Biophysics 1 – theory exam questions
2018/2019

1 Electromagnetic waves, the electromagnetic spectrum. Light as a wave and its characteristics: diffraction, interference, polarization. The dual nature of light. Matter waves
2 The photoelectric effect: experimental findings and their explanation. The Einstein equation
3 Rutherford’s experiment, the Rutherford model of the atom. Bohr’s model: Bohr’s postulates, the Franck-Hertz experiment
4 The quantum-mechanical model of the atom, wave function. Heisenberg’s uncertainty relationship. Physical meaning of quantum numbers. The Stern-Gerlach and Einstein-de Haas experiments
6 Properties and spectrum of X-rays. Components and function of an X-ray tube. Types of X-rays and the mechanisms of their generation
7 X-ray diffraction. Principles of the method, interference, conditions of interference maxima, Laue equations. Applications of X-ray diffraction
8 Structure of the atomic nucleus. Size of the atomic nucleus. Nuclear force. Binding energy of the atomic nucleus. Mass defect. The stability of the atomic nucleus. The liquid drop and shell model of the nucleus, the simplified Weizsäcker formula, magic nuclei
9 Radioactivity. The radioactive decay law. Average lifetime, physical, biological and effective half life, decay constant. Real activity vs measured count rate
10 Types and properties of radioactive radiations. LET. Interactions of radioactive radiations with matter. Special interactions of gamma radiation with matter. Applications of radioactive isotopes
12 Ideal gases, gas laws. The equipartition theorem. The zeroth and first law of thermodynamics. Definition of work. Work during isobaric and isochoric processes
13 Classical and statistical definition of entropy. The second law of thermodynamics
14 Thermodynamic potentials: internal energy, enthalpy, entropy, Gibbs free energy. Change of Gibbs free energy during spontaneous processes
15 Diffusion. Fick’s 1st law. Diffusion coefficient. The Einstein-Stokes formula. Fick’s 1st law. Diffusion through the cell membrane: passive, active and facilitated diffusion
16 Osmosis. Van’t Hoff’s law. Osmotic pressure and its significance
17 Types of fluid flow. Reynolds number. Viscosity. Laws of fluid flow: continuity equation, Bernoulli’s law, the Hagen-Poiseuille law, Stokes’ law
18 Structure and characteristics of the circulatory system. Factors affecting the blood flow. Blood pressure. The peripheral resistance. Volume and pressure changes during the cardiac cycle. The work of the heart. Frank-Starling law
19 Levels of protein structure. Theory of protein folding: Anfinsen’s experiment, Levinthal’s paradox, the folding funnel model
21 Sensory receptors. Phases of the action potential. Changes of ion fluxes corresponding to the different phases

23 Sound and its characteristics. The decibel scale. Structure and function of the ear. Békésy’s theory. Molecular basis of hair cell function


26 Molecular basis of muscle functioning. Structure of cross-striated muscle, the sarcomere and its building elements. Regulatory proteins. Molecular basis of muscle functioning: sliding filament, steric blocking theories

27 Mechanical properties of muscles. Passive and active muscle function. Length dependence of the force. Velocity dependence of the force and power of muscle. Torque, conditions for equilibrium. Simple machines, examples of type 1., 2., and 3 lever

Biophysics 1 – practical exam questions
2018/2019

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