

## MEDICAL UNIVERSITY - PLEVEN FACULTY OF PHARMACY

# DEVISION OF PHYSICS AND BIOPHYSICS, HIGHER MATHEMATICS AND INFORMATION TECHNOLOGIES

### **EXAMINATION SYNOPSIS**

IN

#### BIOPHYSICS

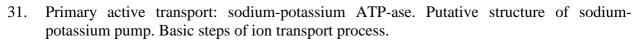
### ENGLISH MEDIUM COURSE OF TRAINING SPECIALTY OF MEDICINE ACADEMIC DEGREE MASTER

### PROFESSIONAL QUALIFICATION MEDICAL DOCTOR

- 1. Nature and subject of biophysics. Biophysics subareas.
- 2. Molecular structure of biological systems. Microphysical and macrophysical behavior. Anisotropy. Intramolecular bonds.
- 3. Subjects of thermodynamics, basic thermodynamic terms: thermodynamic system, variables, state, thermodynamic equilibrium, conjugate variables and thermodynamic process.
- 4. Equilibrium thermodynamics. First law of thermodynamics. Mathematical formulation of the first law. Limitations of the first law.
- 5. Second law of thermodynamics. Phenomenological definition of entropy.



- 6. Order and probability. Thermodynamic probability and entropy. Boltzmann equation of entropy.
- 7. Information and entropy. Statistical definition of entropy. Shannon relation of information content. Maxwell's demon.
- 8. Thermodynamic potentials: internal energy and enthalpy.
- 9. Thermodynamic potentials: Helmholtz and Gibbs free energy.
- 10. Chemical and electrochemical potentials. First law of thermodynamics for open systems
- 11. Linear non-equilibrium thermodynamics Definition and basic terms. Force and motion. Phenomenological coefficients. Conjugated fluxes.
- 12. Stationary state. Dissipative function. Entropy and stability. Steady state.
- 13. Biological structures: general aspects.
- 14. Bioenergetics. Energy. Metabolism. Oxidation as a source of metabolic energy. ATP and energy transduction. Mechanism of coupling the oxidative–phosphorylation reactions.
- 15. A kinetic study of acid-catalyzed sucrose hydrolysis.
- 16. Cell membranes. Plasma membrane. Internal membranes. Lipid bilayer unit membrane. Membrane functions.
- 17. Biological Membranes. Membrane lipids: the supporting structure. Phospholipids, glycolipids and cholesterol. Membrane proteins categories and functions. Membrane dynamics. Cholesterol effects on membrane fluidity.
- 18. Molecular (size exclusion) chromatography: determination of molecular masses.
- 19. Thin-layer chromatography: qualitative analysis of membrane lipids.
- 20. Paper electrophoresis: separation of proteins.
- 21. Transport of matter across cell membranes classification on the basis of transport mechanism, energy supply, number of transported species and direction of their translocation, and trans-membrane potential changes.
- 22. Model membranes: preparation of hemosomes.
- 23. Absorption spectrophotometry: studying acid hemolysis of erythrocytes.
- 24. Free diffusion of non-charged particles. Fick's law.
- 25. Free diffusion of charged particles. Nernst-Planck molar flux equation.
- 26. Simple diffusion through membranes. Permeability.
- 27. Transport of water through membranes. Filtration and osmosis.
- 28. Biophysics of hemodialysis: transport of urea across a semipermeable membrane.
- 29. Facilitated diffusion: transport by carrier proteins. Saturability and specificity important characteristics of the membrane transport systems.
- 30. Facilitated diffusion: transport by channels and pores. Three examples of pores important for cellular physiology. Ionophores.



- 32. Primary active transport: calcium ATP-ase. Putative structure of calcium pump. Basic steps of ion transport process.
- 33. Secondary (ion gradient-driven) active transport. Glucose transport in the intestinal epithelium.
- 34. Lactose permease. Putative mechanism of lactose transport in E. coli.
- 35. Microelectrophoresis: determination of electrokinetic (zeta) potential.
- 36. Diffusion potential. The Henderson equation. Time dependence of diffusion potential
- 37. Membrane (equilibrium) potential. The Nernst equation.
- 38. Donnan potential. Approach to electrical and chemical equilibrium. Gibbs-Donnan equation. Osmotic consequences of the Gibbs-Donnan equilibrium.
- 39. Generation of resting membrane potential. The Goldman and Thomas equations. Factors contributing to the resting potential.
- 40. Generation of action potential. Voltage-gated channels. Saltatory conduction.
- 41. Free radical biology basic terms. Free radical reactions. Classification. Chemical reactivity of free radicals.
- 42. Sources of free radical generation in human body.
- 43. Initiation and propagation of lipid peroxidation.
- 44. Decomposition and termination stages of lipid peroxidation. Metal ions and the peroxidation processes.
- 45. Copper-induced superoxide production in erythrocytes.
- 46. Lipid peroxidation: measuring malonedialdehyde concentration.
- 47. Singlet oxygen generation and role in living systems.
- 48. Consequences of free-radical processes in living systems.
- 49. Enzymatic antioxidants.
- 50. Non enzymatic antioxidants.
- 51. Lipid peroxidation and toxicology. Contribution of oxidative stress to atherosclerosis.
- 52. The importance of oxidative stress in the development of nervous system injury.

#### REFERENCES

- 1. Glaser R (2005) Biophysics. Springer-Verlag Berlin Hedelberg.
- 2. Roy RN (1999) A textbook of biophysics (For medical science and biological students). New Central Book Agency (p) Ltd.
- 3. Halliwell B and Gutteridge J (2007). Free Radicals in Biology and Medicine. 4th Edition, Oxford University Press.
- 4. Boron WF, Boulpaep EL (2012). Medical Physiology: A Cellular and Molecular Approach. Updated second edition, Copyright © 2012 by Saunders.