HUMAN PHYSIOLOGY AND BIOPHYSICS DEPARTEMENT

Common requirements for the 1st cycle laboratory works, General Medicine,

1st semester (2019-2020 academic year)

Each student must have in advance, written in a special notebook for practical works, the following:

1) Number of the current practical work and its subject;
2) Devices and equipment used in the practical work;
3) Important definitions and working formulas. The explanation of the quantities and the unit of measurements (SI);
4) Scheme (flow-chart) of the laboratory installation for the current practical work;
5) Table for recording the results of the measurements and calculus.

ANNOTATION:

- The required formula and figures (schemes) for each laboratory separately are indicated in the common requirements.
- After performing the laboratory work, the values of the studied measurements, the mean values, the errors and the conclusions must be written in the laboratory notebook.
- In order to better understand the material of the laboratory work and then to successfully complete the work, the student is encouraged to repeat and to know the answer to the questions for the repetition. The ignorance of the suggested material for repetition will be negatively appreciated.
- According to the questions from the paper and the questions for repetition, computer tests are performed in order to evaluate the achieved knowledge.

REFERENCIES:

1. „Practical papers of medical biophysics”, D. Croitoru, V. Vovc, N. Gubceac, V. Tonu, I. Cojocaru, 2015
2. „Medical Biophysics, Lectures, exercises” , D. Croitoru, 2014.

LABORATORY WORK № 1.

SUBJECT: VISCOSITY MEASUREMENT OF BIOLOGICAL LIQUIDS.

It is performed in the laboratory No. 5

Formula 5, Fig. 1.4, table of measurements.

t - to be determined with the accuracy of 0.1 s.

η - to be calculated with the accuracy of 0.01 cP.

QUESTIONS:

1. Define the notion of real fluids and ideal fluids.
2. Define the notion of viscosity, viscosity coefficient and its physical meaning.
3. Define the notion of kinematic viscosity coefficient and relative viscosity coefficient.
4. Define the concept of laminar flow and turbulent flow.
5. Explain the Newton's formula for viscosity.
6. The units of measurement for the viscosity coefficient in SI and medical practice. The correlation between them.
7. Poiseulle’s formula. Deduction of the formula for the viscosity coefficient by the relative method.
8. Stokes' formula. Deduction of the formula for the viscosity coefficient determination by the direct method.
9. Devices used to determine the viscosity.
10. Medical applications of the viscosity measurements.

LABORATORY WORK № 2.

SUBJECT: ULTRASOUNDS EFFECTS.

It is performed in the laboratory No. 4

Fig. 2.1 and 2.9

QUESTIONS:

1. Sound. The spectral diagram of the sound.
2. Ultrasound. Wave properties and characteristics (frequency, wavelength).
3. Ultrasound production based on the invers piezoelectric effect. The piezoelectric transducer.
4. Ultrasound production based on the magnetostrictive effect. The magnetostrictive transducer.
5. Ultrasound detection based on the direct piezoelectric effect.
6. Physical effects of ultrasound.
7. Biological effects of ultrasounds.
8. Doppler's effect. Doppler's effect applications in medicine.
9. Determination of the blood velocity by Doppler's effect.
10. Applications of the ultrasounds in medicine:
    a) the ultrasonic wave nebulizer (inhaler)
    b) emulsion formation by ultrasound
    c) ultrasonic cleaners etc.

LABORATORY WORK № 3.

SUBJECT: DETERMINATION OF THE SURFACE TENSION OF THE BIOLOGICAL LIQUIDS.

It is performed in the laboratory No. 3

Formula 5 and 6, Fig. 3.3 and 3.5, the table of measurements.

The force is measured with accuracy of 1dyn, 1dyn = 10^{-5} N.

The coefficient of superficial stress σ will be calculated with the precision of $0.1\frac{dyn}{cm}$, then it will be transformed to the SI system in $\frac{N}{m}$. Finally, the graph of the surface tension coefficient σ dependence on the solution concentration C must be plotted.

QUESTIONS:

1. Interaction between molecules at the liquid-gas interface. Surface tension phenomenon.
2. Surface tension force. Its point of application and orientation.
3. The coefficient of surface tension:
   a. Definition and physical meaning;
   b. The factors on which the coefficient of surface tension depends;
   c. Surface tension coefficient units of measurement in SI and medical practice. The correlation between them.
4. Capillary phenomena.
5. Laplace's pressure and the cause of its occurrence. Laplace's formula.
6. Gas embolism and its consequences.
7. Methods for determining the surface tension coefficient:
   a. stalagmometric method – drop weight method (the relative method); deduction of the working formula;
   b. Wilhelmy plate or du Noüy ring method (direct method); deduction of the working formula.
8. The importance of studying the phenomenon of surface tension for medical practice.

LABORATORY WORK № 4.

SUBJECT: CELL OSMOTIC PHENOMENA.

It is performed in the laboratory No. 4

Fig. 4.1 and 4.4

QUESTIONS:

1. The semipermeable membrane.
2. Definition of the osmosis phenomenon.
3. Definition of the osmotic pressure, units of measurement.
4. Osmosis laws (definitions and mathematical formulas):
   a) The law of temperatures for the osmotic pressure;
   b) The law of concentration for the osmotic pressure;
   c) Van't Hoff's law for the osmotic pressure;
   d) Dalton's law for the osmotic pressure of a mixture of solutions.
5. Isotonic, hypotonic and hypertonic solutions.
6. The method of measuring the osmotic pressure using the Dutrochet’s osmometer.
7. The method of measuring the osmotic pressure using the Beckman’s Cryoscope.
8. Turgescent, plasmolysis and hemolysis phenomena.
9. Dialysis phenomenon. Artificial kidney.
10. The importance of osmosis for medicine.

LABORATORY WORK № 5.

SUBJECT: DETERMINATION OF IONS MOBILITY BY THE ELECTROPHORESIS METHOD.

It is performed in the laboratory No. 5

Formula 1 and 8, Fig. 5.2, the table of measurements.

The mobility of ions M - to be calculated with the accuracy of 10-5 cm^2 / V s.

QUESTIONS:

1. Electrophoresis. Types of electrophoresis that differ according to the nature of the environment.

2. The mobility of a charged particle (or ion) in an environment under the action of an external electric field. The formula for ion mobility and its physical meaning.

4. The units of measurement of the mobility of a charged particle (or ion) in the SI and in medical practice.

5. The forces that acts on a charged spherical particle (or ion) in the electrophoresis process - the electric acceleration force F_e and the resistance Stokes force F_s. Mathematical formulas.

7. The mobility of an ion formula expressed by the size of the electrical charge, the particle radius and the viscosity of the environment in which it moves. Deduction of this formula.

8. Deduction of the mobility formula for an ion in an electrophoretic process.

9. Description of the electrophoresis apparatus and its main elements. Materials used to determine the mobility of an ion by the electrophoretic method.

11. The working procedure for the determination of ion mobility by electrophoretic method.

12. The use of the electrophoretic method in medicine and pharmacy:

a) electrophoretic separation of various components of the biological fluids (DNA, protein, antibiotics, vaccine analysis);

c) Galvanization.

13. What is the name of the picture obtained as a result of blood serum electrophoresis and what can be seen on it?

14. As a result of paper electrophoresis, the mobility of potassium ions M = 0.72 · 10-5 cm2 /(Vs). What does this value mean?