

THE LIST OF PROBLEMS FOR THE LABORATORY CLASSES

IMPORTANT: NUMBERS IN BRACKETS ARE THE NUMBERS OF CHAPTERS IN THE LABORATORY TEXTBOOK: *Laboratory Exercises in Biophysics*, G: – CORRESPONDING CHAPTERS IN DOUGLAS C. GIANCOLI, PHYSICS - PRINCIPLES WITH APPLICATIONS 7TH EDITION (ON-LINE VERSION AVAILABLE).

1. INTRODUCTORY CLASS: PRACTICAL ASPECTS OF PHYSICAL MEASUREMENTS (1)

Discussion of errors of measurements. Sample calculus based on chosen examples: the mean and maximum error - idea of standard deviation, errors of combined quantities. Graphical representation of experimental results and experimental errors.

2. DIFFUSION (9); G: 13-13

The phenomenon of diffusion. The Fick law of diffusion. Concentration gradient. Diffusion coefficient (diffusion constant). Semi-permeable membranes and selectively permeable membranes. Membrane permeability and the permeability constant. The Einstein-Smoluchowski equation. Determination of the coefficient of the diffusion and the membrane permeability.

3. ACTION POTENTIAL (13); G: 18-10

The structure of a neuron. The distribution of sodium, potassium and chloride ions inside and outside of typical axon. The Nernst equation. The Goldman equation. Resting potential. The Action potential. Depolarization and repolarization. Threshold of stimulation. Absolute and relative refractory period. Strength-duration curve, chronaxie and rheobase. Summation of synaptic inputs. "All or none" response.

4. PRINCIPLES OF PHOTOMETRY (for handouts see the University or the Department web page)

The scotopic and photopic vision - the luminous efficiency function $V(\lambda)$. Photometric quantities and their units: luminous intensity, luminous flux, illuminance, luminance. The inverse square law. Photometry: determination of the luminous intensity of a light source.

5. SURFACE TENSION (7); G:10-13 AND MONOMOLECULAR LAYER (8)

Forces between molecules at a surface and in the bulk. Surface tension: definition and units. Methods of determination of the surface tension: the stalagmometer (drop count) method, and the capillary method. The Laplace law and basis of the bubble pressure method. Amphiphilic nature of molecules. Structures formed by amphiphilic molecules in solutions. Surface pressure and surface pressure-area isotherms. Estimation of molecular dimensions by analysis of the thin film parameters.

6. LAWS OF FLOW - for handouts see the University or the Department web page, chapter (19) and G: 10-8, 10-9, 10-10, 10-11, 10-12

The law of continuity. Bernoulli's principle, static and dynamic pressure. The Hagen- Poiseuille law. Resistance to flow and the vascular resistance. Viscosity; definition of the coefficient of viscosity. Flow of viscous fluids. Laminar and turbulent flow. The Reynold number. Velocity of flow (the equation of continuity). Volume rate of flow. Flow of liquids in elastic vessels - the pulse wave.

7. ELECTROMOTIVE FORCE OF A CONCENTRATION CELL: (10)

Chemical and electrochemical potential. Electrode potential. The concentration cell and its electromotive force. The Nernst equation. The diffusion potential and the Henderson equation. The ion mobility.

8. ATTENUATION OF ELECTROMAGNETIC IONIZING RADIATION: (4); G: 27-3, 27-5, 27-6

Mechanisms of attenuation of X- and gamma-radiation (photoelectric effect, Compton effect and electron - positron pair production), The Lambert law, linear and mass attenuation coefficient. Half-value-layer. Determinations of HVL (analysis in a regular and semi-logarithmic scale)

9. MEASUREMENTS OF DIMENSIONS OF SMALL OBJECTS BY MICROSCOPE (20); G: 25-5, 25-7

Index of refraction. Snell's law. Image forming - ray diagrams. Limits of resolution: resolving power; Abbe's and Rayleigh's criteria. Numerical aperture and the aperture angle. Optical system of a microscope. Magnification of

a microscope. Practical magnification. Calibration procedure of the microscope eyepiece. Determination of the dimensions of micro-objects (erythrocytes) by the microscope.

You will need the **Laboratory report forms** which are available at the University web page and alternatively at the Department web page:<http://biofizyka.ump.edu.pl/5year-DDS>