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

APPROVED BY
Vice-Rector
for educational work
and youth policy
Professor
A.A. Sukhinin
May 06, 2024

Department of Inorganic Chemistry and Biophysics

WORKING PROGRAMM

by discipline

"ANALYTICAL CHEMISTRY"

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

Education starts in 2024

Reviewed and accepted
at a department meeting
"02" May 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 THE DISCIPLINE

The main goal of the discipline in the training of veterinarians is to give students fundamental knowledge about chemicals to assess the possibility of their effective use in animal therapy and surgery.

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

a) The general educational task is to in-depth familiarize students with the main chemical substances used in veterinary medicine, their properties and methods of production, which meets the requirements for higher educational institutions of biological profile.

b) The applied task concerns the acquisition of skills in conducting chemical experiments and reactions, including the identification of inorganic substances used as veterinary medicine.

c) The special task is to familiarize students with modern trends and methodological approaches used in inorganic and analytical chemistry, as well as existing achievements in this area.

2. LIST OF PLANNED MASTERING RESULTS IN A 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

Types of professional activity tasks:

- medical;
- expert control;
- scientific and educational.

Student competencies formed as a result of mastering the discipline

Studying the discipline should form the following competencies:

A) Universal Competencies (UC):

UC-1 Able to critically analyze problem situations based on a systematic approach and develop an action strategy:

UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis;

UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies;

UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations.

B) 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.14.02 "Analytical Chemistry" is a mandatory 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).

Mastered in the 2nd semester - full-time.

When teaching the discipline "Analytical Chemistry", the knowledge and skills acquired by students while mastering the school level of chemistry are used. The discipline "Inorganic and Analytical Chemistry" is the basic one on which most subsequent disciplines are built, such as:

1) Organic and physical colloid chemistry.
2) Biological chemistry.
3) Veterinary microbiology and mycology.
4) Veterinary pharmacology.
5) Toxicology.
6) Physiology and ethology of animals.
7) Feeding animals with the basics of feed production.
8) Veterinary and sanitary examination.
9) Life safety.

4. SCOPE OF THE DISCIPLINE "ANALYTICAL CHEMISTRY"

4.1. Scope of the discipline "Analytical Chemistry" for full-time study

Type of educational work	Total hours	Semester
		2
Classroom lessons (total)	**72**	**72**
Including:		
Lectures, including interactive forms		
Practical exercises (PP)), including interactive forms, of which:	34	34
practical training (PT)	2	2
Independent work (total)	**38**	**38**
Control		
Type of intermediate certification (test, exam)	**Test**	**Test**
Total labor intensity hours/credits	**72/2**	**72/2**

5. CONTENT OF THE DISCIPLINE "ANALYTICAL CHEMISTRY"

5.1. Contents of the discipline "Analytical Chemistry" for full-time study

NO.	Name	Formed competencies	Semester	Types of educational work, including independent work of students and labor intensity (in hours)			
				L	PP	PT	S
1.	Introduction to analytical chemistry.	**UC-1**Able to critically analyze problem situations based on a systematic approach and develop an action strategy: UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis; UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies; UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations. **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		2

2.	Basic concepts. Methods of analysis. Classification of analytical chemistry.	**UC-1**Able to critically analyze problem situations based on a systematic approach and develop an action strategy: UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis; UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies; UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations. **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		6		8
3.	Aggregate states of matter and solutions of non-electrolytes. Electrolyte solutions.	**UC-1**Able to critically analyze problem situations based on a systematic approach and develop an action strategy: UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis; UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies; UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations. **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		6		8

4.	Titrimetric methods of analysis. Acid-base titration. Titration curves.	**UC-1**Able to critically analyze problem situations based on a systematic approach and develop an action strategy: UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis; UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies; UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations. **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		6	2	4
5.	Complex connections.	**UC-1**Able to critically analyze problem situations based on a systematic approach and develop an action strategy: UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis; UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies; UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations. **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		6		8

6.	Redoximetry. Complexometric titration. Chelatometry.	**UC-1**Able to critically analyze problem situations based on a systematic approach and develop an action strategy: UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis; UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies; UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations. **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		6		8
		TOTAL FOR 2ND SEMESTER			**32**	**2**	**38**

6. LIST OF EDUCATIONAL AND METHODOLOGICAL SUPPORT FOR INDEPENDENT WORK

6.1.Guidelines for independent work

1. Workbook on inorganic and analytical chemistry: educational method. manual for 1st year students of the Faculty. vet. honey. and vet.-san. fak., for fak. vet. honey. part-time (evening) form of education / A. N. Baryshev [and others]; SPbGAVM. - 4th ed., revised. and additional - St. Petersburg: SPbGAVM, 2017. - 112 p. - URL:https://clck.ru/VWM86(date of access: 04/27/2024). - Access mode: for authorization. users of the SPbSUVM EB. – Text: electronic.

6.2.Literature for independent work

1. Analytical chemistry: educational method. aid for students 1st year FVM, VSE, BEC, VBRIA / comp. T. P. Lutsko [and others]; SPbGAVM. - St. Petersburg. : Publishing house SPbGAVM, 2016. - 39 p. -Quantity – 200. (date of access: 04/27/2024).

2. Analytical chemistry: educational and methodological manual for first-year students of FVM, VSE, BEC, VBRiA / comp. T. P. Lutsko [and others]; SPbGAVM. - St. Petersburg: SPbGAVM, 2016. - 39 p. - URL:https://clck.ru/R6xPh(date of access: 04/27/2024). - Access mode: for authorization. users of the SPbSUVM EB. – Text: electronic

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

a) basic literature:

1. Golovneva I. I. General, inorganic and analytical chemistry: Textbook Krasnoyarsk State Agrarian University. for agricultural universities / G.P. Khomchenko, I.K. Tsitovich. M.: Higher. school, 2009. 463 p. 8. Tsitovich, I.K. Course of analytical chemistry / I.K. Tsitovich. M.: Higher. school, 2009. 496 p. Text: electronic // Lan: electronic library system. — URL:https://e.lanbook.com/book/50684URL: (access date: 04/27/2024)

b) additional literature:

1. Akhmetov, N.S. Laboratory and seminar classes in general and inorganic chemistry [Electronic resource]: textbook. allowance / N. S. Akhmetov, M. K. Azizova, L. I. Badygina. - 6th ed., erased. - St. Petersburg: Lan, 2014. - 368 p. Access mode:http://e.lanbook.com/books/element.php?pl1_id=50685. Quantity – 0.Text. allowance. Access from EBS "Lan". (access date: 04/27/2024).—Access mode: for authorization. Users: – 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. http://vanat.cvm.umn.edu– Inorganic and Analytical Chemistry University of Minnesota

Electronic library systems:

1. EBS "SPBGUVM"
2. EBS "Publishing house "Lan"
3. EBS "Student Consultant"
4. Legal reference system "ConsultantPlus"
5. University information system "RUSSIA"
6. Full text database POLPRED.COM

7. Scientific electronic library ELIBRARY.RU
8. Russian Scientific Network
9. Electronic library system IQlib
10. Web of Science International Science Citation Index Database
11. Full-text interdisciplinary database for agricultural and environmental sciencesProQuest AGRICULTURAL AND ENVIRONMENTAL SCIENCE DATABASE
12. Electronic books from the publishing house "Prospekt Nauki"http://prospektnauki.ru/ebooks/
13. 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:

- 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 educational work (from 8-14 o'clock), then the afternoon (from 16-19 o'clock) and the evening time (from 20-24 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) familiarize yourself with the plan for the upcoming lesson;

2) study the literature sources that were recommended and read the introductory notes 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) classes in the discipline should be focused on modern business 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.

- Recommendations for working with literature.

Working with literature is an important stage of a student's independent work in mastering a subject, contributing not only to consolidation of knowledge, but also to broadening his horizons, mental abilities, memory, ability to think, present and confirm his hypotheses and ideas. In addition, research skills necessary for future professional activities are developed.

When starting to study literature on a topic, it is necessary to make notes, extracts, and notes. It is imperative to take notes on the works of theorists, which allow one to comprehend the theoretical basis of the study. For the rest, you can limit yourself to extracts from studied sources. All extracts and quotations must have an exact "return address" (author, title of work, year of publication, page, etc.). It is advisable to write an abbreviated name of the question to which the extract or quotation relates. In addition, it is necessary to learn how to immediately compile a card index of specialized literature and publications of sources, both proposed by the teacher and identified independently, as well as refer to bibliographic reference books, chronicles of journal articles, book chronicles, and abstract journals. In this case, publications of sources (articles, book titles, etc.) should be written on separate cards, which must be filled out in accordance with the rules of bibliographic description (surname, initials of the author, title of work. Place of publication, publisher, year of publication, number of pages, and for journals articles – journal name, year of publication, page numbers). On each card, it is advisable to record the thought of the author of the book or a fact from this book on only one specific issue. If the work, even in the same paragraph or phrase, contains further judgments or facts on another issue, then they should be written out on a separate card. The presentation should be concise, accurate, without subjective assessments. On the back of the card you can make your own notes about this book or article, its contents, structure, what sources it was written on, etc.

• Explanations about working with test materials for the course, recommendations for completing homework.

Testing is a check that allows you to determine whether the actual behavior of a program corresponds to what is expected if you run a specially selected set of tests. 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.

• Recommendations for completing course work (if it is included in the curriculum), defining their thematic focus, goals and objectives of implementation, requirements for content, volume, design and organization of management of their preparation on the part of departments and teachers.

10. EDUCATIONAL SOCIAL 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;

✓ joint work in the Electronic Information and Educational Environment of St. Petersburg State University of Mathematics and Mathematics: 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**
Analytical chemistry	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, blackboard. *Visual aids and educational materials:*Periodic table of chemical elements D.I. Periodic table, Solubility table
	105 (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, blackboard. *Visual aids and educational materials:*Periodic table of chemical elements D.I. Periodic table, Solubility table
	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
	Box No. 3 Carpentry workshop (196084, St. Petersburg, Chernigovskaya str., building 5) Room for storage and preventive maintenance of educational equipment	*Specialized furniture:*tables, chairs, special equipment; materials for preventive maintenance of specialized furniture

Annex 1 for _18_ 1.

The work program was compiled by:

Candidate of Chemical Sciences, Associate Professor A.N. Baryshev

Annex 1

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

Department of Inorganic Chemistry and Biophysics

FUND OF ASSESMENT TOOLS
for the discipline

for discipline

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

Education starts in 2024

Saint Petersburg
2024

1. PASSPORT OF THE ASSESSMENT FUND

Table 1

No.	Molded competencies	Controlled sections (topics) of the discipline	Evaluation tool
1.	**UC-1**Able to critically analyze problem situations based on a systematic approach and develop an action strategy: UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis; UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies; UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations. **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.	Introduction to analytical chemistry.	Colloquium, tests
2.		Basic concepts. Methods of analysis. Classification of analytical chemistry.	Colloquium, tests
3.		Aggregate states of matter and solutions of non-electrolytes. Electrolyte solutions.	Colloquium, tests
4.		Complex connections.	Colloquium, tests
5.		Titrimetric methods of analysis. Acid-base titration. Titration curves.	Colloquium, tests
6.		Redoximetry. Complexometric titration. Chelatometry.	Colloquium, tests

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 measuring the level of knowledge and skills of the student	Test task fund

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	
UC-1 Able to critically analyze problem situations based on a systematic approach and develop an action strategy:					
UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis;	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
UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies;	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
UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to	When deciding standard tasks Not demonstrated basic skills there were rough	Available minimum set skills for solutions standard tasks with some	Basic skills demonstrated when deciding standard tasks with some shortcomings	Demonstrated skills in decision non-standard tasks without errors and	Colloquium, tests

solve them; demonstrating value judgments in solving problematic professional situations.	errors	shortcomings		shortcomings	
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
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
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

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

4.1.1. Questions for the colloquium

Competency assessment questions:

UC-1 Able to critically analyze problem situations based on a systematic approach and develop an action strategy:

UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis;

1. Methods of expressing the concentrations of solutions and their mutual transition.
2. Working solutions, methods of their preparation.
3. Titrated, standard and standardized solutions.
4. What is a normal (standard substance)? What standard substances do you know?

UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies;

5. Rules for using a burette and pipette.
6. Rules for selecting the test sample.
7. Measuring utensils, their purpose.
8. The principle of titrimetric analysis. Scope of its application.
9. The essence of acid-base titration.

UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations.

10. Acid-base titration indicators. Ionic theory of indicators. Color transition area and indicator titration index.
11. Titration of strong and weak bases with a strong acid. Reactions underlying definitions. The solution environment at the equivalence point.12. Titration curves of strong and weak bases with strong acids and selection of indicators.
12. Titration of strong and weak acids with a strong base. Reactions underlying definitions. The solution environment at the equivalence point.
13. Titration curves of strong and weak acids with a strong base and the choice of indicators.
14. Equivalence point and rules for its determination.
15. Is it possible to determine the quantity of:

NH_4OH, HNO_3, K_2SO_3, NH_4NO_3, $NaOH$, H_2SO_4, K_2SO_4? What working solutions should be used to titrate solutions of these substances, if titration is possible?

Competency assessment questions:

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;

16. Redox reactions as the basis of the permananatometry method.
17. Equivalent to oxidizing and reducing agents. Equivalent to potassium permanganate depending on the medium.
18. Preparation of a standardized solution of potassium permanganate. Conditions for its storage.
19. Initial substances used to standardize potassium permanganate solution.
20. Preparation and storage of working solutions of iodine and sodium thiosulfate.

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

21. Indicators of the iodometry method.
22. How is the equivalence point established in the permanganatometry method?
23. How is the equivalent of oxidizing agents and reducing agents calculated in redoximetry methods? Give examples of reactions used as the basis for the calculation.
24. How is the equivalence point established in the iodometry method?

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

25. Formulas for calculating normality, titer and mass of the analyte in the methods of permanganatometry and iodometry.
26. The quantities of what substances can be determined by permanganatometry?
27. The quantities of what substances can be determined by iodometry?
28. What reactions are the basis of permanganatometry methods?
29. What reactions are the basis of methods and iodometry?
30. Difference between equivalence points in the neutralization method and redoximetry?

4.1.2. Tests

UC-1 Able to critically analyze problem situations based on a systematic approach and develop an action strategy:

UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis;

1.What is the mass number of an atom?

A)number of protons in an atom **b)**number of neutrons in an atom
V)number of nucleons in an atom **G)**number of electrons in an atom

2.What is the number of neutrons in a 31 15 R atom?

A)31 **b)**16
V) 15 **G)**46

3.What quantum number characterizes the direction of the electron cloud in space?
A)n **b)**l
V)ml **G)**ms

4.What values does the magnetic quantum number take for d-sublevel orbitals?
A)0, 1, 2 **b)**□ 2, □ 1.0, +1, +2
V)-1, 0, +1 **G)**1, 2, 3

5.What is the number of orbitals in the *f*-sublevel?
A)1 **b)**3
V)5 **G)**7

6.Atoms of which element have the electronic configuration of the outer layer: 4s24p5?
A)$_{35}$Br **b)**7N
V)$_{33}$As **G)**$_{23}$V

7.How do atoms of isotopes of the same element differ?
A)number of protons **b)**number of neutrons
V)number of electrons **G)**nuclear charge

8.What is the mass number of nitrogen 7N, which contains 8 neutrons?
A)14 **b)**15
V)16 **G)**17

9.What values does the orbital quantum number take for the second energy level?
A)0, 1, 2 **b)** -2, - 1, 0, +1,+2
V)0.1 **G)**1

10. What is the designation for the sublevel for which n = 4 and l = 0?
A)4*f* **b)**4d
V)4p **G)**4s

eleven. Which elements have atoms with the electronic configuration of the outer layer:...3s23p4?
A)$_{6}$WITH **b)**$_{14}$Si
V)$_{16}$S **G)**$_{24}$Cr

12. What is the general formula for a base?
A)Me(OH)y **b)**H2(Ac)
V)Em On **G)**Fur (Ac)y

13. Which oxide is amphoteric?
A)ZnABOUT **b)**SiO2
V)SiABOUT **G)**Na2O

14. Which base is a diacid base?
A)CON **b)**Bi(OH)3
V)NH4HE **G)**Sn(OH)2

15. Which acid is dibasic?

A)HNO2 b)HB2
V)H2CO3 G)H3BO3

16. Which salt is an acidic salt?
A)[Fe(OH)2]2CO3 b)Fe (HCO3)3
V)Fe OH CO3 G)Fe2 (CO3)3

17. What is the valence of the acid-forming element in the perchloric acid molecule HCl O4?
A)II b)III
V)IV G)VII

UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies;

18. Which acid corresponds to the name "sulfurous acid"?
A)H2S b)H2S2O3
V)H2SO3 G)H2SO4

19. Which salt corresponds to the name "bismuth III carbonate"?
A)BiOHCO3 b)Bi2 (CO3)3
V)Bi (HCO3)3 G)[Bi (OH2)] CO3

20. What salt corresponds to the name bismuth hydrosulfate III?
A)Bi (HSO4)3 b)Bi(HSO3)3
V)Bi (OH) SO4 G)[Bi (OH2)]2 SO4

21. What salt corresponds to the name "aluminum dihydroxosulfite"?
A)[AL(OH)2]2 SO_4 b)ALONSO3
V)[AL(OH)2SO_3 G)ALONSO4

22. Which of the following substances are crystalline hydrates?
A)K2SO3 b) $Sn(NO_3)_2$
V)RbOH G) $BaS \cdot 6H_2O$

23. Which of the following substances are soluble in water?
A)$AlPO_4$ b) $C_aÑÎ_3$
V)AgNO3 G)CuS

24. Which of the following substances are soluble in water?
A)AgBr b)Cu(OH)2
V)Zn(NO3)2 G)HgS

25. What formula can be used to calculate the mass fraction of a dissolved substance?
A) $m = V \cdot p$ b) $C = \frac{n}{V}$

V) $m(в-ва)=m(р-ра)-m(H_2O)$ G) $\omega=\frac{m(в-ва)}{m(р-ра)}$

26. How many grams of dissolved substance are contained in 50 g of solution with a mass fraction $\omega\%$ (in □ va) = 10%?

A)10g **b)**20g
V)5g **G)**40g

27. How many moles of solute are contained in 1 liter of decimolar solution?

A)0.2mol **b)**1mol
V)0.1mol **G)**0.01mol

28. What formula can be used to calculate the molecular concentration of a solution?

A) $\omega=\frac{m(в-ва)}{m(р-ра)}$ **b)** $C=\frac{n}{V}$
V) $m=V\cdot p$ **G)** $m(р-ра)=m(в-ва)+m(H_2O)$

UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations.

29. How many grams of dissolved substance are contained in 150 g of solution with a mass fraction $\omega\%$ (in □ va) = 5%?

A)15g **b)**7.5g
V)10g **G)**5.0g

30. Which of the following electrolytes, when dissociated, form H+ and OH□ ions simultaneously?

A)Ca(OH)2 **b)**CON
V)H3PO4 **G)**AI(OH)3

31. Which particles are anions?

A)Fe3+ **b)** NO_3^-
V) CU^{2+} **G)**Mn2+

32. Which electrolytes are strong?

A)HI **b)**KOH
V)H2S **G)**H3PO4

33. Which of the following elements can correspond to ions with charge □ 2?

A)Ca **b)**O
V)Fe **G)**Sn

34. How many ions are formed during the dissociation of the (NH4)2SO4 molecule?

A)2 **b)**9
V)3 **G)**4

35. Which of the following reactions is expressed by the abbreviated ionic equation H+ + OH□ = H2O?

A) $HCI + Cu(OH)_2 \rightarrow$ CuOHCI+H2O b)HBr+KOH+KBr+H2O

V) $2HNO_3 + Fe(OH)_2 \rightarrow Fe(NO_3)_2 + 2H_2O$ G) $H_2SO_3 + RbOH \rightarrow RbHSO_3 + H_2O$

36. Which electrolytes are written as ions in the ionic equation of the following reaction: $CaCO_3 + 2HI = CaI_2 + CO_2 \uparrow + H_2O$?

A)CaCO3 b)HI

V)CaI2 G)CO2

37. What substances form Mn2+ ions upon dissociation?

A)KMnO4 b)MnCI2

V)Na2MnO4 G)MnO2

38. What electrolytes form chloride ions CI- upon dissociation?

A)KCIO3 b)HCI

V)Ca(CIO)2 G)HCIO

39. Ions with a charge of +1 can correspond to which of the following elements?

A)N b)Sr

V)Sa G)Fe

40. Which particles are cations?

A) NH_4^+ b) $Cr_2O_7^{2-}$

V) NO_3^- G) $H_2PO_4^-$

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;

1.Which of the following electrolytes are weak?

A)H2SO4 b)NaCI

V)AI(NO3)3 G)H3PO4

2.How many ions are formed when two FeCI3 molecules dissociate?

A)4 b)10

V)8 G)5

3.Which of the following reactions is an ion exchange reaction?

A) $H_2O + CI_2 \rightarrow HCI + HCIO$ b)CaO + H2O = Ca(OH)2

V) $Ba(NO_3)_2 + Na_2SO_4 = BaSO_4 \downarrow + 2NaNO_3$ G) $2H_2 + O_2 \rightarrow 2H_2O$

4.Which substances in the ionic equation of the following reaction are written in the form of molecules: $H_2S + Pb(NO_3)_2 = PbS \downarrow + 2HNO_3$?

A)H2S b)Pb(NO3)2

V)PbS G)HNO3

5.Which of the following electrolytes produces hydroxide ions when dissociated?
A)H_2SO_4 **b)**AI(OH)2CI
V)Ca(HCO3)2 **G)**Sn(OH)2

6.What is the solution environment if [OH□] = 10-11 mol/l?
A)sour **b)**alkaline
V)neutral

7.What is the ionic product of water (t = 250C)?
A)10-12 **b)**10-10
V)10-14 **G)**10-9

8.What is the solution environment if pH < 7?
A)neutral **b)**sour
V)alkaline

9.What is the pH of the solution if [H+] = 10-5 mol/l?
A)8 **b)**12
V)5 **G)**9

10. Which of the following salts does not undergo hydrolysis?
A)PbNO3 **b)**KNO3
V)$AI_2(SO_4)_3$ **G)**Pb2CO3

eleven. Solutions of which electrolytes are characterized by pH values > 7?
A)Na2CO3 **b)**CaS
V)AI(NO3)3 **G)**BaCI2

12. In solutions of which salts does methyl orange appear yellow?
A)Na2S **b)**LiCI
V)HCI **G)**H3PO4

13. At what pH values does phenolphthalein turn crimson?
A)12 **b)**4
V)7 **G)**14

14. What color does litmus acquire in a neutral environment?
A)raspberry **b)**blue
V)red **G)**purple

15. Solutions of which salts are characterized by pH values > 7?
A)NaBr **b)**$AgNO_3$
V)FeCI3 **G)**CuSO4

16. Which of the following substances can sulfur(VI) oxide react with?
A)NaCI **b)**Na2O
V)HNO3 **G)**HCI

17. Which of the following substances can zinc oxide react with?
A)H2O **b)**KOH
V)H2SO4 **G)**AI2(SO4)3

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

18. When two substances interact, a neutralization reaction occurs?
A)NaCI+AgNO3 **b)**BaCI2+H2O
V)NaOH+HNO3 **G)**BaCI2+H2SO4

19. What metals can a copper(II) chloride solution react with?
A)Zn **b)**Hg
V)Fe **G)**Ag

20. What acid is formed when phosphorus (III) oxide reacts with water?
A)H3PO4 **b)**H2SO4
V)HPO3 **G)**H3PO3

21. Isotopes of a chemical element differ from each other:
A)by number of neutrons **b)**by number of electrons
V) by number of protons **G)**by position in the periodic table

22. What gas is released when dilute sulfuric acid reacts with iron?
A)H2S **b)**H2
V)SO2 **G)**SO3

23. Nitric oxide (V) can react with which of the following substances?
A)CaCI2 **b)**H2O
V)H2SO4 **G)**HCI

24. Which of the following substances can sodium oxide react with?
A)H2O **b)**BaO
V)NaOH **G)**BaSO4

25. What metals can lead(II) nitrate solution react with?
A)Hg **b)**Cu
V)Au **G)**Al

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

26. Which scientist discovered the law of constancy?
A)J. Priestley **b)**J.L. Proust
V)K. Scheele **G)**J. Dalton

27. What chemical compounds of variable composition are called:
A)complex substances **b)**colorblind
V)complex substances **G)**berthollides

28. What chemical compounds of constant composition are called:
A)berthollides **b)**substances
V)colorblind **G)**corpusculids

29. The basis of modern qualification of chemical elements is:
A)valence **b)**atomic structure
V)atomic mass **G)**number of protons in the nucleus of an atom

30. How a covalent bond occurs:
A)electron clouds
b)valence electrons
V)two shared electrons, or electron pair
G)electrostatic forces of attraction

31. What is the total number of electrons in the Cr3+ ion:
a) 21 b) 24 c) 27 d) 52

32. Only ionic bonding exists in:
a) NaOH b) SiF4 c) CaF2 d) K2SO4

33. How does the entropy change in the reaction:
$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$
1) will not change 3) will decrease
2) will increase 4) first decrease, then increase

34. Which reaction occurs spontaneously?
a) $\Delta G > 0$ b) $\Delta G < 0$ c) $\Delta S < 0$ d) $\Delta H > 0$ $\Delta S < 0$

35. In a reversible chemical reaction $2NO(g)+O_2(g) \leftrightarrow 2NO_2$ $\Delta H < 0$, the equilibrium will shift towards the reaction product when:
1) increasing pressure 3) increasing product concentration
2) increasing the temperature 4) introducing a catalyst

36. What is the mass of potassium hydroxide that must be dissolved in 300 ml of water to obtain a 15% solution?
a) 52.9 b) 60.3 c) 45.7 d) 54.8

37. What is the mass fraction (%) of magnesium chloride in the solution obtained by mixing 200 g of a 10% solution and 300 ml. 0.5 M solution (c = 1.08 g/ml) is equal to:
a) 6.5 b) 12.0 c) 8.4 d)9.3

38. How to calculate the degree of hydrolysis of potassium acetate in a 0.1 M solution $K(CH_3COOH)=1.8 \cdot 10^{-5}$:
a) $5.5 \cdot 10^{-3}$ b) $5.56 \cdot 10^{-3}$ c) $5.5 \cdot 10^{-8}$ d) $7.45 \cdot 10^{-5}$

39. How to calculate the ratio of the concentrations of a weak acid and its salt (Ca: Cs) in a buffer solution if pH = 1.74 and pKa = 3.74.
a) 2:1 b) 100:1 c) 1:2 d) 1:100

40. How alkali metals are obtained in industry:
a) electrolysis of halide solutions
b) electrolysis of halide melts
c) thermal decomposition of alkalis
d) reduction of oxides.

3.2. Typical tasks for intermediate certification

3.2.1. Questions for testing

Formed competencies:
UC-1 Able to critically analyze problem situations based on a systematic approach and develop an action strategy:

UC-1ID-1 Know the methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis;

1.Tasks and classification of methods of analytical chemistry.
2.Types and methods of analysis.
3.Analytical properties and reactions.
4. Methods of expressing the composition of a solution.
5.Electrolytic dissociation.
6. Chemical equilibrium.

UC-1ID-2 Be able to obtain new knowledge based on analysis, synthesis, etc.; collect and summarize data on current scientific issues related to the professional field; search for information and solutions based on actions, experiment, experience, information and communication technologies;

7.Homogeneous chemical equilibrium.
8. Heterogeneous chemical equilibrium.
9.Salt effect.
10. Fractional precipitation.
11.Main types of chemical reactions.
12. Calculation of pH in aqueous solutions of acids.

UC-1ID-3 Be able to study the problem of professional activity using analysis, synthesis and other methods of intellectual activity, including the use of information and communication technologies; identifying problems and using adequate methods to solve them; demonstrating value judgments in solving problematic professional situations.

13.Characteristics of complex compounds.
14. Oxidation – reduction reactions.
15. Qualitative chemical analysis: reactions, reagents, methods, classification of cations.
16. Analytical reactions of cations of analytical group 4.

17. Analytical classification of anions using the example of groups 1 and 2.
18.Elemental and functional analysis of organic compounds.
19.Quantitative chemical analysis: gravimetric analysis.

Formed competencies:
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;

20. Quantitative chemical analysis: titrimetric.
21. Acid - basic titration.
22. Complexometric titration.

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

23. Oxidation-reduction titration.
24. Precipitation titration.
25.Electrochemical methods of analysis: characteristics, indicator electrodes and comparisons.

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

26. Spectroscopic methods and their classification.
27.Atomic spectral methods.
28. Molecular spectral methods.
29. Sorption is the basis of chromatography.
30.Types of indicators.

4.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 5 questions:

- **Mark "excellent"**– 5 correct answers.
- **Mark "good"**– 4 correct answers.
- **Mark "satisfactory"** –3 correct answers.
- **Mark "unsatisfactory"**– less than 2 correct answers

Criteria for assessing knowledge during the test:

- **Grade "passed"** must meet the parameters of any of the positive ratings ("excellent", "good", "satisfactory").
- A "failed" grade must correspond to the parameters of an "unsatisfactory" grade.
- Mark "excellent" – all types of academic 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 errors are made, a lack of knowledge, abilities, and skills is manifested in a larger number of indicators; the student experiences significant difficulties in operating knowledge and skills when transferring them to new situations

5. 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 can 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.