

Документ подписан простой электронной подписью

Информация о владельце:

ФИО: Сухинин Александр Александрович

Должность: Проректор по учебно-воспитательной работе

Дата подписания: 26.06.2026 10:08:25

Уникальный программный ключ:

e0eb125161f4cee9ef898b5de88f5c7dcefdc28a

Abstract of the discipline's work program

B1.O.13 "Biological Physics"

for training specialists in the field of training

36.05.01 Veterinary Medicine

Profile: «General clinical veterinary medicine»

The purpose of mastering the discipline: the main goal of the discipline is the formation of ideas, concepts, knowledge about the fundamental laws of classical and modern physics, the application of the laws of physics in the description of processes occurring in biological objects, the acquisition of skills in the use of physical measurement and research methods in professional activities.

Place of discipline in the curriculum: Discipline B1.O.13 "Biological Physics" is a discipline in Block 1 of the mandatory part of the federal state educational standard of higher education in specialty 36.05.01 "Veterinary Medicine" (specialty level).

The discipline is mastered in the 2nd semester of full-time study.

Requirements for the results of mastering the discipline: as a result of mastering the discipline, the following competencies are formed: GPC-4

GPC-4Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:

GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;

GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;

GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.

Brief content of the discipline:

History of the formation and development of "Biological physics" as a science. Biomechanic Introduction to biomechanics: Laws of mechanics, levers and rotational motion in living organisms. Properties of solids and biological tissues. Introduction to bioacoustics. Bioacoustics: hearing transduction. Infra-sound.

Thermodynamics of biological processes. An organism as an open thermodynamic system. Stationary state of biological systems. Prigogine's equation for an open system.

Hydrodynamics and hemodynamics. Energy of blood circulation. Hemodynamics: Physical properties of blood, patterns of blood movement through the vascular system. The heart as a mechanical system. Methods for measuring blood pressure.

Optics. Path of light rays in a microscope. Magnification and resolution of the microscope. The structure of the eye, features of vision. Photometry. Basic definitions and laws of photometry. Photometric quantities and units of measurement. Thermal radiation. Thermal radiation and physical quantities characterizing it: emissive and absorptive abilities. The influence of thermal radiation on a living organism.

The effect of direct and alternating electric current on a living organism, the effect of a constant magnetic field on the body of mammals, electrography methods.

X-ray spectra. Bremsstrahlung and characteristic X-rays, absorption of X-rays by matter. Application of X-ray radiation in medicine and veterinary medicine.

Ionizing radiation. Biological effects of ionizing radiation. Dosimetry. Application of isotope analysis.

The total labor intensity of the discipline is: 3 credit units (108 hours).

Final control of the discipline: test, test with assessment.

Ministry of Agriculture of the Russian Federation
Federal State Budgetary Educational Institution of
Higher Education
"St. Petersburg State University of Veterinary Medicine"



APPROVED BY
Vice-Rector
for educational work
and youth policy
A.A. Sukhinin
April 10, 2026

Department of Inorganic Chemistry and Biophysics

WORKING PROGRAMM

by discipline

BIOLOGICAL PHYSICS

Level of higher education

SPECIALTY

Specialty 36.05.01 Veterinary Medicine

Profile: «General clinical veterinary medicine»

Full-time education

Education starts in 2026

Reviewed and accepted
at a department meeting
on March 18, 2026
Protocol No. 08-03-25/26

Head department of
Inorganic Chemistry and Biophysics
Candidate of Chemical Sciences, Associate Professor
A.N. Baryshev

Saint Petersburg
2026

1. GOALS AND OBJECTIVES OF DISCIPLINE

The main goal of the discipline is the formation of ideas, concepts, knowledge about the fundamental laws of classical and modern physics, the application of these laws in the description of processes occurring in biological objects, the acquisition of skills in the use of physical measurement and research methods in professional activities.

To achieve this goal, it is necessary to solve the following tasks:

- the general educational task is study of the laws of mechanics, thermodynamics, electromagnetism, optics and nuclear physics as applied to biological objects;
- the application task is mastering laboratory research methods;
- the special task is to developing skills in applying the laws of physics to biological objects.

2. LIST OF PLANNED LEARNING RESULTS IN THE DISCIPLINE (MODULE), CORRELATED WITH THE PLANNED RESULTS OF MASTERING THE EDUCATIONAL PROGRAM

As a result of mastering the discipline, the student prepares for the following types of activities, in accordance with the educational standard of Federal State Educational Standard of Higher Education 36.05.01 "Veterinary Medicine".

Area of professional activity:

13 Agriculture

Student competencies formed as a result of mastering the discipline

Studying the discipline should form the following competencies:

a) general professional competencies (GPC):

GPC-4 Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:

GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;

GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;

GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.

3. THE PLACE OF DISCIPLINE IN THE STRUCTURE OF THE MPEP

Discipline B1.O.13 "Biological Physics" is a discipline in Block 1 of the mandatory part of the federal state educational standard of higher education in specialty 36.05.01 "Veterinary Medicine" (specialty level).

The discipline is mastered in the 2nd semester of full-time and part-time courses and in the 2nd year of correspondence courses.

To study the course "Biological Physics" at a university, a student must know the basics of algebra, geometry and trigonometry, biology, and know the formulations of basic physical laws. Be able to perform mathematical calculations when solving physical problems and be competent in reading and plotting graphs of physical processes. The previous disciplines on which "Biological Physics" is based are: school course of physics, mathematics and biology, higher mathematics, vector algebra.

The course "Biological Physics" is basic for all areas of veterinary education; it allows students to gain in-depth knowledge of basic physical phenomena, fundamental laws of classical and modern physics and biophysics, skills for successful professional activity and continued professional education in a master's degree.

The discipline is prior to the following disciplines:

1. Physiology and ethology of animals;
2. Animal Anatomy;
3. Pathological physiology;

4. Animal hygiene;
5. Veterinary and sanitary examination.

4. SCOPE OF DISCIPLINE “BIOLOGICAL PHYSICS”

4.1.SCOPE OF THE DISCIPLINE “BIOLOGICAL PHYSICS” FOR FULL-TIME STUDY

Type of educational work	Total hours	Semester
		2
Auditory lessons (Total)	52	52
Including:		
Lectures, including interactive forms	18	18
Practical lessons (PL), including interactive forms, including:	34	34
practical training (PT)	6	6
Independent work (Total)	56	56
Type of intermediate certification (test with grade)	test with grade	test with grade
Total labor intensity hours/credits	108/3	108/3

5.1. CONTENT OF THE DISCIPLINE "BIOLOGICAL PHYSICS" FOR FULL-TIME STUDIES

N O.	Name	Formed competencies	Semester	Types of educational work, including independent work of students and labor intensity (in hours)			
				L	PL	PT	IW
1.	History of the formation and development of "Biological physics" as a science. Biomechanics Introduction to biomechanics Mechanical properties of solids and biological tissues. Introduction to bioacoustics.	<p>GPC-4 Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:</p> <p>GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;</p> <p>GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;</p> <p>GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.</p>	2	4	6	12	
2.	Hydrodynamics and hemodynamics. Thermodynamics of biological processes.	<p>GPC-4 Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:</p> <p>GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;</p> <p>GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;</p> <p>GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.</p>	2	8	8	2	24
3.	Optics. Path of light rays in a microscope. Magnification and resolution of the microscope. The structure of the eye, features of vision. Photometry. Thermal radiation. Application of X-ray radiation in medicine and veterinary medicine.	<p>GPC-4 Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:</p> <p>GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;</p> <p>GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;</p> <p>GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.</p>	2	4	8	2	12

4.	Ionizing radiation. Biological effects of ionizing radiation. Dosimetry. Application of isotope analysis.	<p>GPC-4Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:</p> <p>GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;</p> <p>GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;</p> <p>GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.</p>	2	2	6	2	8
TOTAL FOR 2ND SEMESTER			18	28	6		56

6. LIST OF EDUCATIONAL AND METHODOLOGICAL SUPPORT FOR INDEPENDENT WORK OF STUDENTS

6.1. Guidelines for independent work

1. Methods of computational and graphical processing of experimental data in biological physics Educational and methodological manual / Krushelnitsky A.N., Skvortsov D.A., Chistyakova O.V., Karulina O.A.: - St. Petersburg, Publishing House SPbGAVM, 2019. — 41 s

6.2. Literature for independent work

1. Methods of computational and graphical processing of experimental data in biological physics : an educational and methodical manual / E. A. Karulina, A. N. Krushelnitsky, D. A. Skvortsov [et al.] ; Ministry of Agriculture of the Russian Federation, SPbGAVM. - Saint Petersburg : SPbGAVM, 2019. - 60 p. - Access mode: for authors. EB SPbGUVUM users. — URL: <https://search.spbguvum.informsistema.ru/viewer.jsp?aWQ9NDQ4JnBzPTYw> (date of request: 18.03.2026) - Text : electronic.

7. LIST OF BASIC AND ADDITIONAL LITERATURE REQUIRED FOR MASTERING THE DISCIPLINE

a) basic literature:

1. Ivanov, S. A., Mechanics. Molecular physics and thermodynamics: textbook / S. A. Ivanov, A. E. Ivanov. — Moscow: KnoRus, 2024. — 950 p. — ISBN 978-5-406-13459-7. — URL: <https://book.ru/book/954637> (date of request: 18.03.2026). — Text: electronic.

b) additional literature:

1. Rubin, A.B. Practicum on Biophysics: at 2 p.m. 2nd ed. / A.B. Rubin, G.V. Maksimov; edited by S.M. Remennikov — Moscow : Laboratory of Knowledge, 2025. — 511 p. — ISBN 978-5-93208-817-3. — URL: <https://book.ru/book/957118> (date of request: 18.03.2026). — Text: electronic.

8. LIST OF RESOURCES OF THE INTERNET INFORMATION AND TELECOMMUNICATION NETWORK NECESSARY FOR MASTERING THE DISCIPLINE

To prepare for practical classes and perform independent work, students can use the following Internet resources:

1. <https://meduniver.com> – Medical information site.
2. Science is a journal published by the American Association for the Advancement of Science-<http://www.sciencemag.org/content/by/year>
3. Annual Reviews - annual scientific reviews -<http://www.annualreviews.org/action/showJournals>
4. <http://www.nkj.ru/>- journal “Science and Life” (open access)
5. <http://www.inauka.ru/>- popular science newspaper “Izvestia Nauki” (open access)<http://www.science.ru/>- website “Science in Russia” (open access)

Electronic library systems:

1. [EBS "SPBGUVM"](#)
2. [University information system "RUSSIA"](#)
3. [Full text database POLPRED.COM](#)
4. [Scientific electronic library ELIBRARY.RU](#)
5. [Russian Scientific Network](#)
6. [Electronic library system IQlib](#)
7. [Web of Science International Science Citation Index Database](#)
8. Full-text interdisciplinary database for agricultural and environmental sciences ProQuest [AGRICULTURAL AND ENVIRONMENTAL SCIENCE DATABASE](#)

9. Electronic books from the publishing house "Prospekt Nauki"
<http://prospektnauki.ru/ebooks/>

10. Collection "Agriculture. Veterinary" publishing house "Kvadro"
<http://www.iprbookshop.ru/586.html>

9. METHODOLOGICAL INSTRUCTIONS FOR STUDENTS ON MASTERING THE DISCIPLINE

Methodological recommendations for students are a set of recommendations and explanations that allow the student to optimally organize the process of studying this discipline. The content of methodological recommendations, as a rule, may include the following information.

- Tips for planning and organizing the time needed to study the discipline. Description of the sequence of student actions, or "scenario for studying the discipline."

The morning time is the most fruitful for academic work (from 8 to 14 o'clock), followed by the afternoon (from 16 to 19 o'clock) and evening time (from 20 to 23 o'clock). The most difficult material is recommended to be studied at the beginning of each time interval after rest. After 1.5 hours of work, a break (10-15 minutes) is required; after 4 hours of work, the break should be 1 hour. Part of the scientific organization of labor is mastering the technique of mental work. Normally, a student should devote about 10 hours a day to studying (6 hours at the university, 4 hours at home).

- Recommendations for working on lecture material

When preparing for a lecture, the student is recommended to:

- 1) review the recordings of the previous lecture and recall previously studied material in memory;
- 2) it is useful to review the upcoming material of the future lecture;
- 3) if independent study of individual fragments of the topic of the last lecture is assigned, then it must be completed without delay;
- 4) prepare yourself psychologically for the lecture.

This work includes two main stages: taking notes of lectures and subsequent work on lecture material.

Note-taking means drawing up notes, i.e. a brief written statement of the content of something (oral presentation - speech, lecture, report, etc. or a written source - document, article, book, etc.).

The method of work when taking notes on oral presentations differs significantly from the method of work when taking notes from written sources.

By taking notes from written sources, the student has the opportunity to repeatedly read the desired passage of text, reflect on it, highlight the main thoughts of the author, briefly formulate them, and then write them down. If necessary, he can also note his attitude to this point of view. While listening to a lecture, the student must put off most of the above-mentioned work for another time, trying to use every minute to record the lecture, and not to comprehend it - there is no time left for this. Therefore, when taking notes from a lecture, it is recommended to separate fields on each page for subsequent entries in addition to the notes.

After recording a lecture or taking notes, you should not leave work on the lecture material until you begin preparing for the test. It is necessary to do as early as possible the work that accompanies note-taking of written sources and which was not possible to do while recording the lecture - read your notes, deciphering individual abbreviations, analyze the text, establish logical connections between its elements, in some cases show them graphically, highlight main thoughts, note issues that require additional processing, in particular, teacher consultation.

When working on the text of a lecture, the student needs to pay special attention to the problematic questions posed by the teacher when giving the lecture, as well as to his assignments and recommendations.

For each lecture, practical lesson and laboratory work, the number, topic, list of issues covered, volume in hours and links to recommended literature are provided. For classes conducted

in interactive forms, their organizational form must be indicated: computer simulation, business or role-playing game, analysis of a specific situation, etc.

- Recommendations for preparing for practical classes.

Practical (seminar) classes constitute an important part of students' professional training. The main goal of conducting practical (seminar) classes is to develop analytical, creative thinking in students by acquiring practical skills. Practical classes are also conducted with the aim of deepening and consolidating the knowledge gained at lectures and in the process of independent work on regulatory documents, educational and scientific literature. When preparing for a practical lesson for students, it is necessary to study or repeat theoretical material on a given topic.

When preparing for a practical lesson, the student is recommended to adhere to the following algorithm;

- 1) get acquainted with the plan of the upcoming lesson;
- 2) study the literature sources that were recommended and familiarize yourself with the introductory comments to the relevant sections.

Methodological instructions for practical (seminar) classes in the discipline, along with the work program and schedule of the educational process, refer to methodological documents that determine the level of organization and quality of the educational process.

The content of practical (seminar) classes is recorded in the working curriculum of the disciplines in the sections "List of topics for practical (seminar) classes."

The most important component of any form of practical training is assignments. The basis of the assignment is an example, which is analyzed from the perspective of the theory developed in the lecture. As a rule, the main attention is paid to the formation of specific skills and abilities, which determines the content of students' activities - problem solving, laboratory work, clarification of the categories and concepts of science, which are a prerequisite for correct thinking and speech.

Practical (seminar) classes perform the following tasks:

- stimulate regular study of recommended literature, as well as attentive attention to the lecture course;
- consolidate the knowledge gained in the process of lecture training and independent work on literature;
- expand the scope of professionally significant knowledge, skills and abilities;
- allow you to check the correctness of previously acquired knowledge;
- instill skills of independent thinking and oral presentation;
- promote free use of terminology;
- provide the teacher with the opportunity to systematically monitor the level of students' independent work.

Methodological instructions for practical (seminar and laboratory) classes in the discipline should be focused on modern economic conditions, current regulatory documents, advanced technologies, on the latest achievements of science, technology and practice, on modern ideas about certain phenomena and the reality being studied.

Practical (laboratory work) constitutes an important part of students' professional training. They are aimed at experimental confirmation of theoretical principles and the formation of educational and professional practical skills.

Students' performance of laboratory work is aimed at:

- generalization, systematization, deepening, consolidation of acquired theoretical knowledge on specific topics of disciplines;
- formation of necessary professional skills and abilities;

The disciplines for which laboratory work is planned and their volumes are determined by the working curriculum.

Guidelines for conducting practical (laboratory work) are developed for the duration of the working curriculum and include:

- title, which indicates the type of work (laboratory), its serial number, volume in hours and name;

- Objective;
- subject and content of the work;
- equipment, technical means, tools;
- order (sequence) of work execution;
- safety and labor protection rules for this work (if necessary);
- general rules for the design of work;
- Control questions;
- tasks;
- list of references (if necessary).
- Explanations about working with test materials for the course, recommendations for completing homework.

Testing is a check that allows, by performing a specially selected set of tests, to determine whether the actual result obtained corresponds to the expected mastery of the program. A test is the fulfillment of certain conditions and actions necessary to verify the operation of the function being tested or its part. Each question in the discipline must be answered correctly by choosing one option.

10. EDUCATIONAL WORK

As part of the implementation of the discipline, educational work is carried out to form a modern scientific worldview and a system of basic values, the formation and development of spiritual, moral, civil and patriotic values, a system of aesthetic and ethical knowledge and values, attitudes of tolerant consciousness in society, the formation in students of the need to work as the first vital necessity, the highest value and the main way to achieve success in life, to understand the social significance of your future profession.

11. LIST OF INFORMATION TECHNOLOGIES USED IN THE EDUCATIONAL PROCESS

11.1. The educational process in the discipline provides for the use of information technologies:

- ✓ conducting practical classes using multimedia;
- ✓ interactive technologies (conducting dialogues, collective discussion of various approaches to solving a particular educational and professional problem);
- ✓ interaction with students via email;
- ✓ collaboration in the Electronic Information and Educational Environment SPbSUVM: <https://spbguv.ru/academy/eios/>
- ✓

11.2. Software

List of licensed and freely distributed software, including domestically produced ones

No.	Name of technical and computer training aids recommended by sections and topics of the program	License
1	MS PowerPoint	67580828
2	LibreOffice	free software
3	OS Alt Education 8	AAO.0022.00
4	ABIS "MARK-SQL"	02102014155
5	MS Windows 10	67580828
6	System ConsultantPlus	503/KL
7	Android OS	free software

12. MATERIAL AND TECHNICAL BASE REQUIRED FOR THE IMPLEMENTATION OF THE EDUCATIONAL PROCESS IN THE DISCIPLINE

Name of the discipline (module), practice in accordance with the curriculum	Name of special premises and premises for independent work	Equipping special rooms and rooms for independent work
Biological physics	103 (196084, St. Petersburg, Chernigovskaya str., building 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification	<p><i>Specialized furniture:</i> desks, chairs, stools, blackboard, multimedia equipment.</p> <p><i>Laboratory equipment and educational materials :</i> refractometers, polarimeters, lasers, calorimeters, laboratory tables and screw stools, colored and neutral glass filters, calipers, micrometers, posters on sections of anatomy.</p>
	104 (196084, St. Petersburg, Chernigovskaya str., building 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification	<p><i>Specialized furniture:</i> desks, chairs, stools, blackboard, multimedia equipment.</p> <p><i>Laboratory equipment and educational materials:</i> refractometers, polarimeters, lasers, calorimeters, laboratory tables and screw stools, colored and neutral glass filters, calipers, micrometers, posters on sections of anatomy.</p>
	107 (196084, St. Petersburg, Chernigovskaya str., building 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification	<p><i>Specialized furniture:</i> desks, chairs, stools, blackboard, multimedia equipment.</p> <p><i>Laboratory equipment and educational materials :</i> refractometers, polarimeters, lasers, calorimeters, laboratory tables and screw stools, colored and neutral glass filters, calipers, micrometers, posters on sections of anatomy.</p>
	206 Large reading room (196084, St. Petersburg, Chernigovskaya str., building 5) Room for independent work	<p><i>Specialized furniture:</i> tables, chairs</p> <p><i>Technical training aids :</i> computers with an Internet connection and access to the electronic information and educational environment</p>
	214 Small reading room (196084, St. Petersburg, Chernigovskaya str., building 5) Room for independent work	<p><i>Specialized furniture:</i> tables, chairs</p> <p><i>Technical training aids:</i> computers with an Internet connection and access to the electronic information and educational environment</p>
	324 Department of Information Technologies (196084, St. Petersburg, Chernigovskaya str., building 5) Room for storage and preventive maintenance of educational equipment	<p><i>Specialized furniture:</i> tables, chairs, special equipment, materials and spare parts for preventive maintenance of educational equipment</p>

Annex 1 on 26 pages

Developer:

Head of the department, associate professor



A.N. Baryshev

Ministry of Agriculture of the Russian Federation
Federal State Budgetary Educational Institution
higher education
"St. Petersburg State University of Veterinary Medicine"

Department of Inorganic Chemistry and Biophysics

FUND OF ASSESMENT TOOLS
for the discipline

for discipline

"BIOLOGICAL PHYSICS"

Level of higher education

SPECIALTY

Specialty 36.05.01 Veterinary Medicine

Profile: «General clinical veterinary medicine»

Full-time education

Education starts in 2026

Saint Petersburg
2026

1. PASSPORT OF THE ASSESSMENT FUND

Table 1

No	Molded competencies	Controlled sections (topics) disciplines	Evaluation tool
1.	<p>GPC-4Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:</p> <p>GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;</p> <p>GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;</p> <p>GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.</p>	Section 1. Biomechanics	Tests, colloquium, test.
2.		Section 2. Hydrodynamics and hemodynamics. Thermodynamics of biological systems	Tests, colloquium, test.
3.		Section 3. Optics.	Tests, colloquium, test.
4.		Section 4 Ionizing radiation.	Tests, colloquium, test.

2. Approximate list of assessment tools

table 2

No	Name evaluation tool	Brief description of the evaluation tool	Presentation of the assessment tool in the fund
1.	Colloquium	A means of monitoring the assimilation of educational material of a topic, section or sections of a discipline, organized as a training session in the form of an interview between a teacher and students	Questions on topics/sections of the discipline
2.	Test	A system of standardized tasks that allows you to automate the procedure for measuring the level of knowledge and skills of a student	Fund of test and control tasks
3	Test	A tool for testing the ability to apply acquired knowledge to solve problems of a certain type on a topic or section	Set of control tasks for options

3. INDICATORS AND CRITERIA FOR ASSESSING COMPETENCIES AT VARIOUS STAGES OF THEIR FORMATION, DESCRIPTION OF ASSESSMENT SCALES

Table 3

Planned results of mastering the competency	Mastery level			Evaluation tool	
	unsatisfactory	satisfactorily	Fine		Great
<p>GPC-4Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:</p>					
GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;	Knowledge level below minimum requirements, had the place is rude errors	Minimum acceptable knowledge level, a lot was allowed minor mistakes	Level of knowledge in volume, appropriate program preparation, admitted a few rough ones errors	Level of knowledge in volume, appropriate program preparation, without errors.	Colloquium, tests, work
GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;	When deciding standard tasks Not basic skills demonstrated, there were rough errors	The main skills, solved typical tasks with not rude mistakes, all completed tasks, but not in full	All the main ones are demonstrated skills, all solved main tasks with not rude mistakes, all completed assignments in full volume, but some with shortcomings	All the main ones are demonstrated skills, all solved main tasks with separate insignificant shortcomings, all completed assignments in full volume	Colloquium, tests, work
GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.	When deciding standard tasks Not demonstrated basic skills there were rough errors	Available minimum set skills for solutions standard tasks with some shortcomings	Basic skills demonstrated when deciding standard tasks with some shortcomings	Demonstrated skills in decision non-standard tasks without errors and shortcomings	Colloquium, tests, work

4. LIST OF CHECK TASKS AND OTHER MATERIALS REQUIRED FOR THE ASSESSMENT OF KNOWLEDGE, ABILITIES, SKILLS AND ACTIVITY EXPERIENCE

4.1. Typical tasks for ongoing progress monitoring

Formed competence:

GPC-4 Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:

4.1.1. Questions for the colloquium

GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;

1. What types of viscometers do you know (their main differences)?
2. Physical foundations of sound research methods in medicine.
3. Infrasound (frequency range, physical properties). Infrasound sources.
4. Infrasound. Application of infrasound.
5. What does the term "laser" mean?
6. How does laser radiation differ from ordinary light?
7. Give the basic properties of laser radiation.
8. Give a classification of lasers.
9. How to get the inverse population of levels?
10. Explain what spontaneous emission is?
11. Explain what stimulated emission is?
12. Difference between spontaneous and forced transitions.
13. Tell us, what is the operating principle of the laser based on?
14. Explain what the term "population inversion" means?
15. Feedback as it is carried out in lasers. The role of the optical cavity in lasers.
16. Infrared radiation, its absorption. Ultraviolet radiation. Name the zones of ultraviolet radiation depending on their biological action.
17. What is the photoelectric effect? Laws of the Stoletov photoelectric effect. Einstein's photoelectric effect equation
18. X-ray radiation (definition). Method for producing x-ray radiation.
19. Radioactivity. Types of radioactive radiation. Law of radioactive decay.
20. Dosimetry.

GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;

21. Application of ultrasound in veterinary medicine.
22. The heart as a mechanical system.
23. What is the reason for its therapeutic effect? What is thermography?
24. Methods of protection against infrasound.
25. Why is the thermal effect of significant importance in characterizing damage to biological tissues under the influence of radiation in the red and infrared regions of the spectrum?
26. List the groups of biological effects that occur when exposed to laser radiation on the human body.
27. Give examples of the use of laser radiation in veterinary medicine and medicine.
28. The use of a mixture of two gases in a helium-neon laser - helium and neon. The role of each of them.
29. What related factors of laser radiation do you know?

30. Efficiency of a heat engine. Carnot's theorems.

GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.

31. Levers in biomechanics (types of levers, moment equation, examples of levers in living organisms).
32. Mechanical properties of biological tissues (Hooke's law, types of deformations, elastic properties of various types of tissues of living organisms).
33. Oscillations in biophysics (oscillations of the human body, center of mass, changes in the center of mass during various types of movement).
34. Bioacoustics. Physical (objective) characteristics of sound.
35. Bioacoustics. Physiological (subjective) characteristics of sound.
36. Sound transduction in mammals (using the example of the human hearing system).
37. Thermodynamic parameters and processes. First law of thermodynamics.
38. Second law of thermodynamics, formulation and recording.
39. Thermodynamic features of biological systems.
40. The first law of thermodynamics in biology. Hess's law.
41. The second law of thermodynamics in biology, features of the thermodynamics of open systems.
42. Reduced amount of heat. Entropy. Clausius inequality.

4.1.2. Test topics for assessing competencies

GPC-4Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:

GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;

GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;

GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.

1.

- Ultrasound. Methods for obtaining ultrasound.

- When the temperature of the environment surrounding the membrane changes, the diffusion coefficient will increase by 3 times. Will the permeability of the membrane change?

2.

- Reflection and absorption of ultrasonic waves by biological tissues, acoustic impedance. Principles of the use of ultrasound in the diagnosis and treatment of animals in the practice of a veterinarian.

- The concentration of potassium ions (K^+) on the outer side of the membrane is 10 mol/l, on the inner side - 20 mol/l. Will the flow of a substance through the membrane change if, other things being equal, the concentration of potassium ions on the outer and inner sides of the membrane increases 4 times?

3.

- Assessment of the effect of electromagnetic radiation of various ranges on biological objects, its physical mechanisms.
 - What is the difference in formamide concentrations at the initial moment of time, if the flux density of formamide through a plasma membrane 10 nm thick is $10.08 \text{ Kmol/m}^2 \cdot \text{s}$. The diffusion coefficient of this substance is $0.7 \cdot 10^{-4} \text{ m}^2/\text{s}$.
- 4.
- The use of electromagnetic radiation in veterinary practice.
 - What is the Young's modulus of a tendon with a length of 0.12 m and a cross-sectional area of 2 mm^2 if under the action of a force of 68.8 N it lengthens by 2.9 mm?
- 5.
- Mechanical properties of biological tissues (Hooke's law, types of deformations, elastic properties of various types of tissues of living organisms).
 - What is the Young's modulus of a tendon with a length of 0.12 m and a cross-sectional area of 2 mm^2 if under the action of a force of 68.8 N it lengthens by 2.9 mm?
- 6.
- Using knowledge of the biophysical characteristics of living tissues in veterinary practice.
 - How many times is the relative elongation of the artery greater than the vein, with the same stress in them, if the modulus of elasticity of the artery is $5 \cdot 10^4 \text{ Pa}$, and the modulus of elasticity of the vein is $8.5 \cdot 10^5 \text{ Pa}$?
- 7.
- Infrasound as one of the mechanisms of sound emission in the animal world. Biological effect of infrasound on animals. Sources of infrasound in nature.
 - What mechanical stress occurs in the vessel walls at an average arterial pressure of 11 kPa, if the ratio of the radius of the lumen to the thickness of the vessel wall is 6?
- 8.
- Application of infrasound in veterinary medicine. Methods of protection against infrasound.
 - What is the permissible maximum force that causes compressive deformation of the femur of a weightlifter weighing 80 kg when lifting a barbell, if the diameter of the femur is 30 mm, and the permissible stress is $15 \cdot 10^7 \text{ Pa}$ and $g = 10 \text{ m/s}^2$?
- 9.
- Evidence of the applicability of the second law of thermodynamics to biosystems. I. Prigogine's theorem and the direction of the evolution of biosystems.
 - What is the effective cross-sectional area of the bone if compression with a force of 1800 N causes a relative deformation of $3 \cdot 10^{-4}$, and the modulus of elasticity of the bone is $2 \cdot 10^9 \text{ Pa}$?
- 10.
- Mechanism of action of ionizing radiation on animals Dosimetry
 - How many times is the relative elongation of the muscle greater than the tendon, with the same tension in them, if the elastic modulus of the muscle is 0.9 MPa, and the elastic modulus of the tendon is $1.6 \cdot 10^8 \text{ Pa}$?
- 11.
- Main types of radiometric and dosimetric instruments.
 - What is the tone of the vessel if the ratio of the radius of the lumen to the thickness of the vessel wall is 5, and the difference between the mean arterial pressure and the external tissue is 4 kPa?
- 12.
- Methods of clinical and laboratory research for radiation injuries in animals.
 - What force is required to fracture by compression a femur with a diameter of 30 mm if the tensile strength of the bone is $1.4 \cdot 10^8 \text{ Pa}$?
- 13.
- Development of ideas about the structure of biomembranes (from living to artificial); types of membrane models, the importance of this knowledge in the practice of a veterinarian.

- The optical powers of the lenses are 5 diopters and 8 diopters. Determine what their focal lengths are?

14.

- Various types of luminescence. Photoluminescence of solids and liquids. Stokes rule. Vavilov's law.

- What will be the relative index of refraction of the two media if the angle of incidence is 60° and the angle between the reflected and refracted rays is 90° ?

15.

- Quantum mechanism of luminescence. Bioluminescence. Luminescent analysis.
- What will be the refractive index of the second medium relative to the first if, when light passes from the first medium to the second, the angle of refraction is 30° , and the angle of incidence is 2 times greater?

16.

- Spectral analysis. Bouguer's and Beer's laws. Colorimetric method. Photoelectric colorimeter.
- In the laboratory, when studying the properties of an artificial membrane, it was found that the flow of a substance through a membrane with an area of 2 square centimeters is 0.02 mol/s. Calculate the diffusion coefficient of a substance for this membrane if the concentration gradient is 10^4 mol/m^4 ?

17.

- Optical quantum generators (lasers). Classification. Physical and biological properties of laser radiation. Laser radiation in biological research, medicine and veterinary medicine.
- What is the flux density of formamide through the plasma membrane of Characera topophylla 8 nm thick, if the diffusion coefficient of this substance is $0.7 \cdot 10^{-4} \text{ m}^2/\text{s}$, the concentration of formamide at the initial time outside was equal to 0.2 mol/m^3 , and inside 10 times less?

18.

- Thermodynamic coupling of exergonic and endergonic stages of bioprocesses; give examples.
- Find the permeability coefficient of the Mycoplasma plasma membrane for formamide, with a difference in the concentrations of this substance inside and outside the membrane equal to $0.5 \cdot 10^{-4} \text{ mol/l}$, its flux density through the membrane is $6 \cdot 10^{-4} \text{ mol cm}^2/\text{s}$:

4.1.3. Test tasks for assessing competencies

GPC-4Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:

GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity

CLOSED TYPE TASKS

Tasks of a combined type with the choice of one correct answer from the proposed options

Task 1.

Read the task and choose the correct answer.

Find the minimum wavelength in the spectrum of bremsstrahlung X-rays if the voltage in the X-ray tube $U = 2 \text{ kV}$?

- 1) 2.46 nm
- 2) 0.615 nm
- 3) 3.25 nm
- 4) 0.018 nm
- 5) 9.72 nm

Write down the number under which the correct answer is indicated.

Answer: 2

Task 2.

Read the task and choose the correct answer.

Will the X-ray flux change if, without changing the voltage, the current in the X-ray tube is increased by 10 times?

- 1) Will increase 100 times
- 2) Will increase 10 times
- 3) Will decrease by 100 times
- 4) Will decrease by 10 times

Write down the number under which the correct answer is indicated.

Answer: 3

Task 3.

Read the task and choose the correct answer.

100 g of tissue absorbs 15×10^{11} beta particles with an energy of 1.5×10^{-15} J each. Determine the absorbed dose of radiation.

- 1) $22.5 \cdot 10^{-3}$ J/kg
- 2) $19.6 \cdot 10^{-3}$ J/kg
- 3) $4.5 \cdot 10^{-3}$ J/kg
- 4) $22.5 \cdot 10^{-5}$ J/kg
- 5) $45 \cdot 10^{-3}$ J/kg

Write down the number under which the correct answer is indicated.

Answer: 1

Tasks of a combined type with a choice of several correct answers from the proposed options

Task 4.

Read the task, choose the correct answers.

How are viscoelastic properties of biological tissues modeled?

- 1) Systems consisting of various combinations of a spring (elastic element) and a piston (viscous element);
- 2) Systems consisting of a spring (elastic element) and a piston (viscous element) connected in series;
- 3) Systems consisting of a spring (elastic element) and a piston (viscous element) connected in parallel;
- 4) Systems consisting of combinations of springs (elastic elements);
- 5) Systems consisting of springs connected in series and springs and pistons connected in parallel.
- 6) Zener, Maxwell, Kelvin-Voigt models

Write down the numbers under which the correct answers are indicated.

Answer: 16

Task 5.

Read the task, choose the correct answers.

What is a bone?

- 1) Highly elastic material consisting of collagen, elastin and smooth muscle fibers.
- 2) Heterogeneous tissue consisting of three layers superimposed on each other: epidermis, dermis and subcutaneous tissue.

- 3) A collection of muscle cells and extracellular substance consisting of collagen and elastin.
- 4) Reinforced composite material, half of the volume of which is hydroxyapatite.
- 5) Collagen, elastin and main substance fibers - matrix.
- 6) It is a material consisting mainly of hydroxyapatite.

Write down the numbers under which the correct answers are indicated.
 Answer: 46

Closed-ended tasks to establish compliance

GPC-4.2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;

Task 6.

Read the task and match.

Establish a correspondence: between the problem and the correct answer

Task		Answer	
A	Determine the amount of heat transferred to the system at a temperature of 27 degrees Celsius if the reduced heat was equal to 30 J/K	1	810 J
B	90 J of heat were transferred to the system. Determine the change in the internal energy of the system if the system performed work $A=80$ J.	2	9000 J
		3	9 J
		4	10 J
		5	170 J

Write the selected numbers in the table under the corresponding letters.

A	B

Answer: A2B4

Task 7.

Read the task and match.

Establish a correspondence: between the problem and the correct answer

Task		Answer	
A	Will the X-ray flux change if, without changing the voltage, the current in the X-ray tube is increased by 10 times?	1	Will increase 10 times
B	Will the X-ray flux change if, without changing the current, the voltage in the X-ray tube is doubled?	2	Will decrease by 2 times

IN	Will the X-ray flux change if, without changing the voltage, the current in the X-ray tube is increased by 4 times?	3	Will decrease by 4 times
		4	Will increase 4 times
		5	Will decrease by 10 times

Write the selected numbers in the table under the corresponding letters.

A	B	IN

Answer: A1B4B4

Task 8.

Read the task and match.

Establish a correspondence between the law and its definition

Law		Definition	
A	Bouguer-Lambert-Baer law	1	At a given wavelength, the optical density of a mixture of components that do not interact with each other is equal to the sum of the optical densities of the individual components at the same wavelength
B	Law of additivity	2	The current strength of the complete circuit is directly proportional to the EMF of the source and inversely proportional to the total resistance of the circuit
IN	Faraday's Law	3	Homogeneous layers of the same substance of the same thickness absorb the same proportion of incident light energy (at a constant concentration of the dissolved substance)
G	Stern-Volmer law	4	The ratio of fluorescence quantum yields to quencher concentration has a linear section during dynamic interaction of molecules
		5	The partial pressure of the saturated vapor of a component of a solution is

			directly proportional to its mole fraction in the solution, and the proportionality coefficient is equal to the saturated vapor pressure over the pure component
--	--	--	------------------------------------------------------------------------------------------------------------------------------------------------------------------

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G

Answer: A3B1B2G4

Task 9.

Read the task and match.

Match the definition and concept

Concept		Definition	
A	Elastic body model	1	A system consisting of various combinations of a spring (elastic element) and a piston (viscous element)
B	Bone tissue model	2	A system consisting of a spring (elastic element) and a piston (viscous element) connected in parallel;
IN	Zener Model	3	Hooke's law spring
		4	A system consisting of a spring connected in series and a spring and piston connected in parallel.
		5	A system consisting of an elastic element and a Kelvin-Voigt model connected in series.

Write the selected numbers in the table under the corresponding letters.

A	B	IN

Answer: A3B4B5

Task 10.

Read the task and match.

Establish a correspondence between the analysis method and its characteristics

Method of analysis		Characteristic	
A	Spectrophotometry	1	Degree of light diffusion

B	Potentiometrics	2	Absorption of monochromatic light
IN	Refractometry	3	Study of refraction effects
G	Photometry	4	Absorption of visible light
		5	Measuring electrochemical signal

Write the selected numbers in the table under the corresponding letters.

A	B	IN	G

Answer: A4B5V3G2

CLOSED-ENDED TASKS TO ESTABLISH A SEQUENCE

GPC-4.3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.

Task 11.

Read the task and establish the sequence.

Build an algorithm for working on the FEC KFK-3 device

1. Select the wavelength for the study.
2. Place the test solution in a cuvette and load it into the device.
3. Turn on the device and wait 30 minutes.
4. Check the zero setting.

Answer: 3421

Task 12.

Read the task and establish the sequence.

Establish the correct sequence: Ohm's law for a section of a circuit...

1. resistance.
2. voltage.
3. current strength.
4. directly proportional.
5. inversely proportional.

Answer: 34251

Task 13.

Read the task and establish the sequence.

Build an algorithm of actions for determining viscosity using the Stokes method

1. Select balls.
2. Calculate measurement errors.
3. Calculate the dynamic viscosity using the formula.
4. Throw the balls into a viscous liquid and time the fall to a certain height.
5. Measure the diameter of the balls.
6. Weigh the balls.

Answer: 1,5,6,4,3,2 or 1,6,5,4,3,2

Task 14.

Read the task and establish the sequence.

Set the correct sequence: electric field strength

1. charge value
 2. tension
 3. force acting on a stationary small point charge
 4. directly proportional
 5. inversely proportional
- Answer: 24351

Task 15.

Read the task and establish the sequence.

Put the sequence in the right order: Newton's second law

1. atacceleration
 2. weight
 3. resultant force
 4. directly proportional
 5. inversely proportional
- Answer: 14352

OPEN-TYPE TASKS

Task 16.

Read the task and give a reasoned answer.

If other bodies act on a body and their action does not change over time, then the body moves.....

Answer: with constant acceleration.

Task 17.

Read the task and give a reasoned answer..

Electric current is an ordered flow

Answer: movement of charged particles in a conductor.

Task 18.

Read the task and give a reasoned answer..

The phenomenon of maintaining the speed of a body in the absence of any impact on it.....

Answer: other bodies is called inertia.

Task 19.

Read the task and give a reasoned answer..

Pressure is the ratio of force to area over which.....

Answer: a force acts in the perpendicular direction.

Task 20.

Read the text and give a detailed, reasoned answer.

The quantity that characterizes the speed of work is called.....

Answer: power.

a. Typical tasks for intermediate certification

Interim certification in the discipline is carried out in the form of a test. The test is given based on the results of successful completion of the current certification

and analysis of practical work by prepared students, their participation in discussions, while competencies are assessed.

If the result of the current certification does not suit the student, then he will have to take a test, during which he must demonstrate the knowledge, skills and abilities listed above.

Formed competence:

GPC-4Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:

GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;

1. Sound transduction in mammals (using the example of the human hearing system).
2. The structure of the human ear. Functions of the outer, middle and inner ear.
3. The essence of the binaural effect.
4. Sound coding theory.
5. Tympanometry.
6. Physical foundations of sound research methods in medicine.
7. Infrasound (frequency range, physical properties). Sources of infrasound in nature.
8. Infrasound in nature. Application of infrasound. Methods of protection against infrasound.
9. Ultrasound and hypersound in nature.
10. Application of ultrasound in technology, science and medicine.
11. Physical and physiological characteristics of sound. Hearing diagram. Intensity levels and sound volume levels, their units of measurement. Weber-Fechner law.
12. Ultrasound. Methods for obtaining ultrasound. Reflection and absorption of ultrasonic waves by biological tissues, acoustic impedance. Physical mechanisms of interaction of ultrasonic waves with biological tissues. Therapeutic and surgical applications of ultrasound.
13. Ultrasound diagnostics. Principles of obtaining images of organs using ultrasound.
14. The Doppler effect, its use to measure blood flow speed.
15. Bernoulli's equation, the condition of jet continuity, the limits of their applicability for describing blood flow.
16. Liquid viscosity, methods for its determination. Newtonian and non-Newtonian fluids. Blood viscosity. Factors affecting blood viscosity in the body.
17. Poiseuille's formula. Distribution of pressure and blood flow velocity throughout the vascular system.
18. Pulse waves, the mechanism of their occurrence. Pulse wave speed. Moens-Korteweg formula. Registration of pulse waves.
19. Laminar and turbulent fluid flow. Reynolds number. Manifestations of turbulence in the cardiovascular system.
20. Work and power of the heart.
21. Current in liquids. Ion mobility. Electrical conductivity of electrolytes. Galvanization. Therapeutic electrophoresis.
22. Diathermy. Electrosurgery. Monoactive and biactive methods. Electrotomy and electrocoagulation. Areas of application of electrosurgery.
23. Local darsonvalization. Impact parameters, method of supplying current to the patient.
24. UHF therapy. Continuous and pulse mode. UHF therapy devices.
25. Inductothermy. Microwave SMV and UHF therapy. EHF therapy.

GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;

1. Biophysics is...

- A. science that studies the most general and fundamental laws that determine the structure and evolution of the material world +
- B. science that studies the physical and physicochemical processes occurring in living organisms, as well as the ultrastructure of biological systems at all levels of organization of living matter - from submolecular and molecular to cells and the whole organism
- B. section of variation statistics, using the methods of which experimental data and observations are processed, as well as the planning of quantitative experiments in biological research
- D. a complex of biological sciences that study the mechanisms of storage, transmission and implementation of genetic information, the structure and functions of irregular biopolymers

2. During stationary fluid flow, pressure... in those places where the flow velocity is lower.

- A. has different meanings.
- B. less.
- B. more.
- G. has the same meaning.

3. Bernoulli's equation has the form:

A. $p_1 + \frac{\rho v_1^2}{2} + \rho g h_1 = p_2 + \frac{\rho v_2^2}{2} + \rho g h_2$

B. $\frac{s_1}{s_2} = \frac{v_2}{v_1}$ IN. $\frac{F_1}{F_2} = \frac{S_1}{S_2}$ G. $\frac{s_1}{s_2} = \frac{v_1}{v_2}$

4. In stationary fluid flow, the velocity... is in those places where the cross-sectional area is smaller.

- A. has different meanings.
- B. less.
- B. more.
- G. has the same meaning.

5. Select the parameters that include Newton's formula for the force of internal friction.

- A. Velocity gradient, area of interacting layers, viscosity coefficient.
- B. Vessel radius, pressure difference, viscosity coefficient, hydraulic resistance.
- C. Area of interacting layers, pressure difference, vessel thickness, speed.
- D. Hydraulic resistance, viscosity coefficient, speed.
- E. Pressure difference, vessel radius, speed.

6. Select the parameters that go into the formula for calculating the Reynolds number.

- A. Area of interacting layers, fluid flow velocity, fluid density, viscosity coefficient.
- B. Liquid flow rate, liquid density, vessel diameter, viscosity coefficient.
- C. Velocity gradient, fluid density, viscosity coefficient.
- D. Fluid flow rate, pressure difference, vessel diameter, vessel length.
- E. Velocity gradient, liquid density, viscosity coefficient, vessel diameter.

7. What is a pulse wave?

- A. A wave propagating through blood vessels (arteries, veins, etc.) when the heart beats.
- B. A wave of increased pressure spreading through the veins.

C. A wave of increased pressure spreading through the aorta and arteries, caused by the ejection of blood from the left ventricle during systole.

D. A wave propagating through the aorta and arteries caused by the speed of blood flow.

8. Wavelength range of visible light....

1. 380 - 760 nm
2. 300- 600 nm
3. 500 - 800 nm
4. 120-400 nm
5. 700 - 1200 nm

9. The bone is...

1. reinforced composite material, half of the volume of which is hydroxylapatite, and the other half is an organic (mainly collagen) connective tissue base;
2. heterogeneous tissue, consisting of 3 layers superimposed on each other: epidermis, dermis and subcutaneous tissue;
3. a collection of muscle cells and extracellular substance consisting of collagen and elastin;
4. highly elastic material consisting of collagen, elastin and smooth muscle fibers;
5. fibers of collagen, elastin and the main substance - matrix.

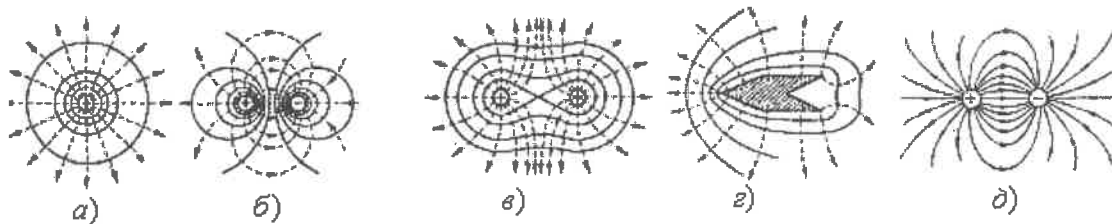
10. Relative deformation is called...

1. Change in the relative position of bodies;
2. Changes in the size and shape of bodies under the influence of external forces;
3. The difference between the final and initial values of the size of bodies on which external forces act;
4. Ratio of absolute deformation to original length;
5. The angle by which one part of the body is displaced relative to its other parts.

11. The phenomenon of thermal conductivity occurs in the presence of a gradient...

- A. # temperature
- B. # concentration
- C. # velocities of liquid or gas layers
- D. # electric charge

12. The equipotential surfaces of the electric field of the dipole are shown in the figure



1. #A
2. #b
3. #V
4. #G
5. #d

13. Which of the following parameters are objective characteristics of sound?

- A. Reverberation, amplitude, frequency, timbre.
- B. Frequency, acoustic spectrum, amplitude.
- C. Frequency, pitch, amplitude, volume.

- D. Timbre, pitch, amplitude, volume.
E. Amplitude, reverb, timbre.

14. Select the definition of infrasound.

- A. These are mechanical vibrations with a frequency of less than 20 Hz.
B. These are electromagnetic oscillations with a frequency from 20Hz to 20000Hz.
C. These are mechanical vibrations with a frequency from 20 kHz to 20000 kHz.
D. These are electromagnetic oscillations with a frequency from 20 kHz to 20000 kHz.
E. These are mechanical vibrations with a frequency above 20000Hz.

15. What is considered the starting level on the intensity scale for sound?

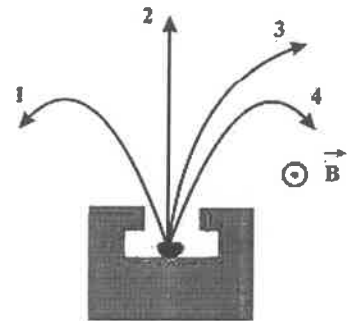
- A. The sound intensity value is 10-12 W/m².
B. The sound intensity value is zero.
C. The sound intensity value is close to zero.
D. Sound intensity value equal to 10 W/m².
E. The sound intensity value is randomly selected.

16. In what units is the data presented on the loudness scale?

- A. W/m²
B. V m²
C. B
D. Pa
E. Background

17. What frequency range corresponds to ultrasound?

- A. Below 20 Hz.
B. 20-20000 Hz.
C. Above 20000 Hz.
D. 100-1000 Hz.
E. Above 20 Hz.



18. Four types of radioactive radiation α -, β^{\pm} -, γ -the rays are

deflected in a magnetic field, the induction of which is directed towards us (Fig.). β^{-} - rays deviate in the direction...

A#1B #4C #2

D#3

19. Radioactive decay activity is defined as follows:

- A. $A = N \cdot e^{-\lambda t}$
B. $A = \lambda \cdot N_0$
C. $A = -\lambda \cdot N_0$
D. $A = \lambda \cdot N_0 \cdot e^{-\lambda t}$
E. $A = \lambda \cdot N_0 \cdot e^{\lambda t}$

20. What types of protection against ionizing radiation are there?

- A. Time, material, distance.
B. Dispersion, time.
C. Material, scattering, time, distance.

D. Distance.

21. The continuity equation has the form:

A. $p_1 + \frac{\rho v_1^2}{2} + \rho g h_1 = p_2 + \frac{\rho v_2^2}{2} + \rho g h_2$

B. $\frac{s_1}{s_2} = \frac{v_2}{v_1}$ IN. $\frac{F_1}{F_2} = \frac{S_1}{S_2}$ G. $\frac{s_1}{s_2} = \frac{v_1}{v_2}$

22. The presence of viscosity in a liquid leads to the fact that when the liquid flows through a pipe of constant cross-section, the pressure...

A. is the same at all points of the liquid.

B. increases in the direction of its flow according to a complex mathematical relationship.

The water increases in the direction of its flow according to a linear law.

The gas falls in the direction of its flow according to a linear law.

23. Select the parameters that are included in the Poiseuille formula.

A. Velocity gradient, vessel length, viscosity coefficient.

B. Vessel radius, vessel length, pressure difference, viscosity coefficient.

C. Vessel radius, vessel length, area of interacting layers, viscosity coefficient.

D. Length of the vessel, area of interacting layers, viscosity coefficient.

E. Pressure difference, blood density, vessel length, viscosity coefficient.

24. Why is blood a non-Newtonian fluid?

A. This is due to the presence of formed elements in it.

B. This is due to the fact that for blood the Reynolds number takes on a critical value.

C. This is due to the high blood viscosity coefficient.

D. This is due to the small coefficient of blood viscosity.

25. Skin is...

1. reinforced composite material, half of which is hydroxylapatite;

2. heterogeneous tissue, consisting of 3 layers superimposed on each other: epidermis, dermis and subcutaneous tissue;

3. a collection of muscle cells and extracellular substance consisting of collagen and elastin;

4. highly elastic material consisting of collagen, elastin and smooth muscle fibers;

5. fibers of collagen, elastin and the main substance - matrix.

26. The process of releasing a substance on the electrodes when an electric current flows through solutions or melts of electrolytes:

1 electrolysis 2 electrolyte

3 electrolytic dissociation 4 refining

27. The phenomenon of diffusion characterizes the transfer...

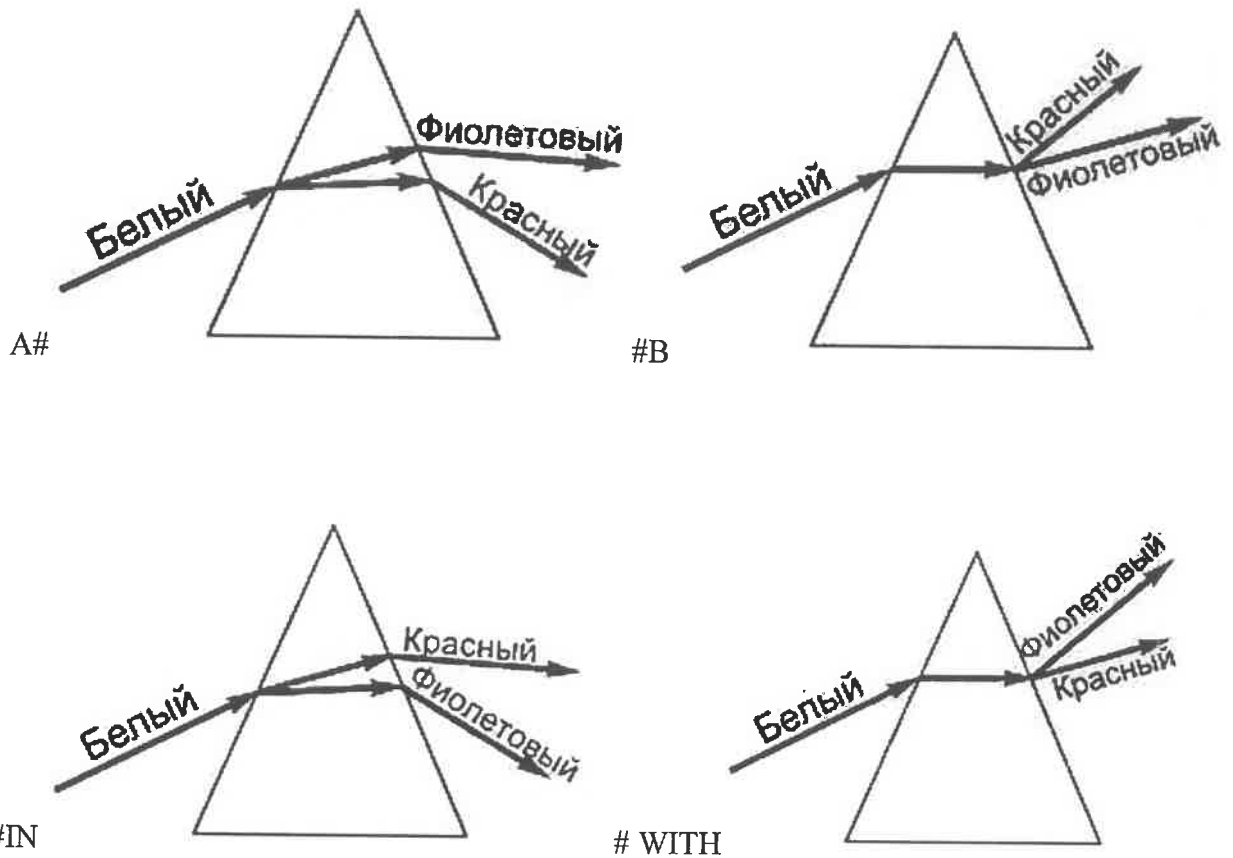
A. # masses

B. #energy

C. # directional impulse

D. # electric charge

28. A glass prism decomposes white light. The figures show the path of rays in a prism. The drawing correctly reflects the actual path of rays...



GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.

29. Which of the following parameters relate to the subjective characteristics of sound?
- Timbre, volume, reverberation.
 - Frequency, volume, reverberation.
 - Pitch, volume, timbre.
 - Pitch, volume, reverberation, frequency.
 - Amplitude, timbre, frequency.
30. Which of the following parameters affects sound volume?
- Reverberation, pitch.
 - Frequency, amplitude.
 - Pitch, acoustic spectrum.
 - Acoustic spectrum, amplitude.
 - Amplitude, pitch, acoustic spectrum.
31. Which of the statements below is incorrect?
- # All admissible microstates of a closed system are equally probable.
 - # The entropy of an isolated body remains constant.
 - # The entropy of a body in an equilibrium state is maximum.
 - # Entropy, up to a constant factor, is equal to the logarithm of the number of permissible microscopic states of the body.
32. Select a sound definition.

- A. These are mechanical vibrations with a frequency from 20 Hz to 20,000 Hz.
- B. These are electromagnetic oscillations with a frequency from 20Hz to 20000Hz.
- C. These are mechanical vibrations with a frequency from 20 kHz to 20000 kHz.
- D. These are electromagnetic oscillations with a frequency from 20 kHz to 20000 kHz.
- E. These are mechanical vibrations with a frequency above 20000Hz.

33. Select the definition of ultrasound.

- A. These are mechanical vibrations with a frequency of less than 20 Hz.
- B. These are electromagnetic oscillations with a frequency from 20Hz to 20000Hz.
- C. These are mechanical vibrations with a frequency from 20 kHz to 20000 kHz.
- D. These are electromagnetic oscillations with a frequency from 20 kHz to 20000 kHz.
- E. These are mechanical vibrations with a frequency above 20000Hz.

34. What is the relationship between volume and sound intensity?

- A. Logarithmic
- B. Directly proportional
- C. Exponential
- D. Inversely proportional
- E. Indicative.

35. What physical parameters does the hearing threshold depend on?

- A. On the frequency and intensity of sound signals.
- B. Only on the intensity of sound signals.
- C. From the amplitude of sound signals.
- D. From the acoustic spectrum.
- E. Only on the frequency of sound signals.

36. What kind of radiation is called X-ray radiation?

- A. X-ray radiation refers to electromagnetic waves with a wavelength from 80 to 10⁻⁵ microns.
- B. X-ray radiation is a flow of high-energy electrons;
- C. X-ray radiation refers to electromagnetic waves with a wavelength from 80 to 10⁻⁵ nm.
- D. X-ray radiation refers to waves with a wavelength from 80 to 10⁻⁵ m.
- E. X-ray radiation is a flow of electrons with energy from 80 to 10⁻⁵ MeV.

37. Select the definition of radioactivity?

- A. Radioactivity is the spontaneous decay of atoms and molecules.
- B. Radioactivity is the induced decay of atomic nuclei with the emission of other nuclei and elementary particles.
- C. Radioactivity is the spontaneous decay of unstable nuclei with the emission of other nuclei and elementary particles.
- D. Radioactivity is the induced decay of atoms and molecules to form other atoms and molecules.
- E. Radioactivity is the spontaneous process of ionization of atoms and molecules.

38. Radioactive radiation, which has a very high penetrating ability, relatively weak ionizing ability, is not deflected by electric and magnetic fields, does not cause a change in the charge and mass number of decaying nuclei, is ...

- E. α -radiation
- F. γ -ραδιατιον
- G. β^- ραδιατιον
- H. β^+ ραδιατιον

39. In what units is the activity of a radioactive drug measured?

- A. Becquerel, curie, rutherford.

- B. Sievert, roentgen, rem.
- C. Curie, X-ray, sievert.
- D. Rutherford, rem, grey.
- E. Rutherford, rem, x-ray.

40. What is the Young's modulus of a tendon with a length of 0.12 m and a cross-sectional area of 2 mm² if under the action of a force of 68.8 N it lengthens by 2.9 mm?
- A. $3.44 \cdot 10^8$ Pa;
 - B. $2.4 \cdot 10^8$ Pa;
 - C. **$1.42 \cdot 10^9$ Pa;**
 - D. $1.62 \cdot 10^8$ Pa;
 - E. $1.25 \cdot 10^8$ Pa.

b. Test topics

GPC-4 Able to use methods for solving problems in professional activities using modern equipment when developing new technologies and use modern professional methodology to conduct experimental studies and interpret their results:

GPC-4ID-1 Know the technical capabilities of modern specialized equipment, methods for solving problems of professional activity;

GPC-4ID-2 Be able to apply modern technologies, including digital ones, and research methods in professional activities, interpret the results obtained;

GPC-4ID-3 Possess skills in working with specialized equipment to implement assigned tasks when conducting research and developing new technologies, including digital ones.

Federal State Budgetary Educational Institution of Higher Education "St. Petersburg State University of Veterinary Medicine"

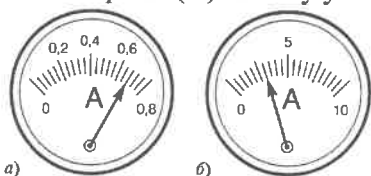
Department of Inorganic Chemistry and Biophysics

Faculty of Veterinary Medicine

Test No. 1

Option 1

1. Forces of 18 N and 6 N act on the lever. The arm of the first force is 3 cm. Find the arm of the second force if the lever is balanced
2. Which of the two ammeters, a or b, can most accurately measure the current in an electrical circuit in amperes (A)? Justify your answer. Determine the readings of the ammeters.



3. A voltage of $U=80$ V is applied to a conductor with a resistance of $R=40$ Ohm. What is the current strength in the conductor?
4. What amount of heat will be released during crystallization and cooling to a temperature of t 20 °C of aluminum weighing m 80 g, located at the melting point? Specific heat of aluminum $c=9.2 \cdot 10^2$ J/(kg·°C), melting point of aluminum $t_{\text{mel}}=660$ °C, specific heat of melting of aluminum $\lambda=3.9 \cdot 10^5$ J/kg



5. In which case (see figure) will the pressure be less?

Federal State Budgetary Educational Institution of Higher Education "St. Petersburg State University of Veterinary Medicine"

Department of Inorganic Chemistry and Biophysics

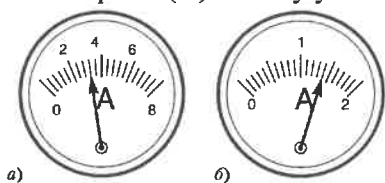
Faculty of Veterinary Medicine

Test No. 1

Option 2

1. Forces of 13 N and 3 N act on the lever. The arm of the first force is 3 cm. Find the arm of the second force if the lever is balanced

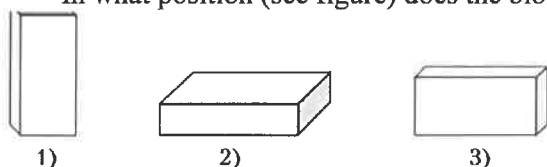
2. Which of the two ammeters, a or b, can most accurately measure the current in an electrical circuit in amperes (A)? Justify your answer. Determine the readings of the ammeters.



3. The resistance of the spiral of an electric soldering iron is $R=500 \text{ Ohm}$. At what voltage does the soldering iron operate if the current in the soldering iron coil is $I=0.440 \text{ A}$?

4. What amount of heat must be imparted to ice of mass $m 1.5 \text{ kg}$, located at a temperature of $t -20 \text{ }^\circ\text{C}$, in order to heat it to the melting temperature and completely melt it? The specific heat capacity of ice is $2.1 \cdot 10^3 \text{ J/(kg}\cdot^\circ\text{C)}$, the melting temperature of ice $t_{\text{mel}}=0.0^\circ\text{C}$, the specific heat of melting of ice $\lambda=3.33 \cdot 10^5 \text{ J/kg}$.

5. In what position (see figure) does the block produce the greatest pressure?



Federal State Budgetary Educational Institution of Higher Education "St. Petersburg State University of Veterinary Medicine"

Department of Inorganic Chemistry and Biophysics

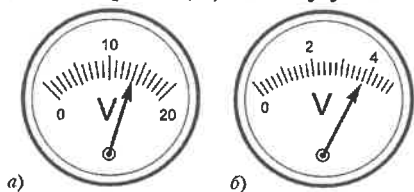
Faculty of Veterinary Medicine

Test No. 1

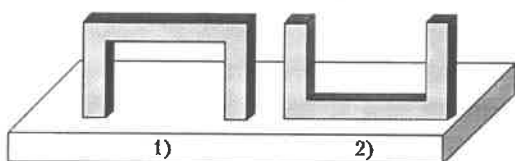
Option 3

1. Forces of 10 N and 2 N act on the lever. The arm of the first force is 3 cm. Find the arm of the second force if the lever is balanced

2. Which of the two ammeters, a or b, can most accurately measure the current in an electrical circuit in amperes (A)? Justify your answer. Determine the readings of the ammeters.



3. How many times is the resistance of a lead wire greater than the resistance of an iron wire if the lengths and cross-sectional areas of the wires are the same? (Resistivity of lead $\rho_1=0.21 \text{ Ohm}\cdot\text{mm}^2/\text{m}$, resistivity of iron $\rho_2=0.10 \text{ Ohm}\cdot\text{mm}^2/\text{m}$)
4. How much will the temperature of water with a volume $V_1=300 \text{ ml}$ change if it receives all the energy released when an iron bar of mass $m_2=0.18 \text{ kg}$ is cooled from a temperature $t_1=85 \text{ }^\circ\text{C}$ to a temperature $t_2=15 \text{ }^\circ\text{C}$? Specific heat capacity of water $c_1=4.2 \cdot 10^3 \text{ J}/(\text{kg}\cdot^\circ\text{C})$, specific heat capacity of iron $c_2=4.6 \cdot 10^2 \text{ J}/(\text{kg}\cdot^\circ\text{C})$, density of water $\rho=1.0 \cdot 10^3 \text{ kg}/\text{m}^3$
5. In which case (see figure) will the pressure be greater?



Federal State Budgetary Educational Institution of Higher Education "St. Petersburg State University of Veterinary Medicine"

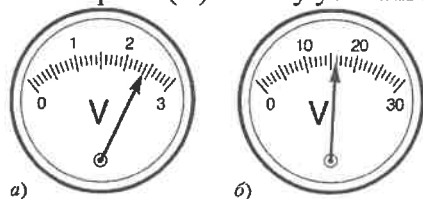
Department of Inorganic Chemistry and Biophysics

Faculty of Veterinary Medicine

Test No. 1

Option 4

1. Forces of 1 N and 3 N act on the lever. The arm of the first force is 30 cm. Find the arm of the second force if the lever is balanced
2. Which of the two ammeters, a or b, can most accurately measure the current in an electrical circuit in amperes (A)? Justify your answer. Determine the readings of the ammeters.

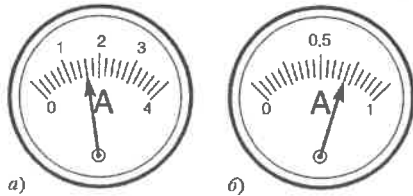


3. There are two wires made of the same material with the same cross-sectional area. How many times does the resistance of the first wire differ from the resistance of the second, if the length of the first wire is $l_1=1.0 \text{ m}$, the length of the second is $l_2=0.2 \text{ m}$?
4. What amount of heat must be imparted to tin with a mass of $m = 1.4 \text{ kg}$, located at a temperature of $t = 22 \text{ }^\circ\text{C}$, in order to heat it to the melting temperature and completely melt it? Specific heat capacity of tin $c=250 \text{ J}/(\text{kg}\cdot^\circ\text{C})$, melting temperature of tin $t_{\text{mel}}=232 \text{ }^\circ\text{C}$, specific heat of fusion of tin $\lambda=6.03 \cdot 10^4 \text{ J}/\text{kg}$
5. How does the internal energy of a medical thermometer change when measuring temperature?

Federal State Budgetary Educational Institution of Higher Education "St. Petersburg State University of Veterinary Medicine"

Department of Inorganic Chemistry and Biophysics

- Forces of 9 N and 3 N act on the lever. The arm of the first force is 15 cm. Find the arm of the second force if the lever is balanced
- Which of the two ammeters, a or b, can most accurately measure the current in an electrical circuit in amperes (A)? Justify your answer. Determine the readings of the ammeters.



- The cross-sectional areas and lengths of nichrome and iron wires are the same. How many times does the resistance of nichrome wire differ from the resistance of iron wire? (Resistivity of nichrome $\rho_1=1.1 \text{ Ohm}\cdot\text{mm}^2/\text{m}$, iron $\rho_2=0.10 \text{ Ohm}\cdot\text{mm}^2/\text{m}$)
- What amount of heat will be released during crystallization and cooling to a temperature $t = 25 \text{ }^\circ\text{C}$ of copper weighing $m = 50 \text{ g}$, located at the melting point? Specific heat capacity of copper $c=3.8 \cdot 10^2 \text{ J}/(\text{kg}\cdot^\circ\text{C})$, melting point of copper $t_{\text{melting}}=1085 \text{ }^\circ\text{C}$, specific heat of fusion of copper $\lambda=2.1 \cdot 10^5 \text{ J}/\text{kg}$
- Why is the candle flame set vertically when there is no wind?

5. METHODOLOGICAL MATERIALS DETERMINING PROCEDURES FOR ASSESSING KNOWLEDGE, ABILITIES AND SKILLS AND ACTIVITY EXPERIENCE CHARACTERIZING THE STAGES OF COMPETENCY FORMATION

Criteria for assessing students' knowledge during the colloquium:

- **Mark "excellent"**- the student clearly expresses his point of view on the issues under consideration, giving relevant examples.
- **Mark "good"** - the student makes some errors in the answer
- **Mark "satisfactory"**- the student discovers gaps in knowledge of the basic educational and regulatory material.
- **Mark "unsatisfactory"** - the student reveals significant gaps in knowledge of the basic principles of the discipline, inability, with the help of the teacher, to obtain the correct solution to a specific practical problem.

Criteria for assessing students' knowledge during testing:

The test result is assessed on a percentage rating scale. Each student is offered a set of test tasks consisting of 25 questions:

- **Mark "excellent"**– 25-22 correct answers.
- **Mark "good"**– 21-18 correct answers.
- **Mark "satisfactory"** –17-13 correct answers.
- **Mark "unsatisfactory"**– less than 13 correct answers

Criteria for assessing students' knowledge when checking test papers:

- **Mark "excellent"**- the problem is identified and its relevance is justified; an analysis of various points of view on the problem under consideration was made and one's own position was logically stated; conclusions are formulated, the topic is fully disclosed, the scope is maintained; requirements for external design have been met, basic requirements for the abstract have been met

- Marked “good” - some shortcomings have been made. In particular, there are inaccuracies in the presentation of the material; there is no logical consistency in judgments; the volume of the abstract is not maintained; there are omissions in the design, there are significant deviations from the requirements for abstracting.

- Marked “satisfactory” - the topic is only partially covered; there were factual errors in the content of the abstract; there are no conclusions, the topic of the abstract is not disclosed.

- **Mark "unsatisfactory"** - there is a significant misunderstanding of the problem or the abstract is not presented at all.

Knowledge criteria when conducting a test with assessment:

- **Mark "excellent"** – all types of educational work provided for by the curriculum have been completed. The student demonstrates the correspondence of knowledge, skills and abilities to the indicators given in the tables, operates with acquired knowledge, skills and abilities, and applies them in situations of increased complexity. In this case, inaccuracies and difficulties may occur during analytical operations and the transfer of knowledge and skills to new, non-standard situations.

- Mark “good” – all types of educational work provided for by the curriculum have been completed. The student demonstrates the correspondence of knowledge, skills and abilities to the indicators given in the tables, operates with acquired knowledge, skills and abilities, and applies them in standard situations. In this case, minor errors, inaccuracies, and difficulties during analytical operations and the transfer of knowledge and skills to new, non-standard situations may be made.

- Mark “satisfactory” – one or more types of academic work provided for by the curriculum have not been completed. The student demonstrates incomplete compliance of knowledge, abilities, skills with the indicators given in the tables, significant mistakes are made, a partial lack of knowledge, abilities, and skills is manifested in a number of indicators, the student experiences significant difficulties in operating knowledge and skills when transferring them to new situations.

–

- The mark “unsatisfactory” means that the types of educational work provided for by the curriculum have not been completed. demonstrates incomplete compliance of knowledge, abilities, and skills with those given in the tables of indicators, significant mistakes are made, a lack of knowledge, abilities, and skills in a larger number of indicators is manifested; the student experiences significant difficulties in operating knowledge and skills when transferring them to new situations.

6. ACCESSIBILITY AND QUALITY OF EDUCATION FOR PERSONS WITH DISABILITIES

If necessary, disabled people and persons with limited health capabilities are given additional time to prepare an answer for the test.

When carrying out the procedure for assessing the learning outcomes of people with disabilities and people with limited health capabilities, their own technical means may be used.

The procedure for assessing the learning outcomes of people with disabilities and people with limited health capabilities in the discipline provides for the provision of information in forms adapted to the limitations of their health and perception of information:

For people with visual impairments:	– in printed form in enlarged font, – in the form of an electronic document.
For people with hearing impairments:	– in printed form, – in the form of an electronic document.
For persons with musculoskeletal disorders	– in printed form, device: – in the form of an electronic document.

When carrying out the procedure for assessing the learning outcomes of disabled people and persons with limited health capabilities in the discipline, it ensures the fulfillment of the following additional requirements depending on the individual characteristics of the students:

a) instructions on the procedure for conducting the assessment procedure are provided in an accessible form (orally, in writing);

b) an accessible form for submitting assignments of assessment tools (in printed form, in printed form in enlarged font, in the form of an electronic document, assignments are read out by the teacher);

c) an accessible form of providing answers to assignments (written on paper, typing answers on a computer, orally).

If necessary, for students with disabilities and people with disabilities, the procedure for assessing learning outcomes in the discipline can be carried out in several stages.

The procedure for assessing the learning outcomes of disabled people and persons with limited health capabilities is permitted using distance learning technologies.