Ministry of Agriculture of the Russian Federation
Federal State Budgetary Educational Institution of
higher education
"St. Petersburg State University of Veterinary Medicine"
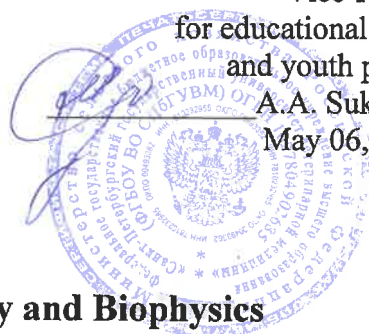
APPROVED BY
Vice-Rector
for educational work
and youth policy
A.A. Sukhinin
May 06, 2024

Department of Inorganic Chemistry and Biophysics

WORKING PROGRAMM

by discipline

BIOLOGICAL PHYSICS

Level of higher education
SPECIALTY
Specialty 05/36/01 Veterinary
Full-time education

Education starts in 2024

Reviewed and accepted
at a department meeting
May 02, 2024
Protocol No. 15-05-23/24

Head department
inorganic chemistry and biophysics
Candidate of Chemical Sciences, Associate Professor
_____ A.N. Baryshev

Saint Petersburg
2024

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-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.

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 exercises (PP), including interactive forms, including:	34	34
practical training (PT)	6	6
Independent work(Total)	56	56
Test	+	+
Type of intermediate certification (test with assessment)	**test with grade**	**test with grade**
Total labor intensityhours/credits	**108/3**	**108/3**

5. CONTENT OF DISCIPLINE "BIOLOGICAL PHYSICS"

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

NO.	Name	Formed competencies	Semester	Types of educational work, including independent work of students and labor intensity (in hours)			
				L	PP	PT	IW
1.	History of the formation and development of "Biological physics" as a science. BiomechanicsIntroduction to biomechanicsMechanical properties of solids and biological tissues. Introduction to bioacoustics.	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.	2	4	6		12
2.	Hydrodynamics and hemodynamics. Thermodynamics of biological processes.	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.	2	8	8	2	24

№	Topic	Competencies					
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.	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.	2	4	8	2	12
4.	Ionizing radiation. Biological effects of ionizing radiation. Dosimetry. Application of isotope analysis.	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.	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

2. Yakupov, T. R. Physico-chemical aspects of biological life: textbook / T. R. Yakupov, G. N. Zainasheva. — Kazan: KGAVM im. Bauman, 2020. - 47 p. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/148583 (access date: 04/27/2024).

6.2. Literature for independent work

1. Volkenshtein, M.V. Biophysics [Electronic resource]: textbook. — Electron. Dan. - St. Petersburg: Lan, 2012. - 596 p. - Access mode:http://e.lanbook.com/books/element.php?pl1_id=3898(date of access: 07/27/2024)

2. Pogonyshev, V. A. Biological physics / V. A. Pogonyshev. — 2nd ed., erased. - St. Petersburg: Lan, 2022. - 300 p. https://e.lanbook.com/book/198575 (accessed 07/27/2024)

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

a) basic literature:

1. Volkenshtein, M. V. Biophysics: textbook / M. V. Volkenshtein. — 4th ed., erased. - St. Petersburg: Lan, 2021. - 608 p. — ISBN 978-5-8114-0851-1. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/168433 (access date: 04/27/2024).

2. Ivanov, I.V. Collection of problems on the course of fundamentals of physics and biophysics: textbook / I.V. Ivanov. — 2nd ed., rev. - St. Petersburg: Lan, 2021. - 128 p. — ISBN 978-5-8114-1349-2. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/168419 (access date: 04/27/2024).

b) additional literature:

1. Stepanov, V. G. Veterinary radiobiology: textbook / V. G. Stepanov. - St. Petersburg: Lan, 2021. - 352 p. — ISBN 978-5-8114-3001-7. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/169210 (access date: 04/27/2024).

2. Ivanov, I.V. Fundamentals of physics and biophysics: textbook / I.V. Ivanov. — 2nd ed., revised, added. - St. Petersburg: Lan, 2021. - 208 p. — ISBN 978-5-8114-1350-8. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/168418 (access date: 04/27/2024).

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. EBS "Publishing house "Lan"
3. University information system "RUSSIA"
4. Full text database POLPRED.COM
5. Scientific electronic library ELIBRARY.RU
6. Russian Scientific Network
7. Electronic library system IQlib
8. Web of Science International Science Citation Index Database
9. Full-text interdisciplinary database for agricultural and environmental sciencesProQuest AGRICULTURAL AND ENVIRONMENTAL SCIENCE DATABASE
10. Electronic books from the publishing house "Prospekt Nauki"http://prospektnauki.ru/ebooks/
11. 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 24 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 EnvironmentSPbSUVM: https://spbguvm.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	*Specialized furniture:*desks, chairs, stools, blackboard, multimedia equipment. *Laboratory equipment and educational materials:*refractometers, polarimeters, lasers, calorimeters, laboratory tables and screw stools, colored and neutral glass filters, calipers, micrometers, posters on sections of anatomy.
	104 (196084, St. Petersburg, Chernigovskaya str., building 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification	*Specialized furniture:*desks, chairs, stools, blackboard, multimedia equipment. *Laboratory equipment and educational materials:*refractometers, polarimeters, lasers, calorimeters, laboratory tables and screw stools, colored and neutral glass filters, calipers, micrometers, posters on sections of anatomy.
	107 (196084, St. Petersburg, Chernigovskaya str., building 5) Classroom for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification	*Specialized furniture:*desks, chairs, stools, blackboard, multimedia equipment. *Laboratory equipment and educational materials:*refractometers, polarimeters, lasers, calorimeters, laboratory tables and screw stools, colored and neutral glass filters, calipers, micrometers, posters on sections of anatomy.
	206 Large reading room (196084, St. Petersburg, Chernigovskaya str., building 5) Room for independent work	*Specialized furniture*: tables, chairs *Technical training aids:*computers with an Internet connection and access to the electronic information and educational environment

	214 Small reading room (196084, St. Petersburg, Chernigovskaya str., building 5) Room for independent work	*Specialized furniture:*tables, chairs *Technical training aids:*computers with an Internet connection and access to the electronic information and educational environment
	324 Department of Information Technologies (196084, St. Petersburg, Chernigovskaya str., building 5) Room for storage and preventive maintenance of educational equipment	*Specialized furniture:*tables, chairs, special equipment, materials and spare parts for preventive maintenance of educational equipment

Appendix No. 1, 28 p.

The work program was drawn up
Head of the department, associate professor   A.N. Baryshev

Ministry of Agriculture of the Russian Federation
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Department of Inorganic Chemistry and Biophysics

FUND OF ASSESMENT TOOLS
for the discipline

for discipline

" BIOLOGICAL PHYSICS"
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Full-time education

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1. PASSPORT OF THE ASSESSMENT FUND

<div align="right">**Table 1**</div>

No.	Molded competencies	Controlled sections (topics) disciplines	Evaluation tool
1.	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.	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

<div align="right">**table 2**</div>

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	
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;	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, test, 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 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, test, 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, test, 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-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:

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 Kmol/m2 s. The diffusion coefficient of this substance is 0.7·10-4 m2/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 mm2 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 mm2 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 $5\square104$ Pa, and the modulus of elasticity of the vein is 8.5·105 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 $15\square107$ Pa and g = 10 m/s2?

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 $3\square10$-4, and the modulus of elasticity of the bone is 2·109Pa?

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 1.6·108 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 $1.4\square108$ 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.

6

- 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 104 mol/m4?

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 Characeratophylla 8 nm thick, if the diffusion coefficient of this substance is 0.7 10-4 m2/s, the concentration of formamide at the initial time outside was equal to 0.2 mol/m3, 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 10-4 mol/l, its flux density through the membrane is 6 10-4 mol cm/(l 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;

1. 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□108 Pa;
B.   2.4·108 Pa;
C.   **1.42·109 Pa;**
D.   1.62·108 Pa;
E.   1.25·108 Pa.
2.   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□104 Pa, and the modulus of elasticity of the vein is 8.5·105 Pa?
A.   **0.59;**
B.   42.5;
C.   3.5;

D. 17;
E. 13.5.

3. 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? ·
A. 1.83 kPa;
B. 66 kPa;
C. 0.54 kPa;
D. 17 kPa;
E. 5 kPa.

4. 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 $15\square 10^7$ Pa and g = 10 m/s2?
A. **105.175 kN;**
B. 800.125 kN;
C. 30.134 kN;
D. 80.723 kN;
E. 92.325 kN.

5. Determine the amount of heat transferred to the system at a temperature of 27 degrees Celsius, if the reduced heat turns out to be equal to $Q_{\text{пр}}$=30 J/K.
A. 810 J
B. 9000 J
C. 1.1 J
D. 9 J
E. 0.001 J

6. At what temperature was the amount of heat transferred to the system? Q=500 J if the reduced heat is 1 J/K?
A. **500 K**
B. 67 K
C. 41 K
D. 5.07 K
E. 294 K

7. The amount of heat transferred to the system Q=250 J. The system has done some work. Determine the change in the internal energy of the system.
A. 20 J
B. 60 J
C. Doesn't change
D. There is not enough data for calculation
E. 250 J

8. 90 J of heat was transferred to the system. Determine the change in the internal energy of the system if the system performed work A=80 J.
A. 40 J
B. 720 J
C. 60 J
D. 10 J
E. 170 J

9. 40 J of heat was transferred to the system and 20 J of work was done on the system. Determine the change in the internal energy of the system.
A. 40 J
B. 20 J
C. 60 J
D. 10 J

E.   100 J

10. Find the minimum wavelength in the spectrum of bremsstrahlung X-ray radiation if the voltage in the X-ray tube is U= 2 kV?

A.   2.46 nm
B.   0.615 nm
C.   3.25 nm
D.   0.018 nm
E.   9.72 nm

11. What is the voltage in the X-ray tube if the minimum wavelength in the X-ray spectrum is 3.075·10-10 m?

A.   4000 V
B.   0.3782 kV
C.   8 kV
D.   3.18 V
E.   16000 V

12. Will the flux of X-ray radiation change if, without changing the voltage, we increase the current in the X-ray tube by 10 times?

A.   Will not change
B.   Will increase 100 times
C.   Will increase 10 times
D.   Will decrease by 100 times
E.   Will decrease by 10 times

13. Will the X-ray flux change if, without changing the current, the voltage in the X-ray tube is doubled?

A.   Will increase 2 times
B.   Will decrease by 4 times
C.   Will not change
D.   Will increase 4 times
E.   Will decrease by 2 times

14. Will the X-ray flux change if the voltage in the X-ray tube is increased by 5 times and the current is decreased by 5 times?

A.   Will not change
B.   Will increase 5 times
C.   Will decrease by 5 times
D.   Will increase 25 times
E.   Will decrease by 25 times

15. Find the X-ray flux at U = 10 kV, I = 1 mA. The anode is made of tungsten (Z=74, k=10-9 V-1).

A.   14 W
B.   7.4 mW
C.   28 kW
D.   6.25 mW
E.   2.8 kW

16. What is the current strength in the X-ray tube if the X-ray flux at U = 20 kV is 52 mW. The anode is made of iron (Z=26, k=10-9 V-1).

A.   0.005 A
B.   0.001 A
C.   10 mA
D.   20 mA
E.   2 mA

17. Assuming that the absorption of X-ray radiation does not depend on the compound in which the atom is present in the substance, determine how many times the mass attenuation coefficient of bone $Ca_3(PO_4)_2$ is greater than the mass attenuation coefficient of water H_2O?
A. 354
B. 68
C. 5.2
D. 345
E. 86

18. For X-ray diagnostics of soft tissues, contrast agents are used, for example, the stomach and intestines are filled with a mass of sodium sulfate $BaSO_4$. How many times is the mass attenuation coefficient of barium sulfate greater than the mass attenuation coefficient of soft tissue (water)?
A. 5.2
B. 354
C. 68
D. 89
E. 345

19. In 100 g of tissue, $15 \cdot 10^{11}$ beta particles with an energy of $1.5 \cdot 10^{-15}$ J each are absorbed. Determine the absorbed dose of radiation.
A. 22.5 10^{-3} J/kg
B. 19.6 10^{-3} J/kg
C. 4.5 10^{-3} J/kg
D. 22.5 10^{-5} J/kg
E. 45 10^{-3} J/kg

20. Determine the equivalent dose of neutron radiation if the absorbed dose is $5 \cdot 10^{-3}$ Gy and the quality factor for neutrons is 7.
A. 12 10^{-3} Sv
B. $2.7 \cdot 10^{-3}$ Sv
C. 35 $\cdot 10^{-3}$ Sv
D. $0.7 \cdot 10^{-3}$ Sv
E. $7 \cdot 10^{-3}$ Sv

21. Determine the absorbed dose of proton radiation if the equivalent dose is $7.28 \cdot 10^{-3}$ Sv. The quality factor for neutrons is 10.
A. 72.8 10^{-2} Gy
B. 7.28 10^{-4} Gy
C. 0.728 10^{-3} Gy
D. $282 \cdot 10^{-2}$ Gy
E. $17.28 \cdot 10^{-2}$ Gy

22. A body weighing 20 kg absorbed 1 J of energy within 3 hours. Determine the absorbed radiation dose rate.
A. $4.6 \cdot 10^{-6}$ W/kg
B. $46 \cdot 10^{-5}$ W/kg
C. $80 \cdot 10^{-2}$ W/kg
D. $90 \cdot 10^{-3}$ W/kg
E. $102 \cdot 10^{-2}$ W/kg

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

23. A body weighing m=75 kg absorbed the energy of ionizing radiation E=14 J during t=18 hours. Calculate the absorbed dose.

A. 0.12 J/kg

B. 0.50 J/kg

C. 0.21 J/kg

D. 0.19 J/kg

E. 194 J/kg

24. A mouse weighing 25g found itself in a field of alpha radiation. His body absorbed about 109 alpha particles, the energy of each particle is about 5 MeV. Determine the equivalent absorption dose. Quality factor k=20 (electron charge 1.6·10-19 C).

A. 500 Sv.

B. 2.2· 1012 Sv.

C. 0.64 Sv.

D. 12.53 Sv.

E. 64· 1012 Sv.

25. The average radiation exposure dose rate in the X-ray room is 6·10-12 C/(kg·s). The doctor spends 5 hours a day in this office. What is his radiation dose over 12 working days?

A. 0.2·10-8 C/kg.

B. 180·10-8 C/kg.

C. 129.6·10-8 C/kg.

D. 5· 10-12 C/kg.

E. 0.0077·10-6 C/kg.

26. How many times is the relative elongation of the abdominal skin greater than that of collagen, at the same tension in them, if the elastic modulus of collagen is 100 MPa, and the elastic modulus of skin is 36 MPa?

A. 2.78;

B. 0.36;

C. 3600;

D. 64;

E. 136.

27. .What is the average arterial pressure that causes a mechanical stress of 60 kPa in the vessel walls if the ratio of the radius of the lumen to the thickness of the vessel wall is 4?

A. 56 kPa;

B. 0.07 kPa;

C. 64 kPa;

D. 240 kPa;

E. 15 kPa

28. .What is the relative transverse strain if Poisson's ratio is 0.3 and the relative longitudinal strain is 0.7?

A. -3.7;

B. -2.3;

C. -4.3;

D. -0.021;

E. -0.23.

29. To what area was a force of 10 N of bone applied if the relative deformation of the muscle was 0.4 and the elastic modulus of the muscle was 105 Pa?

A. 25 mm2;

B. 250 mm2;

C. 4 mm2;

D. 0.04 mm2;

30. How many times is the relative elongation of the ligaments of large joints greater than that of collagen, at the same stress in them, if the elastic modulus of collagen is 100 MPa, and the elastic modulus of ligaments is 10 MPa?
A.　0.1;
B.　110;
C.　90;
D.　1000;
E.　10.

31. What average arterial pressure caused a mechanical stress of 90 kPa in the vessel walls if the ratio of the radius of the lumen to the thickness of the vessel wall is 6?
A.　0.067 kPa;
B.　84 kPa;
C.　15 kPa;
D.　96 kPa;
E.　540 kPa

32. What was the initial length of the muscle if the relative strain due to stretching was 0.4 and the final length of the muscle was 8.4 cm?
A.　8 cm;
B.　0.05 cm;
C.　8.8 cm;
D.　6 cm;
E.　3.36 cm.

33. What is the absolute elongation of the bone if a force of 200 N acts on a bone with a length of 14 cm and a cross-sectional area of 1.4 cm2, and the modulus of elasticity of the bone is 2·109 Pa?
A.　0.01 cm;
B.　1 cm;
C.　0.5 cm;
D.　1.2 cm;
E.　1.25 cm.

34. How many times is the relative elongation of smooth muscle greater than elastin, with the same tension in them, if the elastic modulus of elastin is 105 Pa, and the elastic modulus of smooth muscle is 104 Pa?
A.　0.1;
B.　10;
C.　108;
D.　109;
E.　100.

35. What is the ratio of the radius of the lumen to the thickness of the vessel wall if the vessel tone is 60 kPa and the difference between the mean arterial pressure and the external tissue is 15 kPa?
A.　0.25;
B.　45;
C.　75;
D.　900;
E.　4.

36. What was the length of the tendon, the initial length of which was 5 cm, and the relative elongation when stretched was 0.24?
A.　20.83 cm;
B.　0.048 cm;
C.　6.2 cm;
D.　5.24 cm;

E.   4.76 cm.

37. What was the original length if the absolute deformation of the bone under the action of a force of $12 \cdot 10^2$N per 6 mm2 was 0.2 cm, and the elastic modulus of the bone was $2 \cdot 10^9$Pa?

A.   0.25 cm;
B.   0.2 cm;
C.   4 cm;
D.   2 cm;
E.   1.25.

38. .How many times is the relative elongation of the tendon greater than the bone, with the same stress in them, if the modulus of elasticity of the tendon is $1.6 \cdot 10^8$ Pa, and the modulus of elasticity of the bone is $2 \cdot 10^9$ Pa?

A.   0.8;
B.   3.2;
C.   12.5;
D.   1.8;
E.   1.4.

39. What mechanical stress occurs in the walls of the vessel if the ratio of the radius of the lumen to the thickness of the vessel wall is 3, and the mean arterial pressure is 14 kPa?

A.   4.7 kPa;
B.   11 kPa;
C.   17 kPa;
D.   17 Kpa;
E.   42 kPa

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

40. What mechanical stress occurs in the muscle if the relative strain due to stretching is 0.3 and the elastic modulus for the muscles is $9 \cdot 10^5$ Pa?

A. $0.003 \cdot 10^{-5}$ Pa;
B. $2.7 \cdot 10^5$ Pa;
C. $30 \cdot 10^5$ Pa;
D. $8.7 \cdot 10^5$ Pa;

41. 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.

42. 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 $5 \cdot 10^4$ Pa, and the modulus of elasticity of the vein is $8.5 \cdot 10^5$ Pa?

A.   0.59;
B.   42.5;
C.   3.5;
D.   17;

43. 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?

A.   1.83 kPa;
B.   66 kPa;
C.   0.54 kPa;
D.   17 kPa;
E.   5 kPa.

44. 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 $15 \square 10^7$ Pa and $g = 10$ m/s2?

A.   105.175 kN;
B.   800.125 kN;
C.   30.134 kN;
D.   80.723 kN;
E.   92.325 kN.

45. What is the effective cross-sectional area of the bone if compression with a force of 1800 N causes a relative deformation of $3 \square 10^{-4}$, and the modulus of elasticity of the bone is $2 \cdot 10^9$ Pa?

A.   600 mm2;
B.   3000 mm2;
C.   3600 mm2;
D.   10800 mm2;
E.   1250 mm2.

46. 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 $1.6 \cdot 10^8$ Pa?

A.   180;
B.   144;
C.   56.25;
D.   70;

47. 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?

A.   1.25 kPa;
B.   1 kPa;
C.   9 kPa;
D.   20 kPa;
E.   0.8 kPa

48. What force is required to fracture by compression a femur with a diameter of 30 mm if the tensile strength of the bone is $1.4 \square 10^8$ Pa?

A.   395.64 kN;
B.   420 kN;
C.   21.43 kN;
D.   467 KN;
E.   588 kN.

A.   Find the optical powers of lenses whose focal lengths are 25 cm and 50 cm.1) 0.04 diopters and 0.02 diopters2) 4 diopters and 2 diopters3) 1 diopters and 2 diopters4) 4 diopters and 1 diopters

49. The optical powers of the lenses are 5 diopters and 8 diopters. Determine what their focal lengths are?1) 2 m and 1.25 m2) 20 cm and 12.5 cm3) 2 cm and 1.25 cm4) 20 m and 12.5 m

50. What must be the angle of incidence of the light beam so that the reflected beam makes an angle of 40° with the incident beam?
1) 20°2) 50°3) 40°4) 25°

51. What will be the relative refractive index of the two media if the angle of incidence is 60° and the angle between the reflected and refracted rays is 90°?1) 1.52) √23) √34) 1.2

52. 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?1) 1/√32) √23) 1.54) √3

53. 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 104 mol/m4?

10-8 m2/s

0.005 m2/s.

0.0002 m2/s.

0.01 m2/s.

10-3 m2/s.

54. What is the flux density of formamide through the plasma membrane of Characeratophylla 8 nm thick, if the diffusion coefficient of this substance is 0.7 10-4 m2/s, the concentration of formamide at the initial time outside was equal to 0.2 mol/m3, and inside 10 times less?
A.   3.15 10-6 mol/m2 s
B.   2.02·10-4 mol/m2·s
C.   **1.575 Kmol/m2 s**
D.   100.5 mol/m2 s
E.   3.15 Kmol/m2 s

55. 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 10-4 mol/l, its flux density through the membrane is 6 10-4 mol cm/(l s):
A.   4 cm/s
B.   **12 cm/s**
C.   8.5 cm/s
D.   7.5 cm/s
E.   16 cm/s

52.   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 Kmol/m2 s. The diffusion coefficient of this substance is 0.7·10-4 m2/s.
F.   0.4 mol/m2.
G.   **1.44 mol/m2.**
H.   3.15 Kmol/m2.
I.   7.056 Kmol/m2.
J.   0.72 mol/m2.

53.   How 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? The concentration of potassium ions (K+) on the outer side of the membrane is 10 mol/l, on the inner side - 20 mol/l .?

A. **Will not change.**
B. Will increase 8 times.
C. Will decrease by 2 times.
D. Will increase 4 times.
E. Will decrease by 1.41 times.

54. 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?

A. No. The diffusion coefficient is not related to the permeability of the membrane.
B. **Will increase 3 times.**
C. Will decrease by 1.7 times.
D. Will increase by 1.7 times.

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

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

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

a)   б)   в)   г)   д)
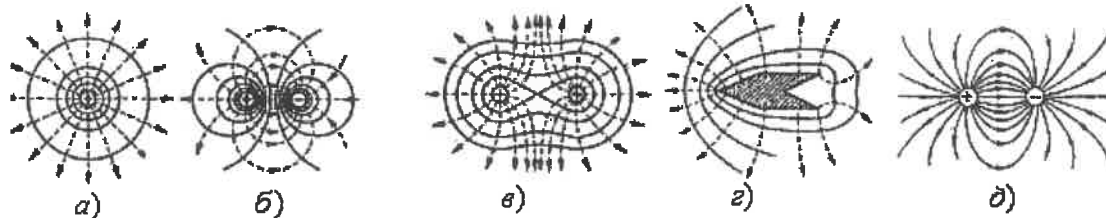
1. #A
2. #b
3. #V
4. #G
   5. #d

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.

19
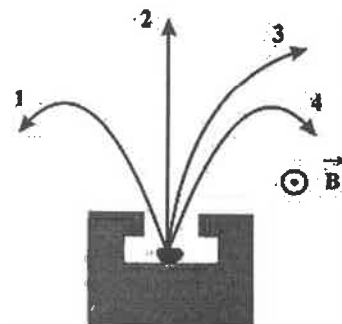
18. Four types of radioactive radiation $\alpha-, \beta^{\pm}-, \gamma$ –the rays are deflected in a magnetic field, the induction of which is directed towards us (Fig.). β^- – rays deviate in the direction...

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. $A = \lambda \cdot N_0 \cdot e^{\mu t}$

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

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

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:
1electrolysis 2 electrolyte
3electrolytic 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...
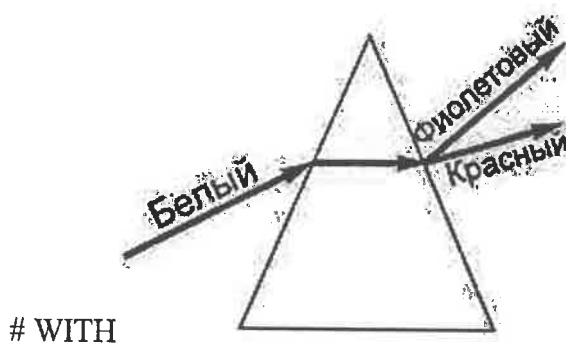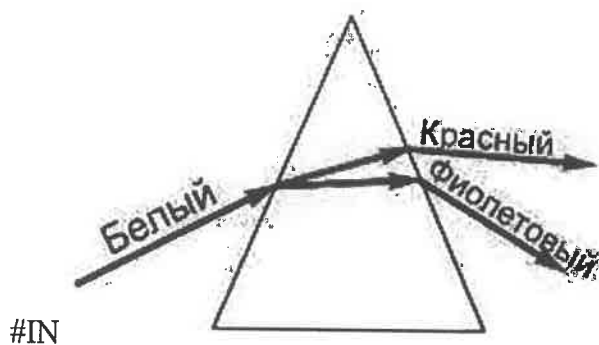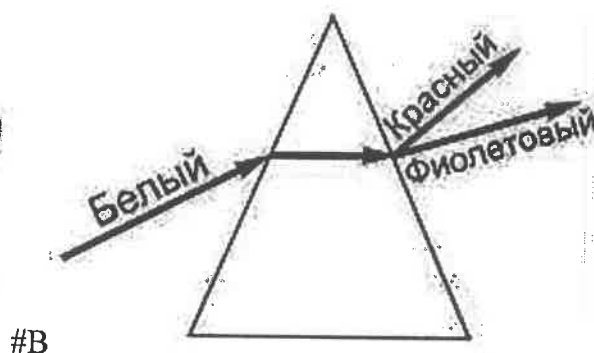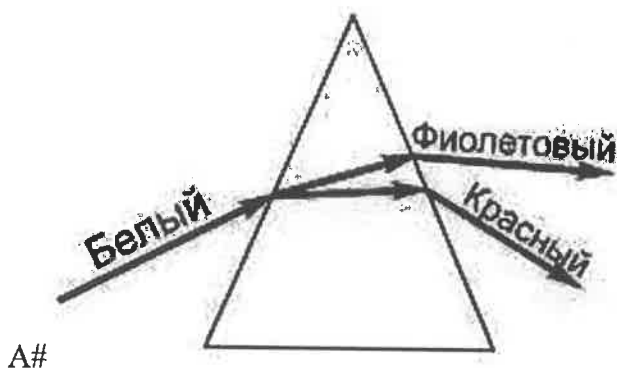
A#   #B

#IN   # WITH

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?

A. Timbre, volume, reverberation.
B. Frequency, volume, reverberation.
C. Pitch, volume, timbre.
D. Pitch, volume, reverberation, frequency.
E. Amplitude, timbre, frequency.

30.   Which of the following parameters affects sound volume?
A. Reverberation, pitch.
B. Frequency, amplitude.
C. Pitch, acoustic spectrum.
D. Acoustic spectrum, amplitude.
E. Amplitude, pitch, acoustic spectrum.

31.   Which of the statements below is incorrect?
A.   # All admissible microstates of a closed system are equally probable.
B.   # The entropy of an isolated body remains constant.
C.   # The entropy of a body in an equilibrium state is maximum.
D.   # 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?

F.	3.44□108 Pa;

G.	2.4·108 Pa;

H.	**1.42·109 Pa;**

I.	1.62·108 Pa;

J.	1.25·108 Pa.

b. Test topics

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.

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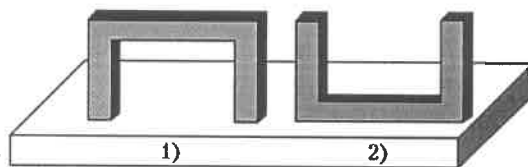
Faculty of Veterinary Medicine

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.
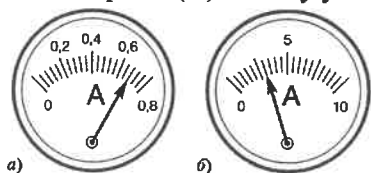
3.   A voltage of U=80 V is applied to a conductor with a resistance of R=40 Ohm. What is the current strength in the conductor?

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 · 10^2 J/(kg*°C), melting point of aluminum tmel=660°C, specific heat of melting of aluminum λ=3.9 · 10^5 J/kg

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

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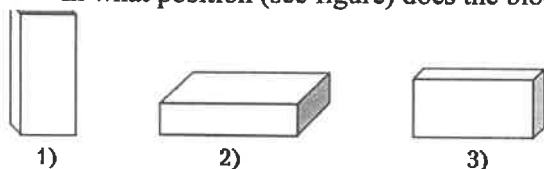Faculty of Veterinary Medicine

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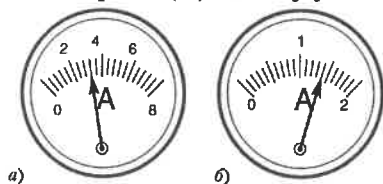
3.   The resistance of the spiral of an electric soldering iron is R=500 Ohm. At what voltage does the soldering iron operate if the current in the soldering iron coil is I=0.440 A?

4.   What amount of heat must be imparted to ice of mass m 1.5 kg, located at a temperature of t −20 °C, in order to heat it to the melting temperature and completely melt it? The specific heat capacity of ice is 2.1 · 10^3 J/(kg*°C), the melting temperature of ice tmel=0.0°C, the specific heat of melting of ice λ=3.33 · 10^5 J/kg.

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

1)   2)   3)

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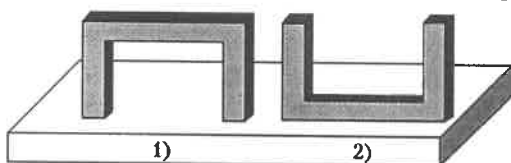
Faculty of Veterinary Medicine

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.

a)   б)
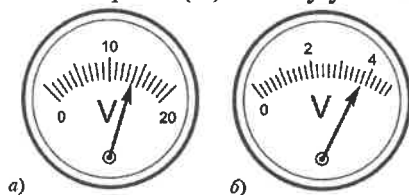
3. How many times is the resistance of a lead wire greater than the resistance of an iron wire if the lengths and cross-sectional areas of the wires are the same? (Resistivity of lead $\rho_1 = 0.21$ Ohm*mm^2/m, resistivity of iron $\rho_2 = 0.10$ Ohm*mm^2/m

4. How much will the temperature of water with a volume $V_1 = 300$ ml change if it receives all the energy released when an iron bar of mass $m_2 = 0.18$ kg is cooled from a temperature $t_1 = 85$ °C to a temperature $t_2 = 15$ °C? Specific heat capacity of water $c_1 = 4.2 \cdot 10^3$ J/(kg*°C), specific heat capacity of iron $c_2 = 4.6 \cdot 10^2$ J/(kg*°C), density of water $\rho = 1.0 \cdot 10^3$ kg/m^3

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

1)   2)

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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.

a)   б)
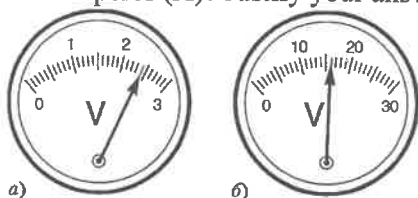
3.   There are two wires made of the same material with the same cross-sectional area. How many times does the resistance of the first wire differ from the resistance of the second, if the length of the first wire is l1=1.0 m, the length of the second is l2=0.2 m?

4.   What amount of heat must be imparted to tin with a mass of m = 1.4 kg, located at a temperature of t = 22 ˚C, in order to heat it to the melting temperature and completely melt it? Specific heat capacity of tin c=250 J/(kg*˚C), melting temperature of tin tmel=232˚C, specific heat of fusion of tin λ=6.03 10^4 J/kg

5.   How does the internal energy of a medical thermometer change when measuring temperature?

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Test No. 1

Option 5

1.   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

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.

a)   б)
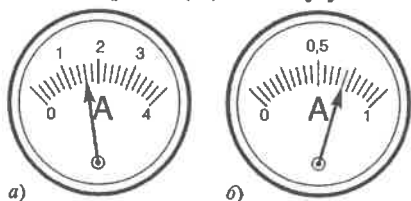
3.   The cross-sectional areas and lengths of nichrome and iron wires are the same. How many times does the resistance of nichrome wire differ from the resistance of iron wire? (Resistivity of nichrome ρ1=1.1 Ohm*mm^2/m, iron ρ2=0.10 Ohm*mm^2/m)

4.   What amount of heat will be released during crystallization and cooling to a temperature t = 25 ˚C of copper weighing m = 50 g, located at the melting point? Specific heat capacity of copper c=3.8 10^2 J/(kg*˚C), melting point of copper tmelting=1085 ˚C, specific heat of fusion of copper λ=2.1 10^5 J/kg

5.   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.