natural radiation background.