

ЛД-21 ИИ

**State budgetary educational institution of higher professional education
"NORTH-OSSETIAN STATE MEDICAL ACADEMY"
Ministry of Health Russian Federation**

Department of the Chemistry and Physics

**METHODOLOGICAL RECOMMENDATIONS
FOR PERFORMING INDEPENDENT WORK ON DISCIPLINE**

"PHYSICS, MATHEMATICS"

of the main professional educational program of higher education - specialty program in the
specialty 31.05.01 General Medicine

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The manual was developed in accordance with the requirements of the Federal State Educational Standards of Higher Education in the areas of preparation 31.05.01 "General Medicine" and contains teaching materials for laboratory studies in the discipline "Physics, Mathematics".

For students of medical faculty

Theme: "BASIC CONCEPTS OF MATHEMATICAL ANALYSIS"

1. Questions to check the initial (basic) level of knowledge:

1. Transformation of algebraic expressions.
2. Abbreviated multiplication formulas.
3. Logging. Potentiation.
4. Functional dependence.
5. Domain and function domain.
6. Elementary functions.
7. Limit and continuity of function.
8. Basic theorems on limits.

2. Aim:

The student should know: - Determination of the derivative of the function, geometric and physical meanings of the derivative - Derivatives of basic elementary functions - Definition of the differential function, geometric and analytical meanings of the differential - Understanding of indefinite and definite integral -Table main integrals -Properties of indefinite and definite integral -Newton-Leibniz formula -The concepts of an ordinary differential equation, general and particular solutions of a differential equation -Algorithm for solving a first-order differential equation with separable variables The student should be able to: -Calculate derivatives and differentials of functions - Calculate indefinite and definite integrals by various methods - to find the general and particular solution of differential equations with separable variables	Literature: 1. L.V. Kukhareno, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, "Medical and biological physics for medical students", Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. What are the physical and geometric meanings of the derivative?
2. What are the analytical and geometric meanings of the differential?
3. Give the definition of the differential function.
4. Find the derivative of the following functions:

$$1. \quad y = x \sin^{-1} x$$

$$4. \quad y = \sin^2(\ln 5x)$$

$$2. \quad y = x^2 \log_3 x$$

$$5. \quad y = \ln \tan \sqrt{1+x^5}$$

$$3. \quad y = \sqrt{\ln^3 x}$$

$$6. \quad y = \frac{\ln 4}{\sin x}$$

5. Find the differentials of the following functions:

$$1. \quad y = \frac{5x}{\ln 5x}$$

$$4. \quad y = \sqrt{x^4 + \sin^4 x}$$

$$2. \quad y = \tan(4x+1)^3$$

$$5. \quad y = e^{x^2}$$

$$3. \quad y = \ln(x + \sqrt{4+x^2})$$

$$6. \quad y = \frac{3}{x^4} + 5\sqrt[3]{x}$$

Theme: "ELEMENTS OF THEORY OF PROBABILITY"

1. Questions to check the initial (basic) level of knowledge:

1. The concept of the set.
2. Limit function.
3. Basic theorems on limits.

2. Aim:

The student should know: -statistical and classical definitions of probability -types of random events -main probability theorems -concept discrete and continuous random variable -the law of the distribution of random variables -formulas for the basic numerical characteristics of a discrete and continuous random variable - properties of the distribution function of a continuous random variable The student should be able to: -solve problems using the basic probability theorems - to find the main numerical characteristics of a random variable -find the probability of falling normally distributed random variable in a given interval	Literature: 1. L.V. Kukhareenko, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, "Medical and biological physics for medical students", Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. What is the main characteristic of a random event?
2. Write down the definition of a trial?
3. Write down the Bernoulli formula.
4. Write down the formula of classical definition of probability.
5. What formula is applied for finding the probability of the sum of two mutually exclusive events A and B?
6. What event is called impossible one?
7. What events are called mutually exclusive ones?

8. There are 3 white and 4 black balls in a box. 2 balls have been taken out of the box. Find the probability that both balls will be white.
9. There are 14 students in one group (6 of them are girls) and there are 11 students in second group (3 of them are boys). One student is invited to take part in a conference. What is the probability that it will be girl?
10. There are 3 children in family. The birth a girl and a boy is considered to be equally possible. Find out the probability of the fact that all children in the family are boys.
11. There are 30 students in the group. The marks for the control test were the following: 8 students received “excellent” marks, 12 students - “good” marks, 8 students – “satisfactory”. What is the probability that 3 students invited for answer have “good” marks?

**Theme: “BASES OF MATHEMATICAL STATISTICS.
STATISTICAL PROCESSING OF EXPERIMENTAL DATA »**

1. Questions to check the initial (basic) level of knowledge:

1. Random values.
2. The main numerical characteristics of a discrete random variable.
3. Basic numerical characteristics of a continuous random variable.
4. Normal distribution law.

2. Aim:

The student should know: - Definitions of statistical aggregate, general and selective statistical aggregate - Conceptual statistical discrete and interval series distribution - Point and interval estimates of the main numerical characteristics of the general population The student should be able to: - Build polygons and histograms of frequencies and relative frequencies - Find the point and interval estimates of the numerical characteristics of the population	Literature: 1. L.V. Kukhareno, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, “Medical and biological physics for medical students”, Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. What is called a statistical discrete series of distribution? statistical interval near distribution?
2. Write down the formulas for the general average, the sample average, the general variance, the corrected sample variance, the general standard deviation, the corrected selective standard deviation.
3. What is the interval estimate of a numerical characteristic?
4. To give a point estimate of the general variance for a given distribution of the sample size $n = 100$

X	125	127	128	130
M	26	20	30	24

Theme: "AUDIOMETRY"

1. Questions to check the initial (basic) level of knowledge:

1. Definition of sound.
2. Types of sounds: tones, noises, sound beats.
3. Pitch.
4. Volume of sound.
5. Timbre of sound.

2. Aim:

The student should know: -The concept of sound intensity -The concept of sound pressure -Subjective and objective sound characteristics - Understanding the pain threshold and hearing threshold -The Weber-Fechner Act - Units scale levels of volume and intensity -Sound research methods in the clinic: auscultation, percussion The student should be able to: -Using curves of equal loudness, find the correspondence between loudness and intensity at different frequencies -Explain the principle of the audiometer	Literature: 1. L.V. Kukhareenko, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, "Medical and biological physics for medical students", Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. What is called sound? List the types of sounds.
2. List the main subjective characteristics of a sound and indicate how they are related to objective characteristics.
 - 1).depends on
 - 2).depends on
 - 3).depends on
3. Draw the acoustic spectra of complex tone and noise.

4. Write down the Weber-Fechner law.

5. Fill in the missing information in the text below:

- The vowel sound has spectrum, and the consonant sound has spectrum.
- Percussion allows you to define internal organs.
- Bel is the unit of the level scale sound corresponding to the change in the level 10 times.

Theme: "PHYSICAL BASIS OF ULTRASOUND RESEARCH"

1. Questions to check the initial (basic) level of knowledge:

1. Types of sounds
2. Objective and subjective characteristics of sound, the relationship between them
3. Law of Weber-Fechner
4. Equation of a plane wave.
5. Energy and intensity of the wave. Umov Vector.

2. Aim:

The student should know: - Types of ultrasound sources and receivers -Main properties of ultrasonic waves -Application of the Doppler effect in medicine and pharmacy -Physical basis of ultrasonic echolocation - Use of ultrasound in medicine and pharmacy The student should be able to: - Explain the methods of obtaining ultrasound - Explain the use of ultrasound based on the Doppler effect	Literature: 1. L.V. Kukhareenko, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, "Medical and biological physics for medical students", Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. What is ultrasound?
2. Write the formula for the Doppler frequency shift.
3. What specific features does ultrasound have?
4. Describe the process of formation of cavitation. Where is this phenomenon used?
5. What is called the Doppler effect?
6. Determine the minimum frequency of ultrasonic waves in the premise of 8 periods, if in the study of bone it is required to distinguish a 2 mm crack, $c = 3500 \text{ m / s}$.

Theme: "DETERMINATION OF THE LIQUID VISCOSITY"

1. Questions to check the initial (basic) level of knowledge:

1. Aggregate state of matter.
2. The concept of diffusion.
3. Archimedes Law.
4. Formula for finding the volume of the ball.
5. The concept of the density of a substance.

2. Aim:

The student should know: - The physical nature of a viscous fluid - Newton's equation - units of viscosity - Definitions of Newton and non-Newtonian fluids - Laminar and turbulent flow concepts -Law of Hagen-Poiseuille - Methods for determining the viscosity of the liquid The student should be able to: -Graphically interpret laminar and turbulent fluid flow -Calculate Reynolds number - Explain the clinical method for determining fluid viscosity - Derive a formula for determining the coefficient of viscosity of a fluid according to the Stokes method	Literature: 1. L.V. Kukhareno, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, "Medical and biological physics for medical students", Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. What is called internal friction?
2. Write down Newton's equation for viscous flow.
3. What characterizes the velocity gradient?
4. In which units is the viscosity coefficient measured?
5. What characterizes the Reynolds number?
6. Write down the Hagen-Poiseuille formula.

Topic: "REFRACTOMETRY"

1. Questions to check the initial (basic) level of knowledge:

1. The laws of reflection and refraction of light.
2. Absolute and relative refractive indices of the medium.
3. The maximum angle of refraction.
4. The maximum angle of total reflection.
5. Dependence of the limiting angle of refraction and the total angle of reflection on the refractive indices.

2. Aim:

The student should know: -Phenomena occurring during the propagation of light from an optically more dense medium into an optically less dense -Phenomena occurring during the propagation of light from an optically less dense medium into an optically denser - Appointment, device and principle of operation of the refractometer The student should be able to: -Build the course of rays in transmitted and reflected light when determining the refractive index of a liquid using a refractometer - Explain the method of studying the dependence of the refractive index of the liquid on the concentration of the solution	Literature: 1. L.V. Kukhareenko, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, "Medical and biological physics for medical students", Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. Write the formulas of absolute and relative refractive indices.
2. What determines the limiting angle of refraction and the limiting angle of total reflection? The answer is confirmed by the formula.
3. What is the ultimate angle of refraction?
4. What angle is called the ultimate angle of total reflection?
5. Mark on Fig. 1 a) the limit angle of refraction and compare the refractive indices of the media n_1 and n_2 .

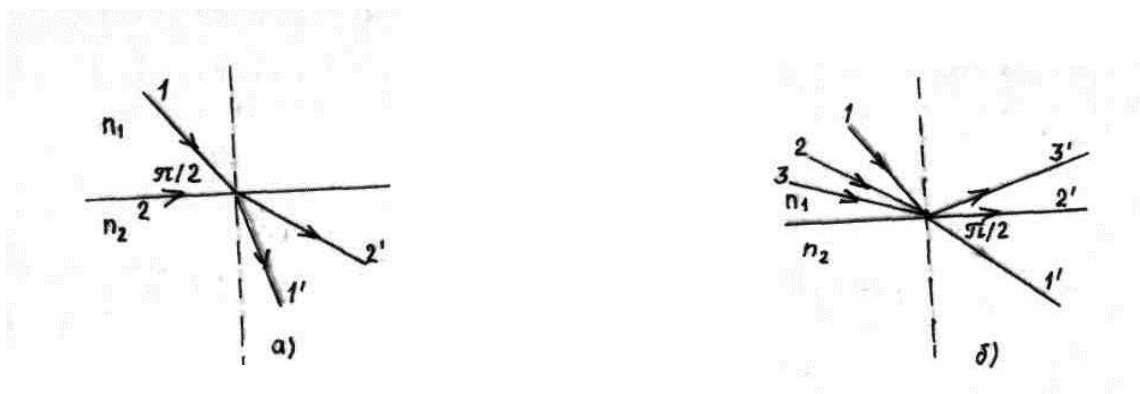


Fig. 1

6. Mark in Fig. 1 b) the limiting angle of total reflection and compare the refractive indices of the media n_1 and n_2 .

Theme: "PASSIVE ELECTRIC PROPERTIES OF TISSUES"

1. Questions to check the initial (basic) level of knowledge:

1. Constant electric current.
2. AC electric current.
3. Ohm's law for the chain section.
4. Ohm's law for a complete circuit.

2. Aim:

The student should know: -The concepts of active and reactive resistances in the AC circuit -Concept impedance in the AC circuit - Features of the electrical conductivity of living tissues - Physical basis of rheography -Equivalent circuits of body tissues The student should be able to: - Explain the frequency dependence of the impedance	Literature: 1. L.V. Kukhareenko, O.V. Nedzved, M.V. Goltsev, V.G. Leshchenko, "Medical and biological physics for medical students", Minsk BSMU 2016. 2. Materials of the guidelines.
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3. Tasks for independent work on the topic of study:

1. What is called alternating current?
2. What is called electrical conductivity?
3. What is the AC impedance called?
4. Write down the formula of the generalized Ohm's law.
5. What is the equivalent circuit model for living tissue?
6. Write expressions for ohmic, inductive, and capacitive impedances.
7. Draw a graph of muscle impedance versus frequency.