MINISTRY OF HEALTH OF UKRAINE

ODESSA NATIONAL MEDICAL UNIVERSITY

Department of Pharmaceutical Chemistry

APPROVED by

Vice-rector for scientific and pedagogical work

_____ Eduard BURYACHKIVSKY

September 1, 2023

WORK PROGRAM OF EDUCATIONAL DISCIPLINE "GENERAL AND INORGANIC CHEMISTRY"

Level of higher education:second (master's)

Field of knowledge:22 "Health care"

Specialty:226 "Pharmacy, industrial pharmacy"

Specialization:226.01 Pharmacy

Educational and professional program: Pharmacy, industrial pharmacy

2023

The work program is based on the educational and professional program "Pharmacy, industrial pharmacy" of training specialists of the second (master's) level of higher education in specialty 226 "Pharmacy, industrial pharmacy" field of knowledge 22 "Health care", approved by the Scientific Council of ONMedU (protocol no. 8 of June 29, 2023).

Developers: prof. Gelmboldt V.O., assistant. Lytvynchuk I.V., senior lecturer Nikitin O.V., assistant. Golubchyk H.O.

The working program is approved at the meeting of the department of pharmaceutical chemistry Minutes No. 1 dated 28/08/2023.

Head of the department _____ Volodymyr GELMBOLDT

Approved by the guarantor of
the educational and professional program _____ Liana UNHURIAN

Approved by the subject-cycle methodological commission on pharmaceutical disciplines Minutes No. 1 dated 29/06/2023

Head of the subject-cycle methodological commission on pharmaceutical disciplines

_____ Iryna BORYSYUK

Revised and approved at the meeting of the department of pharmaceutical chemistry and Drug Technology
Minutes No. 1 dated 7 /09/2023.

Head of the department _____ Volodymyr GELMBOLDT

Revised and approved at the meeting of the department of pharmaceutical chemistry
Minutes No. __ dated __/__/20__.

Head of the department _____ Volodymyr GELMBOLDT

1. Description of the academic discipline:

<table>
<tr><th>Name of indicators</th><th>Field of knowledge, specialty, specialization, level of higher education</th><th>Characteristics of the academic discipline</th></tr>
<tr><td rowspan="7">The total number of:

Credits: 7

Hours: 210

Content modules: 6</td><td rowspan="14">Branch of knowledge
22 "Health care"

Specialty
226 "Pharmacy, industrial pharmacy"

Specialization
226.01 "Pharmacy"

Level of higher education
second (master’s degree)</td><td>Full-time education
Compulsory discipline</td></tr>
<tr><td>Year of training 1</td></tr>
<tr><td>Semester I-II</td></tr>
<tr><td>Lectures (30 hours)</td></tr>
<tr><td>Practical (80 hours)</td></tr>
<tr><td>Independent work (100 hours)</td></tr>
<tr><td>Final control form- exam</td></tr>
<tr><td rowspan="7">The total number of:

Credits: 6

Hours: 180

Content modules: 6</td><td>External form of education
Compulsory discipline</td></tr>
<tr><td>Year of training 2</td></tr>
<tr><td>SemesterIII</td></tr>
<tr><td>Lectures (4 hours)</td></tr>
<tr><td>Practical (14 hours)</td></tr>
<tr><td>Independent work (162 hours)</td></tr>
<tr><td>Final control form- exam</td></tr>
</table>

2.The purpose and tasks of the educational discipline, competencies, program learning outcomes

The purpose: formation of the initial level of knowledge of students, necessary for the further successful study of chemical and special disciplines and the implementation of professional tasks, instilling in students the skills of chemical thinking and generalization of experimental results, the ability to analyze the properties of substances and predict the possibility of their interaction, products of chemical transformations and offer conditions for their storage and possible methods of analysis.

The tasks of the discipline:

- The formation of basic chemical concepts in students,
- Awareness of the relationship between the composition and structure of substances and their properties,
- Mastering the basic patterns of chemical processes,
- The use of theoretical knowledge in solving practical tasks,
- The development of chemical thinking, the ability to independently acquire scientific knowledge of chemistry.

The process of studying the discipline is aimed at forming elements of the following competencies:

General competencies (GC)

GC 1 – Ability to think abstractly, analyze and synthesize, learn and be modernly trained.
GC 2 – Knowledge and understanding of the subject area and understanding of professional activity.
GC 5 – Ability to evaluate and ensure the quality of performed works.
GC 11- Ability to apply knowledge in practical situations.
GC 16 – Ability to conduct experimental research at the appropriate level.

Professional competencies (PC) are

PC 19 – Ability to organize and carry out quality control of medicinal products of natural and synthetic origin in accordance with the requirements of the current edition of the State

Pharmacopoeia of Ukraine, quality control methods (QC), technological instructions, etc.; to prevent the distribution of low-quality, falsified and unregistered medicinal products.
PC 20 – Ability to develop and evaluate methods of quality control of medicinal products of natural and synthetic origin, including active pharmaceutical ingredients, medicinal plant raw materials and auxiliary substances using physical, chemical, physico-chemical, biological, microbiological, pharmaco-technological methods; carry out standardization of medicinal products in accordance with current requirements.
PC 24 –Ability to use knowledge of regulatory and legal acts of Ukraine and recommendations of proper pharmaceutical practices in professional activities.

Program learning outcomes (PLO):
PLO 3 – To have specialized knowledge and skills/skills for solving professional problems and tasks, including for the purpose of further development of knowledge and procedures in the field of pharmacy.
PLO 23. Determine the main chemical and pharmaceutical characteristics of medicinal products of natural and synthetic origin; choose and/or develop quality control methods for the purpose of their standardization using physical, chemical, physico-chemical, biological, microbiological and pharmaco-technological methods in accordance with current requirements.
PLO 25 – To comply with the norms of the sanitary and hygienic regime and the requirements of safety equipment when carrying out professional activities.
PLO 28 - To carry out professional communication in the state language, use oral communication skills in a foreign language, analyzing specialized texts and translating foreign language information sources.
PLO 29 – To carry out professional activities using information technologies, "Information databases", navigation systems, Internet resources, software and other information and communication technologies.
PLO 36 – Plan and implement professional activities on the basis of normative legal acts of Ukraine and recommendations of proper pharmaceutical practices.

As a result of studying the academic discipline, the student of higher education must:

Know: basic concepts and laws of chemistry; terminology and nomenclature of chemical compounds; regularities of the course of chemical processes, the basis of modern theories of the structure of the atom and chemical bonding; physical and chemical properties of elements and their most important compounds; physico-chemical bases of the use of inorganic substances in medicine and pharmacy.

Be able:

- apply chemical concepts and laws, adapt the acquired knowledge to solve practical problems;
- to classify elements, compounds, chemical processes in accordance with modern chemical nomenclature.
- perform calculations according to the equation of chemical reactions, determine the yield of the product, find the thermal effects of the reaction; determine the possibility of a chemical process and its direction under standard conditions;
- based on the position of the element in the PS, determine the structure of its atom, predict its degree of oxidation in compounds and its chemical properties
- find connections between the composition of a substance, its structure and chemical properties;
- determine the possible formation of various types of chemical bonds;
- use educational, scientific and reference literature.

3. Content of the academic discipline

Content module 1. Introduction to the study of general and inorganic chemistry. Basic concepts and laws of chemistry.Structure of substances. Periodic Law and PSE D.I. Mendeleev.

Topic 1. Introduction to the study of general and inorganic chemistry. Basic concepts and laws of chemistry.
Topic 2. The structure of an atom and its electron shells.
Topic 3. Nucleus. Radioactivity. Nuclear reactions.
Topic 4.D. I. Mendeleev's periodic law and its interpretation based on the electronic structure of atoms.
Topic 5. Chemical bond and structure of molecules.

Content module 2.Classes and commenclature of inorganic compounds. Energetics of chemical and phase transformations. Direction of chemical reactions.The doctrine of solutions

Topic 6. Classes and nomenclature of inorganic compounds. Oxides, peroxides, peroxides, ozonides and hydroxides.
Topic 7. Energetics and directionality of chemical processes.
Topic 8. The speed of chemical reactions.
Topic 9. Catalysis.
Topic 10. Methods of expressing the quantitative composition of solutions.
Topic 11. Properties of solutionselectrolytes and non-electrolytes.
Topic 12. General characteristics of hydrolysis of salts.

Content module 3.Redox reactions. Complex compounds

Topic 13. Redox reactions.
Topic 14. Complex compounds.

Content module 4. Physical and chemical properties of simple substances and compounds of s-elements

Topic 15. Introduction to the chemistry of elements and their compounds. Properties of metals and non-metals.
Topic 16. General characteristics of s-elements. Physical and chemical properties of simple substances and compounds of elements of group IA. Hydrogen.
Topic 17. Physical and chemical properties of simple substances and compounds of elements of group IA. A subgroup of alkali metals.
Topic 18. Physical and chemical properties of simple substances and compounds of elements of the IIA group.

Content module 5. Physical and chemical properties of simple substances and compounds of p-elements.

Topic 19. General characteristics of p-elements. Physical and chemical properties of simple substances and compounds of IIIA group elements.
Topic 20. Physical and chemical properties of simple substances and compounds of elements of group IVA. Properties of carbon, silicon and their compounds.
Topic 21. Physical and chemical properties of simple substances and compounds of elements of group IVA. Elements of the Germany subgroup.
Topic 22. Physical and chemical properties of simple substances and compounds of VA group elements. Nitrogen.
Topic 23. Physical and chemical properties of simple substances and compounds of VA group elements. Phosphorus.
Topic 24. Physical and chemical properties of simple substances and compounds of VA group elements. Elements of the Arsen subgroup.
Topic 25. Physical and chemical properties of simple substances and compounds of VIA group elements. Oxygen.

Topic 26. Physical and chemical properties of simple substances and compounds of VIA group elements. Sulphur. Selenium and Tellurium as analogues of Sulphur.
Topic 27. Physical and chemical properties of simple substances and compounds of VIIA group elements. A subgroup of halogens.
Topic 28. Physical and chemical properties of noble gases.

Content module 6.Physical and chemical properties of simple substances and compounds of d-elements

Topic 29. General characteristics of d-elements. Elements IIIB, IVB, VB groups.
Topic 30. Physical and chemical properties of simple substances and compounds of VIB group elements.
Topic 31. Physical and chemical properties of simple substances and compounds of VIIB group elements.
Topic 32. Physical and chemical properties of simple substances and compounds of VIIIB group elements.
Topic 33. Physical and chemical properties of simple substances and compounds of elements of group IB.
Topic 34. Physical and chemical properties of simple substances and compounds of elements of group IIB.

4. The structure of the academic discipline

4.1. Full-time education

Names of topics	Number of hours					
	That's all	including				
		lectures	seminars	practical	laboratory	Independent work
Content module 1. Introduction to the study of general and inorganic chemistry. Basic concepts and laws of chemistry.Structure of substances. Periodic Law and PSE D.I. Mendeleev.						
Topic 1. Introduction to the study of general and inorganic chemistry. Basic concepts and laws of chemistry.	6.5	0.5	0	4	0	2
Topic 2. The structure of an atom and its electron shells.	7	1	0	2	0	4
Topic 3. Atomic nucleus. Radioactivity. Nuclear reactions.	4.5	0.5	0	2	0	2
Topic 4. D. I. Mendeleev's periodic law and its interpretation based on the electronic structure of the atom.	8	2	0	4	0	2
Topic 5. Chemical bond and structure of molecules.	12	2	0	6	0	4

Together according to content module 1	*38*	*6*	*0*	*18*	*0*	*14*
Content module 2. Classes and commenclature of inorganic compounds. Energetics of chemical and phase transformations. Direction of chemical reactions.The doctrine of solutions						
Topic 6. Classes and nomenclature of inorganic compounds. Oxides, peroxides, superperoxides, ozonides and hydroxides.Acids and salts.	10	2	0	4	0	4
Topic 7. Energetics and directionality of chemical processes	6	2	0	0	0	4
Topic 8. Speed of chemical reactions.Chemical equilibrium.	4	1	0	1	0	2
Topic 9. Catalysis.	6	1	0	1	0	4
Topic 10. Ways of expressing the quantitative composition of solutions.	8	2	0	2	0	4
Topic 11. Properties of solutions of electrolytes and non-electrolytes. Solubility product (SP). Ionic product of water, pH.	16	0	0	8	0	8
Topic 12.General characteristics of hydrolysis of salts.Special cases of hydrolysis.	6	2	0	2	0	2
Together according to content module 2	*56*	*10*	*0*	*18*	*0*	*28*
Content module 3. Redox reactions. Complex compounds						
Topic 13. Redox reactions. Basic concepts. Equations of redox reactions. Standard electrode potential of the system. Direction ROR. Electrolysis.	10	2	0	4	0	4

Topic 14. Complex compounds. Chemical bond in complex compounds. Behavior of complex compounds in solutions.	10	2	0	4	0	4
Together according to content module 3	*20*	*4*	*0*	*8*	*0*	*8*
Content module 4. Physical and chemical properties of simple substances and compounds of s-elements						
Topic 15. Introduction to the chemistry of elements and their compounds. Properties of metals and non-metals.	3.5	1	0	0.5	0	2
Topic 16. Elements of group IA. Hydrogen.	2.5	0	0	0.5	0	2
Topic 17. Elements of group IA. A subgroup of alkali metals.	3.5	0.5	0	1	0	2
Topic 18. Elements of II A group.	6.5	0.5	0	2	0	4
Together according to content module 4	*16*	*2*	*0*	*4*	*0*	*10*
Content module 5. Physical and chemical properties of simple substances and compounds of p-elements.						
Topic 19. Elements of III A group.	4.5	0.5	0	2	0	2
Topic 20.Elements of group IVA. Properties of carbon, silicon and their compounds.	5.5	0.5	0	4	0	1
Topic 21.Elements of group IVA. Subgroup Germany.	3	0	0	0	0	3
Topic 22.Elements of the VA group. Nitrogen.	4.5	0.5	0	2	0	2
Topic 23.Elements of the VA group. Phosphorus.	3.5	0.5	0	2	0	1
Topic 24.Elements of the VA group. Elements of the Arsen subgroup.	3	0	0	0	0	3

Topic 25.Elements of the VIA group. Oxygen.	4.5	0.5	0	2	0	2
Topic 26.Elements of the VIA group. Sulphur. Sulfuric acid. Selenium and Tellurium as analogues of Sulphur.	4.5	0.5	0	2	0	2
Topic 27.Elements of VIIA group. A subgroup of halogens.	9	1	0	4	0	4
Topic 28.Elements of VIII A group.	4	0	0	0	0	4
Together according to content module 5	*46*	*4*	*0*	*18*	*0*	*24*
Content module 6. Physical and chemical properties of simple substances and compounds of d-elements						
Topic 29. Elements of group IIIB, IVB and VB.	5.5	1.5	0	2	0	2
Topic 30. Elements of group VIB	6.5	0.5	0	2	0	4
Topic 31. Elements of group VIIB.	8.5	0.5	0	4	0	4
Topic 32. Elements of group VIIIB.	6.5	0.5	0	4	0	2
Topic 33. Elements of group IB.	3.5	0.5	0	1	0	2
Topic 34. Elements of group IIB.	3.5	0.5	0	1	0	2
Together according to content module 5	*34*	*4*	*0*	*14*	*0*	*16*
Individual tasks	*0*	*0*	*0*	*0*	*0*	*0*
Only hours	**210**	**30**	**0**	**80**	**0**	**100**

4.2. External form of education

Names of topics	**Number of hours**					
	That's all	**including**				
		lectures	**seminars**	**practical**	**laboratory**	**Independent work**
Content module 1. Introduction to the study of general and inorganic chemistry. Basic concepts and laws of chemistry.Structure of substances. Periodic Law and PSE D.I. Mendeleev.						
Topic 1. Introduction to the study of general and inorganic chemistry.	7	2	0	1	0	4

Basic concepts and laws of chemistry.						
Topic 2. The structure of an atom and its electron shells.	7	0	0	1	0	6
Topic 3. Atomic nucleus. Radioactivity. Nuclear reactions.	8	0	0	0	0	8
Topic 4. D. I. Mendeleev's periodic law and its interpretation based on the electronic structure of the atom.	7	0	0	1	0	6
Topic 5. Chemical bond and structure of molecules.	9	0	0	1	0	8
Together according to content module 1	38	2	0	4	0	32
Content module 2. Classes and commenclature of inorganic compounds. Energetics of chemical and phase transformations. Direction of chemical reactions.The doctrine of solutions						
Topic 6. Classes and nomenclature of inorganic compounds. Oxides, peroxides, peroxides, ozonides and hydroxides.Acids and salts.	9	0	0	1	0	8
Topic 7. Energetics and directionality of chemical processes	6	0	0	0	0	6
Topic 8. Speed of chemical reactions.Chemical equilibrium.	6	0	0	0	0	6
Topic 9. Catalysis.	4	0	0	0	0	4
Topic 10. Ways of expressing the quantitative composition of solutions.	4.5	0	0	0.5	0	4
Topic 11. Properties of solutions of electrolytes and non-electrolytes. Solubility product (DR). Ionic product of water, pH.	8	0	0	0	0	8

Topic 12.General characteristics of hydrolysis of salts.Special cases of hydrolysis.	6.5	0	0	0.5	0	6
Together according to content module 2	44	0	0	2	0	42
Content module 3. Redox reactions. Complex compounds						
Topic 13. Redox reactions. Basic concepts. Equations of redox reactions. Standard electrode potential of the system. Direction OVR. Electrolysis.	8	0	0	2	0	6
Topic 14. Complex compounds. Chemical bond in complex compounds. Behavior of complex compounds in solutions.	6	0	0	0	0	6
Together according to content module 3	14	0	0	2	0	12
Content module 4. Physical and chemical properties of simple substances and compounds of s-elements						
Topic 15. Introduction to the chemistry of elements and their compounds. Properties of metals and non-metals.	6	2	0	0	0	4
Topic 16. Elements of group IA. Hydrogen.	3	0	0	0	0	3
Topic 17. Elements of group IA. A subgroup of alkali metals.	4.5	0	0	0.5	0	4
Topic 18. Elements of II A group.	4.5	0	0	0.5	0	4
Together according to content module 4	18	2	0	1	0	15
Content module 5. Physical and chemical properties of simple substances and compounds of p-elements.						
Topic 19. Elements of III A group.	4.5	0	0	0.5	0	4
Topic 20.Elements of group IVA.	2.5	0	0	0.5	0	2

Properties of carbon, silicon and their compounds.						
Topic 21.Elements of group IVA. Subgroup Germany.	3	0	0	0	0	3
Topic 22.Elements of the VA group. Nitrogen.	4.5	0	0	0.5	0	4
Topic 23.Elements of the VA group. Phosphorus.	4.5	0	0	0.5	0	4
Topic 24.Elements of the VA group. Elements of the Arsen subgroup.	4	0	0	0	0	4
Topic 25.Elements of the VIA group. Oxygen.	4	0	0	0	0	4
Topic 26.Elements of the VIA group. Sulphur. Sulfuric acid. Selenium and Tellurium as analogues of Sulphur.	4.5	0	0	0.5	0	4
Topic 27.Elements of VIIA group. A subgroup of halogens.	4.5	0	0	0.5	0	4
Topic 28.Elements of VIII A group.	4	0	0	0	0	4
Together according to content module 5	40	0	0	3	0	37
Content module 6. Physical and chemical properties of simple substances and compounds of d-elements						
Topic 29.Properties of simple substances and compounds of d-elements.Group IIIB, IVB and VB elements.	6	0	0	2	0	4
Topic 30. Elements of group VIB	4	0	0	0	0	4
Topic 31. Elements of group VIIB.	4	0	0	0	0	4
Topic 32. Elements of group VIIIB.	4	0	0	0	0	4
Topic 33. Elements of group IB.	4	0	0	0	0	4
Topic 34. Elements of group IIB.	4	0	0	0	0	4

Together according to content module 5	26	0	0	2	0	24
Individual tasks	0	0	0	0	0	0
Only hours	180	4	0	14	0	162

5. Topics of lectures / seminars / practical / laboratory classes

5.1. Full-time education

5.1.1. Topics of lectures

No	The title of the lecture	Hours
1.	Goals and objectives of inorganic chemistry. The structure of an atom and its electron shells. Electronic and electronic-graphic formulas of atoms of elements and their ions.	2
2.	Periodic law D.I. Mendeleev and his interpretation based on the electronic structure of atoms.The structure of the periodic system of elements.	2
3.	Chemical bonding and the structure of molecules. Modern understanding of the nature of chemical bonding. Types of chemical bonds and their characteristics.	2
4.	Classes and nomenclature of inorganic compounds.Simple substances. Complex substances.	2
5.	Energetics of chemical and phase transformations. Direction of chemical reactions. Thermochemical equations, their features. Hess's law.	2
6.	Speed of chemical reactions and chemical equilibrium. Homogeneous and heterogeneous reactions. Law of active masses.	2
7	The doctrine of solutions. Basic concepts. Solubility. Methods of expressing the concentration of solutions.	2
8	Hydrolysis of salts. Mechanism of hydrolysis. Degree and constant of hydrolysis and factors determining their values. Displacement of the equilibrium of protolytic reactions.	2
9	Redox reactions. Basic concepts. The most important oxidizing agents and reducing agents. The main types of redox reactions.	2
10	Complex compounds. Classification and nomenclature of complex compounds. Formation and dissociation of complex compounds in solutions.	2
11.	The doctrine of chemical elements and their compounds.General characteristics of an element or group of elements by position in the Periodic Table of Elements. Chemical properties of simple substances and compounds of elements IA, II A groups.	2
12.	Chemical properties of simple substances and compounds of elements III A, IV A groups. Chemical properties of simple substances and compounds of elements of the V A group.	2
13.	Chemical properties of simple substances and compounds of VIA group elements. Chemical properties of simple substances and compounds of elements of the VII A group.	2
14.	General characteristics of d-elements. Chemical properties of simple substances and compounds of elements of IIIB, IVB, VB, and VIB groups.	2
15.	Chemical properties of simple substances and compounds of VIIB and VIIIB group elements. Chemical properties of simple substances and compounds of elements of group IB, IIB.	2
Together		**30**

5.1.2. Topics of seminar classes

Seminar classes are not provided.

5.1.3. Topics of practical classes

No	The title of the practical classes	Hours
1.	Topic 1. Practical lesson 1. Introduction to the study of general and inorganic chemistry. Rules of work in a chemical laboratory and safety rules.	2
2.	Topic 1. Practical lesson 2. Basic concepts and laws of chemistry.Structure of substances.Basic laws of chemistry. Law of equivalents.	2
3.	Topic 2-3. Practical lesson 3. Basic theoretical provisions about the structure of the atom. Model of the atom. The composition of the atom, nucleus. Characteristic of electron, proton, neutron.	2
4.	Topic 2-3. Practical lesson 4. Basic theoretical provisions about the structure of the atom. Atomic orbitals. Quantum numbers. The structure of electronic shells.	2
5.	Topic 4. Practical lesson 5. Periodic law D.I. Mendeleev. Structure of PSE. Periodic system of chemical elements as a graphic display of the law of periodicity.	2
6.	Topic 4. Practical lesson 6. The periodic nature of changes in the properties of simple substances and compounds of elements as a function of the electronic structure of atoms. Internal and secondary periodicity.	2
7.	Topic 5. Practical lesson 7. Chemical bond. Types of chemical bond. Covalent bond. Method of valence bonds (MVB). Donor-acceptor mechanism of covalent bond formation.	2
8.	Topic 5. Practical lesson 8. Valence, valence capabilities of elements. Properties of a covalent bond: saturation, directionality, polarity.	2
9.	Topic 5. Practical lesson 9. Theory of hybridization. Multiplicity of communication. The degree of oxidation of elements. The method of molecular orbitals (MMO). Ionic bond. Metallic connection. Hydrogen bond.	2
10.	Topic 1 - 5. Practical lesson 10. Thematic control work on the topics: "Basic concepts and laws of chemistry. Basic theoretical provisions about the structure of the atom. Periodic law D.I. Mendeleev. Chemical bond."	2
11.	Topic 6. Practical lesson 11. Classes and nomenclature of inorganic compounds. Oxides, their classification and nomenclature, properties. Hydroxides (basic, amphoteric), their classification and nomenclature, properties.	2
12.	Topic 6. Practical lesson 12. Classes and nomenclature of inorganic compounds. Acids and salts, their classification and nomenclature, properties.	2
13.	Topic 8 - 9. Practical lesson 13. Irreversible and reversible chemical reactions. Chemical equilibrium. Le Chatelier's principle. Catalysis. Catalysts.	2
14.	Topic 10. Practical lesson 14. The concept of solutions. Theories of solutions. Methods of expressing the concentration of solutions. Solving problems.	2

15.	Topic 11. Practical lesson 15. Theory of strong electrolytes. Theory of electrolytic dissociation. Equilibrium in solutions of weak electrolytes.	2
16.	Topic 11. Practical lesson 16. Solubility product. Solving problems.	2
17.	Topic 11. Practical lesson 17. Dissociation of water. Ionic product of water. The concept of pH. Solving problems.	2
18.	Topic 6 - 11. Practical lesson 18. Thematic control work: "Classes, nomenclature of inorganic compounds. Methods of expressing the concentration of solutions. Theory of electrolytic dissociation. Ionic product of water. The concept of pH."	2
19.	Topic 12. Practical lesson 19. The concept of hydrolysis of salts. Degree and constant of hydrolysis. Special cases of hydrolysis. Combined hydrolysis of salts.	2
20	Topic 13. Practical lesson 20. Basic concepts of redox processes. Strong and weak oxidizing agents and reducing agents. Types of redox reactions.	2
21.	Topic 13. Practical lesson 21. Compilation of equations of redox reactions. Factors influencing the course of redox reactions.	2
22.	Topic 14. Practical lesson 22. Classification and nomenclature of complex compounds. The nature of chemical bonding in complex compounds. The structure of complex compounds. Behavior of complex compounds in solutions.	2
23.	Topic 15 - 17. Practical lesson 23. General characteristics of metals and non-metals. Research of chemical properties of simple substances and compounds of elements of the IA group. Hydrogen. A subgroup of alkali metals.	2
24.	Topic 18. Practical lesson 24. Research of chemical properties of simple substances and compounds of elements of group IIA. Study of the chemical properties of beryllium and magnesium. Research of chemical properties of alkaline earth metals. Qualitative reactions to cations of elements of the IIA group.	2
25.	Topic 12 - 14. Practical lesson 25. Thematic control work on the topics: "The concept of hydrolysis of salts. Basic concepts of redox processes. Compilation of equations of redox reactions. Classification and nomenclature of complex compounds."	2
26.	Topic 19. Practical lesson 26. Research of chemical properties of simple substances and compounds of IIIA group elements. Properties of boron and its compounds. Properties of aluminum and its compounds.	2
27.	Topic 2. Practical lesson 27. Research of chemical properties of simple substances and compounds of elements of the IVA group. Properties of carbon and its compounds. Properties of silicon and its compounds.	2
28.	Topic 15 - 20. Practical lesson 28. Thematic control work on the topics: "Investigation of chemical properties of simple substances and compounds of elements of groups IA, IIA, IIIA, IVA."	2
29.	Topic 22. Practical lesson 29. Research of chemical properties of simple substances and compounds of	2

	VA group elements. Properties of nitrogen and its compounds. Nitrogen oxides. Interaction of nitric acid with metals and non-metals.	
30.	Topic 23. Practical class 30. Research of chemical properties of simple substances and compounds of VA group elements. Properties of phosphorus and its compounds.	2
31.	Topic 25. Practical lesson 31. Research of chemical properties of simple substances and compounds of VIA group elements. Properties of oxygen and its compounds.	2
32.	Topic 26. Practical lesson 32. Research of chemical properties of simple substances and compounds of VIA group elements. Properties of sulfur and its compounds. Oxygen-containing sulfur compounds.	2
33.	Topic 27. Practical lesson 33. Research of chemical properties of simple substances and compounds of VIIA group elements. Halogens. Hydrogen derivatives of halogens. Oxygen derivatives of halogens and their properties.	2
34.	Topic 21 - 27. Practical lesson 34. Thematic control work on the topics: "Investigation of chemical properties of simple substances and compounds of elements of groups VA, VIA, VIIA."	2
35.	Topic 33 - 34. Practical lesson 35. General characteristics of d-elements (transitional elements): variable degrees of oxidation, complex formation. Research of chemical properties of simple substances and compounds of elements of group IB and II B.	2
36.	Topic 29. Practical lesson 36. Research of chemical properties of simple substances and compounds of elements IIIB, IVB and VB groups.	2
37.	Topic 30. Practical lesson 37. Research of chemical properties of simple substances and compounds of VIB group elements. Properties of chromium compounds.	2
38.	Topic 31. Practical lesson 38. Research of chemical properties of simple substances and compounds of VIIB group elements. Manganese. Manganese oxides and hydroxides.	2
39.	Topic 32. Practical lesson 39. Research of chemical properties of simple substances and compounds of VIIIB group elements. Metals of the iron triad (Fe, Co, Ni).	2
40.	Topic 29 - 34. Practical lesson 40. Thematic control work on the topics: "Investigation of chemical properties of simple substances and compounds of d-elements.	2
Together		**80**

5.2. External form of education

5.2.1. Topics of lectures

No	The title of the lecture	Hours
1.	Introductory lecture. Stages of development of chemistry as a science, chemical elements and their compounds. The structure of an atom and its electron shells. Periodic law D.I. Mendeleev. Chemical bond and structure of molecules. Classes and nomenclature of inorganic compounds. Hydrolysis of salts. Solutions, ways of expressing the concentration of solutions. Redox reactions. Complex compounds.	2

2.	The doctrine of chemical elements and their compounds. General characteristics of an element or group of elements. General characteristics of s-, p-, d-elements and their compounds.	2
Together		**4**

5.2.3. Topics of practical classes

No	The title of the practical classes	Hours
1.	Topic 1-2. Practical lesson 1. Introduction to the study of general and inorganic chemistry. Basic concepts and laws of chemistry. Structure of substances. Basic laws of chemistry. Law of equivalents. Basic theoretical provisions about the structure of the atom. Model of the atom. The composition of the atom, nucleus. Atomic orbitals. Quantum numbers. The structure of electronic shells.	2
2.	Topic 4-5. Practical lesson 2. Periodic law D.I. Mendeleev. Structure Periodic system of chemical elements as a graphic representation of the law of periodicity. Chemical bond. Types of chemical bond. Basic parameters of chemical bonding.	2
3.	Topic 6, 10, 12. Practical lesson 3. Classes and nomenclature of inorganic compounds. The concept of hydrolysis of salts. Degree and constant of hydrolysis. Special cases of hydrolysis. The concept of solutions. Theories of solutions. Methods of expressing the concentration of solutions.	2
4.	Topic 13. Practical lesson 4. Basic concepts of redox processes. Formulation of redox reaction equations: electron balance method, half-reaction method. Redox properties of simple substances and compounds of elements. Strong and weak oxidizing agents and reducing agents. Types of redox reactions. Factors affecting the course of oxidation-reduction reactions.	2
5.	Topic 17-20. Practical lesson 5. General characteristics of metals and non-metals. Research of chemical properties of simple substances and compounds of elements of the IA group. Hydrogen. Study of the chemical properties of simple substances and compounds of II A group elements. Research of chemical properties of simple substances and compounds of elements III A and IV A group.	2
6.	Topic 22-23, 26-27. Practical lesson 6. Research of chemical properties of simple substances and compounds of VA group elements. Properties of nitrogen and its compounds. Properties of phosphorus and its compounds. Research of chemical properties of simple substances and compounds of VI A group elements. Properties of oxygen and its compounds. Properties of sulfur and its compounds. Study of the chemical properties of simple substances and compounds of elements of the VII A group. Halogens.	2
7.	Topic 29. Practical lesson 7. General characteristics of d-elements (transitional elements): variable degrees of oxidation, complex formation. Elements III B, IV B and VB, VI B, VIII B, IB and II B groups.	2
Together		**14**

6. Independent work of a student of higher education

6.1. Full-time education

No	Topic name	Hours
1.	Solving problems using the law of equivalents and other basic laws of chemistry. Determination of the equivalent mass of metal by the displacement method.	2
2.	Definition of natural and artificial radioactivity. Radiopharmaceuticals used for treatment (cobalt, phosphorus, iodine) and diagnosis (potassium, phosphorus) of various diseases.	2
3.	Electronic and electronic-graphic formulas of elements in the ground and excited states, zero, positive and negative degrees of oxidation	4
4.	According to the position of the element in the periodic system of elements of D. I. Mendeleev, the determination of its electronic formula and physical and chemical properties of simple substances and their compounds.	2
5.	By the difference in electronegativity of elements, the type of chemical bond is determined. Determination of the shape of molecules, their polarity and magnetic properties.	2
6.	Determination of the type of intermolecular interaction and explanation of the mechanism of its formation.	2
7.	Traditional and systematic name of simple and complex compounds. Modern Ukrainian nomenclature for the name of compounds.	4
8.	Theoretical justification of the physical content of internal energy, enthalpy, entropy, Gibbs energy. Evaluation of the possibility of the course of a chemical reaction based on the values of these quantities.	4
9.	Determination of the type of catalysis and the type of catalyst.	4
10.	On the topic "Solutions of non-electrolytes", solving problems using Van't-Hoff's and Raoult's laws.	4
11.	The strength of the electrolyte is determined by the type of chemical bond and the electronegativity difference of the elements. Solving problems using the Ostwald dilution law, the theory of strong electrolytes. Mastering the skills of a laboratory experiment.	4
12.	Solving problems using the mixing rule and formulas for the transition from one way of expressing concentration to another	4
13.	Mastering the ability to calculate the hydrolysis constants of medium and acidic salts and the acidity of their solutions. Determination of the conditions for preventing the hydrolysis of ZnSO4, NaHCO3 medicines.	4
14.	Determination of coefficients in the equations of redox reactions by the method of half-reactions and electron balance. Based on the values of the standard electrode potentials of redox reactions, the possibility and direction of their progress can be determined.	4
15.	Explanation of the mechanism of chemical bond formation in complex compounds using the method of valence bonds and crystal field theory. Explanation of the shape of molecules, magnetic properties and stability of complex compounds.	4
16.	Evaluation and interpretation of the chemical activity of simple substances and compounds of elements of the IA group. Solving problems and writing reaction equations according to transformation schemes.	6
17.	Evaluation and interpretation of the chemical activity of simple substances	4

	and compounds of elements of the IIA group. Solving problems and writing reactions according to transformation schemes.	
18.	Evaluation and interpretation using reaction equations of chemical activity of simple substances and compounds of elements IIIA, IVA groups.	4
19.	Evaluation and interpretation using reaction equations of chemical activity of simple substances and compounds of VA group elements.	6
20.	Evaluation and interpretation using reaction equations of chemical activity of simple substances and compounds of VIA group elements.	6
21.	Evaluation and interpretation using reaction equations of chemical activity of simple substances and compounds of VIIA group elements.	4
22.	Chemical properties of simple substances and compounds of VIIIA group elements.	4
23.	Evaluation and interpretation using equations of reactions of chemical activity of simple substances and compounds of elements of IIIB, IVB and VB groups.	2
24.	Evaluation of redox properties of chromium compounds depending on the degree of its oxidation. Interpretation of the results of laboratory studies and determination of reaction products according to the acidity of the reaction medium.	4
25.	Determination by the value of the standard electrode potential of the oxidative properties of potassium permanganate and the speed of the reaction depending on the acidity of the medium.	4
26.	Interpretation of the biological role of Ferrum and Cobalt in the body.	2
27.	On the basis of the electronic configuration of the atoms of the elements of the I B and IIV groups, using reaction equations, the reduction of the chemical activity of their simple substances is interpreted.	4
Together		**100**

6.2. External form of education

No	Topic name	Hours
1.	Introduction to the study of general and inorganic chemistry. Rules of work in a chemical laboratory and safety rules. Basic concepts and laws of chemistry.	4
2.	The structure of an atom and its electron shells.	6
3.	Nucleus. Radioactivity. Nuclear reactions.	8
4.	D. I. Mendeleev's periodic law and its interpretation based on the electronic structure of the atom.	6
5.	Chemical bond and structure of molecules.	8
6.	Classes and nomenclature of inorganic compounds. Oxides, peroxides, superperoxides, ozonides and hydroxides.Acids and salts.	8
7.	Energetics and directionality of chemical processes	6
8.	The speed of chemical reactions.Chemical equilibrium.	6
9.	Catalysis.	4
10.	Methods of expressing the quantitative composition of solutions.	4
11.	Properties of solutions of electrolytes and non-electrolytes. Solubility product (DR). Ionic product of water, pH.	8

12.	General characteristics of hydrolysis of salts.Special cases of hydrolysis.	6
13.	Redox reactions. Basic concepts. Equations of redox reactions. Standard electrode potential of the system. Direction OVR. Electrolysis.	6
14.	Complex compounds. Chemical bond in complex compounds. Behavior of complex compounds in solutions.	6
15.	Introduction to the chemistry of elements and their compounds. Properties of metals and non-metals.	4
16.	Elements of group IA. Hydrogen.	3
17.	Elements of group IA. A subgroup of alkali metals.	4
18.	Elements of II A group.	4
19.	Elements of III A group.	4
20.	Elements of group IVA. Properties of carbon, silicon and their compounds.	2
21.	Elements of group IVA. Subgroup Germany.	3
22.	Elements of the VA group. Nitrogen.	4
23.	Elements of the VA group. Phosphorus.	4
24.	Elements of the VA group. Elements of the Arsen subgroup.	4
25.	Elements of the VIA group. Oxygen.	4
26.	Elements of the VIA group. Sulphur. Sulfuric acid. Selenium and Tellurium as analogues of Sulphur.	4
27.	Elements of VIIA group. A subgroup of halogens.	4
28.	Elements of VIII A group.	4
29.	Group IIIB, IVB and VB elements.	4
30.	VIB group elements	4
31.	Group VIIB elements.	4
32.	Group VIIIB elements.	4
33.	Elements of group IB.	4
34.	Group IIB elements.	4
Together		**162**

7. Teaching methods

Practical training:conversation, solving situational problems, conducting control of the knowledge, skills and abilities of the applicants, posing a general problem by the teacher and discussing it with the participation of the applicants, performing control tasks, their verification, evaluation. Performance of laboratory work, in which applicants under the guidance of a teacher conduct educational experiments in specially equipped educational laboratories using equipment adapted to the conditions of the educational process.

Individual work:independent work with the textbook, independent work with a bank of test tasks, independent solution of situational tasks.

8. Forms of control and assessment methods (including criteria for evaluating learning outcomes)

Ongoing control:testing, oral survey, problem solving.

Final control:exam

Assessment of the ongoing learning activity at the practical class:

1. Evaluation of theoretical knowledge on the subject of the lesson:

- methods: survey, testing, solving a situational problem
- the maximum score is 5, the minimum score is 3, the unsatisfactory score is 2.

2. Assessment of practical skills on the topic of the lesson:
   - methods: assessment of the correctness of the performance of practical skills
   - the maximum score is 5, the minimum score is 3, the unsatisfactory score is 2.

The grade for one practical session is the arithmetic average of all components and can only have a whole value (5, 4, 3, 2), which is rounded according to the statistical method.

Criteria of ongoing assessment at the practical class

Score	Assessment criterion
Excellent "5"	The winner takes an active part in discussing the most difficult questions on the subject of the lesson, gives at least 90% correct answers to standardized test tasks, answers written tasks without errors, performs practical work and draws up a report.
Good "4"	The applicant participates in the discussion of the most difficult questions on the topic, gives at least 75% correct answers to standardized test tasks, makes some minor mistakes in the answers to written tasks, performs practical work and draws up a protocol.
Satisfactory "3"	The applicant participates in the discussion of the most difficult questions on the topic, gives at least 60% correct answers to standardized test tasks, makes significant mistakes in answers to written tasks, performs practical work and draws up a protocol.
Unsatisfactory "2"	The applicant does not participate in the discussion of complex questions on the topic, gives less than 60% correct answers to standardized test tasks, makes gross mistakes in answers to written tasks or does not give answers to them at all, does not perform practical work and does not draw up a report.

Only those applicants who have fulfilled the requirements of the training program in the discipline, have no academic debt, their average score for the current educational activity in the discipline is at least 3.00 and they have passed the test control according to the tests are admitted to the final control in the form of an exam. » at least 90% (50 tasks).

The test control is conducted in the Educational and Production Complex of Innovative Technologies of Learning, Informatization and Internal Monitoring of the Quality of Education of the University in the last class before the exam.

Evaluation of the results of the students' training during the final control - exam.

The content of the evaluated activity	Scores
The answer to a theoretical question	2
The answer to a theoretical question	2
Solution of the calculation problem	1

Criteria for evaluating the results of the students' training during final control - exam

Score	Evaluation criteria
Excellent "5"	The applicant worked systematically during the semester, showed during the exam versatile and in-depth knowledge of the program material, is able to successfully perform the tasks provided for in the program, mastered the content of the main and additional literature, realized the relationship of individual sections of the discipline, their importance for the future profession, showed creative abilities in understanding and using educational program material, demonstrated the ability to independently

	update and replenish knowledge; the level of competence is high (creative);
Good "4"	The applicant has demonstrated complete knowledge of the educational program material, successfully performs the tasks provided for by the program, has mastered the basic literature recommended by the program, has shown a sufficient level of knowledge in the discipline and is capable of their independent updating and renewal in the course of further education and professional activity; the level of competence is sufficient (constructive and variable)
Satisfactory "3"	The applicant who has demonstrated knowledge of the main curriculum material in the amount necessary for further education and subsequent work in the profession, copes with the tasks provided for by the program, made some mistakes in the answers on the exam and when completing the exam tasks, but has the necessary knowledge to overcome the mistakes made mistakes under the guidance of a scientific and pedagogical worker; level of competence - average (reproductive)
Unsatisfactory "2"	The applicant did not demonstrate sufficient knowledge of the main educational program material, made fundamental mistakes in the performance of tasks provided for by the program, cannot use the knowledge in further studies without the help of a teacher, did not manage to master the skills of independent work; the level of competence is low (receptive-productive)

9. Distribution of points received by students of higher education

The obtained average score for the academic discipline for applicants who have successfully mastered the work program of the academic discipline is converted from a traditional four-point scale to points on a 200-point scale, as shown in the table:

Conversion table of a traditional assessment into a multi-point scale

Traditional four-point scale	Multipoint 200-point scale
Excellent ("5")	185 - 200
Good ("4")	151 - 184
Satisfactory ("3")	120-150
Unsatisfactory ("2")	Below 120

A multi-point scale (200-point scale) characterizes the actual success of each applicant in learning the educational component. The conversion of the traditional grade (average score for the academic discipline) into a 200-point grade is performed by the information and technical department of the University.

According to the obtained points on a 200-point scale, the achievements of the applicants are evaluated according to the ECTS rating scale. Further ranking according to the ECTS rating scale allows you to evaluate the achievements of students from the educational component who are studying in the same course of the same specialty, according to the points they received.

The ECTS scale is a relative-comparative rating, which establishes the applicant's belonging to the group of better or worse among the reference group of fellow students (faculty, specialty). An "A" grade on the ECTS scale cannot be equal to an "excellent" grade, a "B" grade to a "good" grade, etc. When converting from a multi-point scale, the limits of grades "A", "B", "C", "D", "E" according to the ECTS scale do not coincide with the limits of grades "5", "4", "3" according to the traditional scale. Acquirers who have received grades of "FX" and "F" ("2") are not included in the list of ranked acquirers. The grade "FX" is awarded to students who have obtained the minimum number of points for the current learning activity, but who have not passed the final examination. A grade of "F" is assigned to students who have attended all

classes in the discipline, but have not achieved a grade point average (3.00) for the current academic activity and are not admitted to the final examination.

Applicants who study in one course (one specialty), based on the number of points scored in the discipline, are ranked on the ECTS scale as follows:

Conversion of the traditional grade from the discipline and the sum of points on the ECTS scale

Score on the ECTS scale	Statistical indicator	
A	The best 10% students	
B	Next 25% students	
C	Next 30% students	
D	Next 25% students	
E	Next 10% students	

10. Methodological support:

- Working program of the academic discipline
- Syllabus of the academic discipline
- Textbooks:
- Multimedia presentations
- Situational tasks
- Methodical development of practical classes
- Electronic bank of test tasks by subdivisions of the discipline.

11.List of questions for the exam

1. Equivalent, the equivalent mass of a simple substance and an element in a compound. Equivalent volume. Law of equivalents.
2. Equivalent and equivalent mass of a complex substance (oxide, acid, base, salt). Calculation of equivalent and equivalent mass of H_2SO_4.
3. Equivalent and equivalent mass of a simple and complex substance under the conditions of a chemical reaction.
4. Equivalent and equivalent mass of oxidizing agent and reducing agent under the conditions of a redox reaction.
5. The physical meaning of the principal quantum number. Give the value of the orbital quantum number for the values of the principal quantum number n = 2 and n = 4. Write the electronic formulas of atoms of elements with serial numbers 25 and 33.
6. Write the electron-graphic formulas of the atoms of Magnesium, Oxygen, Chromium. Specify the valence electrons. State Pauli's principle and Hund's rule.
7. Using Klechkovsky's rules, determine the sequence of filling the atomic orbitals of potassium, scandium, and gallium. Write their electronic formulas. Explain to which electron family these elements belong.
8. Write the electronic formulas of potassium and copper atoms. State why they are in different subgroups and differ in chemical properties.
9. Specify the number of free valence d-orbitals and the number of unpaired electrons in the atoms of Phosphorus, Sulfur and Chlorine in the excited state. Indicate to which electronic family these elements belong.
10. Write the electronic formulas of magnesium and copper atoms, Mg^{2+} and Cu^{2+} ions. Indicate to which electronic family these elements belong and which of them has more pronounced metallic properties.
11. Write the electronic formulas of magnesium and strontium atoms, Mg^{2+} and Sr^{2+} ions. Indicate to which electronic family these elements belong and which of them has more pronounced metallic properties.

12. Determination of ionization energy and electron affinity. Units of measurement. Specify the order of change of these values in the elements of the III period and III A group of the periodic system.
13. Definition of concepts: group, subgroup, period of the periodic system of elements. Indicate which electrons are called valence. What is the role of valence electrons in the formation of a chemical bond on the example of SO_3.
14. Covalent bond. Properties of a covalent bond: saturation, directionality, polarity, polarizability. Confirm the answer with examples.
15. The main provisions of the method of valence bonds (VB) and the theory of hybridization of atomic orbitals. Disadvantages of the VB method.
16. Write the electronic formula of the Nitrogen atom. Specify the valence electrons and the number of bonds in the nitrogen molecule from the position of the VB method. Define δ- and π-connection. Indicate which connection is stronger.
17. Based on the relative electronegativity of the elements, indicate the type of chemical bond in the BeCl2 molecule. Give a diagram of the overlapping of electronic clouds. Indicate which type of hybridization of atomic orbitals of beryllium describes the formation of this molecule.
18. It will indicate the type of chemical bond in CH_4 and CCl_4 molecules. Give a diagram of the overlapping of electronic clouds. Indicate what type of hybridization of carbon atomic orbitals describes these molecules.
19. According to the VB method, explain the type of chemical bond and the type of hybridization of AO Oxygen in a water molecule. Hydrogen bond.
20. Specify the type of hybridization of AO Nitrogen in the ammonia molecule. What is the geometric configuration of this molecule? What is the valency and degree of oxidation of Nitrogen in ammonia?
21. In NOH compounds, calculate the difference in relative electronegativities of atoms for H – O and O – H bonds (where H is Cl, Br, I) and determine: a) which of the bonds in each molecule is characterized by a greater degree of ionicity; b) what is the nature of the dissociation of these molecules in an aqueous solution.
22. Ionic bond. Mechanism of its formation. Properties of an ionic bond and its difference from a covalent bond. Examples of ionic compounds. The equation for the transformation of atoms into the corresponding ions using the example of Magnesium, Aluminum, Sulfur and Chlorine.
23. Write the electronic formulas of the atoms of Sodium, Magnesium, Aluminum, Silicon and Chlorine. Specify the type of chemical bond in NaCl, $MgCl_2$, $AlCl_3$, $SiCl_4$ molecules. Confirm the answer by calculating the difference in the relative electronegativities of the interacting atoms.
24. Chemical theory of solutions by D. I. Mendeleev. Concept of solvates and hydrates.
25. Solutions. Methods of expressing the concentration of solutions.
26. Physical and chemical phenomena that affect the magnitude of the thermal effect of dissolution.
27. Molar concentration of solutions. Units of its measurement. Titer of the solution.
28. Molar concentration of the equivalent. Units of its measurement.
29. At 25°C, the solubility of NaCl is equal 36.0 gin100 g water Calculate the mass fraction of the substance in the saturated solution.
30. Calculate the mass of water that must be added to3 kghydrogen peroxide solution with a mass fraction of 30% to obtain a solution with a mass fraction of 3%.
31. Calculate the molar concentration of a solution of hydrochloric acid with a mass fraction of 25%, if its density is 1.2 g/ml.
32. Mechanism of electrolytic dissociation of molecules with ionic and covalent bonds.
33. Degree of dissociation of weak electrolytes. Factors affecting the degree of electrolytic dissociation. Ostwald dilution law.
34. Strong, weak and medium strength electrolytes. Give examples.

35. Determination of the solubility product. Formulate the conditions for the formation and dissolution of the precipitate. Give examples.
36. Hydrolysis. Mechanism of hydrolysis of cations and anions. Degree and constant of hydrolysis. Formulas for their calculation.
37. Write the molecular equation for the hydrolysis of sodium sulfide and the expression for the hydrolysis constant.
38. Write the equation for the hydrolysis of $Al_2(SO_4)_3$ and Al_2S_3.
39. Write the molecular and ionic equation for the hydrolysis of $SbCl_3$.
40. Hydrolysis of acid salts. Specify the acidity of the environment in $NaHSO_3$ and $NaHCO_3$ solutions.
41. Calculate K_{hydrol} KNO_2 if K_d HNO_2 = = $5 \cdot 10^{-4}$.
42. Calculate K_{hydrol} NH4Cl if $K_d NH_3 \cdot H_2O = 2 \cdot 10^{-5}$.
43. Calculate K_{hydrol} NaH_2PO_4 if Kd_1 H_3PO_4 = $7{,}6 \cdot 10^{-3}$, Kd_2 H_3PO_4 = $6{,}2 \cdot 10^{-8}$, Kd_3 H_3PO_4 = $4{,}2 \cdot 10^{-13}$.
44. Redox reactions. Indicate which substances are called oxidizing agents and which are reducing agents. Specify the most important oxidizing agents and reducing agents in pharmaceutical practice.
45. Specify the main types of redox reactions. Give examples.
46. Using the example of $KMnO_4$, determine the role of the medium in redox reactions. Explain why dilute sulfuric acid, rather than nitric and hydrochloric acids, is used to create an acidic environment.
47. Write the reaction equation and select the coefficients by the electron-ion method: $NH_3 + KMnO_4 \rightarrow$.
48. Complete the reaction equation and select the coefficients by the electron-ion method: $KI + KIO_3 + H_2SO_4 \rightarrow$. Calculate the equivalent masses of the oxidizing agent and reducing agent.
49. Complete the reaction equation and select the coefficients by the electron-ion method: $KBr + MnO_2 + H_2SO_4 \rightarrow$. Determine the equivalent mass of the reducing agent.
50. Complete the reaction equations and select the coefficients by the electron-ion method: $H_2S + KMnO_4 + H_2SO_4 \rightarrow S + \ldots$; $NaNO_2 + KMnO_4 + H_2O \rightarrow$
    Specify the type of redox reactions. Calculate the equivalent and equivalent mass of $KMnO_4$.
51. Complete the reaction equations and select the coefficients using the half-reaction method: : $As + HNO_{3(conc.)} \rightarrow$; $Al + HNO_{3(dilute.)} \rightarrow$.
52. Write the reaction equation for the formation of a coordination compound when aluminum hydroxide interacts with an excess of sodium hydroxide solution. Determine the charge of the coordinating agent, the type of coordination compound.
53. Determine the charge of the coordination ion and the coordination number of the iron ions in the compounds: $Na_3[FeF_6]$ and $K_4[Fe(CN)_6]$. Write the equations of the primary and secondary dissociation of the coordination compound and the expression of the general instability constants.
54. Write the reaction equation and name the reaction products:$AgCl\downarrow + NH_3 \rightarrow$, $FeSO_4 + KCN \rightarrow$, $Cr(OH_3)\downarrow + NaOH \rightarrow$.
55. Carbonyls of transition metals. Preparation, structure according to the VB method, properties on the example of tetracarbonylnicole.
56. Make the conversion: $B \rightarrow B_2O_3 \rightarrow H_3BO_3 \rightarrow Na_2B_4O_7 \rightarrow H_3BO_3$
57. Complete the reaction equations, determine the coefficients by the half-reaction method:
    $As + HNO_{3(к)} \rightarrow$, $Al + HNO_{3(р)} \rightarrow$.
58. Write the reaction equation for the determination of bismuth(III) and stanium(II) ions in an alkaline medium.
59. Complete the reaction equations and determine the coefficients by the electron-ion method: $I_2 + HNO_{3(к)} \rightarrow$, $As + HNO_{3(к)} \rightarrow$. Give the resulting compounds traditional names.

60. Write the formulas of possible oxides and hydroxides of phosphorus. Specify the basicity of acids and give their graphic formulas. Give them traditional and systematic names.
61. Obtain phosphine from phosphide, as well as by the disproportionation reaction of phosphorus in an alkaline medium.
62. Obtain potassium bismuthate by the reaction: $BiCl_3 + Cl_2 + KOH \rightarrow$.Determine the coefficients by the half-reaction method.
63. Indicate which oxidizing agents can oxidize a sulfur compound with an oxidation state of –2 to compounds with an oxidation state of + 6, + 4, 0. Give examples and determine the coefficients in the reaction equations using the electron-ion method.
64. Complete the reaction equations and name the products obtained according to the traditional nomenclature: $As_2O_3 + H_2O \rightarrow$, $As_2O_3 + HCl \rightarrow$,
$As_2O_3 + KOH + H_2O \rightarrow$.
65. Write the equation for the reaction between sodium nitrite and potassium iodide in an acidic medium. Select the coefficients by the half-reaction method.
66. Write the reaction equation for the production of ammonia from nitrogen, ammonium chloride, and lithium nitride. Specify the type of hybridization of the nitrogen orbitals in the ammonia molecule.
67. Get nitric acid from ammonia.
68. Write equations for reactions that are characteristic of ammonia: addition, substitution, oxidation, complex formation.
69. Write the formulas of possible nitrogen oxides. Determine their nature and indicate the corresponding hydroxides.
70. Elements of the V A group. General electronic formula, possible oxidation states and examples of compounds in which they are realized for Nitrogen. Maximum valency of Nitrogen and Phosphorus.
71. Obtain hydrogenselinide and hydrogentelluride. Indicate in which of these compounds reducing and acidic properties are more pronounced.
72. Make equations for the reactions of the interaction of dilute and concentrated sulfuric acid with calcium. Select the coefficients by the half-reaction method. Calculate the equivalent mass of the oxidant.
73. Write the equation for the reaction of sodium thiosulfate with chlorine (excess oxidant) and iodine. Select the coefficients by the half-reaction method.
74. Prove the oxidation-reduction bivalent of the sulfite ion by reactions with potassium permanganate and hydrogen sulfide. Select the coefficients by the half-reaction method.
75. The combustion products of hydrogen sulfide and sulfur in an excess of oxygen when passed into water give an acidic reaction of the environment. Explain this fact using chemical reactions. Complete the reaction equation and select the coefficients by the electron-ion method: $H_2S + HNO_{3(smoky.)} \rightarrow$.
76. Write the equation for the reaction of hydrogen sulfide with excess oxygen and potassium dichromate in an acidic medium. Select the coefficients by the electron-ion method.
77. Write the reaction equation for the dissolution of sulfur in concentrated nitric acid. Select the coefficients by the half-reaction method.
78. Write the equation for the reaction of sulfur with chlorine water and concentrated sulfuric acid. Select the coefficients by the half-reaction method.
79. Write the equation for the reaction of hydrogen peroxide and potassium iodide with potassium permanganate in dilute sulfuric acid. Select the coefficients by the electron-ion method.
80. Write the reaction equation for the qualitative detection of hydrogen peroxide. Give the graphic formula of the compound that causes the blue color.
81. Write the equation for the hydrogen peroxide disproportionation reaction. Determine the coefficients in the equation by the electron-ion method.
82. Chalcogens. The general electronic formula, possible oxidation states and examples of compounds in which the specified oxidation state is realized for Sulfur.

83. Write the reaction equations and select the coefficients by the electron-ion method:
$K_3AsO_3 + I_2 + KOH \rightarrow$, $I_2 + Cl_2 + H_2O \rightarrow$.
84. Complete the reaction equations:
$NaCl + H_2SO_{4(к)} \rightarrow$, $NaBr + H_2SO_{4(к)} \rightarrow$, $NaI + H_2SO_{4(к)} \rightarrow$.
In redox reactions, select the coefficients by the electron-ion method, compare the reducing properties of halide ions.
85. Write the formulas of possible oxoacids of chlorine. Give them systematic and traditional names. Determine the order of change of oxidizing and acidic properties.
86. Halogens. General electronic formula, possible oxidation states and examples of compounds in which the specified oxidation state is realized for Chlorine. Change in redox properties of elements in a subgroup. Complete the reaction equation and select the coefficients by the electron-ion method: $MnO_2 + KClO_3 + KOH \rightarrow$.
87. d-Elements. Location in the periodic table. Features of the electronic structure. Valence electrons. Possible degrees of oxidation in compounds of Chromium and Manganese.
88. Write the empirical and graphical formulas of chromium and manganese oxoacids. Name them according to traditional and systematic nomenclature.
89. Write the reaction equation and name the products obtained:
$CrCl_3 + NaOH_{(надл)} \rightarrow$, $Cr(OH)_3 + H_2SO_4 + H_2O \rightarrow$.
90. Chromites, chromates, dichromates. Oxidizing properties of chromium(VI) compounds.
91. Cationic, anionic and neutral coordination compounds on the example of chromium coordination compounds.
92. Hydrate isomerism of complex chromium compounds on the example of the compound $CrCl_3 \cdot 6H_2O$. The nature of its interaction with argentum nitrate.
93. Potassium dichromate is an oxidant used for quantitative determination of Fe(II) salts and iodides. Write the equations of the corresponding reactions in an acidic medium. Calculate the equivalent mass of the oxidant.
94. Perform the conversion: $Cr \rightarrow Cr_2S_3 \rightarrow Cr(OH)_3 \rightarrow K_3[Cr(OH)_6]$
95. Perform the conversion: $Cr \rightarrow CrCI_2 \rightarrow CrCl_3 \rightarrow K_2CrO_4 \rightarrow K_2Cr_2O_7$
96. Write the reaction equation and name the product $Mn + CO \rightarrow$. From the point of view of the VB method, explain the mechanism of formation of a complex compound.
97. Manganese oxides. Using chemical reactions, characterize their acid-base properties.
98. Explain the redox duality of manganese(IV) oxide using the example of the reactions: $MnO_2 + HCl \rightarrow$, $MnO_2 + KClO_3 + KOH \rightarrow$.
99. Potassium permanganate. Production, resistance to heating. Use as an oxidizing agent on the example of the reaction: $Na_2S + KMnO_4 + H_2SO_4 \rightarrow$.
100. Oxidizing properties of $KMnO_4$ depending on the reaction of the environment. The use of potassium permanganate in medical practice.
101. Make the conversion: $Mn^{2+} \rightarrow MnO_2 \rightarrow K_2MnO_4 \rightarrow KMnO_4 \rightarrow MnO_2$
102. Write the reaction equation for the qualitative determination of the cation Mn^{2+} with potassium bismuth in a nitric acid medium. Select the coefficients by the electron-ion method.
103. Elements of the Iron family. Electronic formula. Possible degrees of oxidation and examples of compounds in which the indicated degree of oxidation is realized.
104. Iron (II) hydroxide. Production, properties. Complete the reaction equation and select the coefficients by the electron-ion method: $Fe(OH)_2 + O_2 + H_2O \rightarrow$.
105. Properties of iron(II) and iron(III) oxides and hydroxides. Biological role of Iron. Medicines of Iron.
106. Iron (III) hydroxide. Obtaining, properties, use.
107. Hydrolysis of Fe^{2+} and Fe^{3+} salts. The influence of the nature of iron(II) and iron(III) hydroxide on the degree of hydrolysis of the corresponding salts.
108. Determine the degree of oxidation, the coordination number of Iron in the coordination compounds: $Na_3[FeF_6]$ and $K_4[Fe(CN)_6]$. Write the equations of primary and secondary dissociation, the expression of the general instability constant.

109. Perform the conversion: $Fe \rightarrow FeSO_4 \rightarrow Fe(OH)_2 \rightarrow Fe(OH)_3 \rightarrow FeCI_3 \rightarrow KFe[Fe(CN)_6]$
110. Perform the conversion: $Co \rightarrow Co(NO_3)_2 \rightarrow Co(OH)_2 \rightarrow [Co(NH_3)_6](OH)_2$
111. Write the molecular nonionic equation for the hydrolysis of $NiCl_2$ and $Fe(CH_3COO)_3$ salts.
112. Elements of the Cooper subgroup. General electronic formula. Valence electrons, possible degrees of oxidation. Finding in nature.
113. The use of complex compounds of d-elements in qualitative reactions for the detection of cations and anions on the example of the interaction: $AgCl + NH_3 \rightarrow$. Write the expression for the instability constant of the resulting complex compound.
114. In the coordination compounds $[Cu(NH_3)_4](OH)_2$ and $Na_3[Cr(OH)_6]$, name the components and write an expression for the general instability constants.
115. The use of coordination compounds of d-elements in qualitative reactions for the detection of cations and anions on the example of copper compounds: $Cu(OH)_2 + NH_{3(ecxess)} \rightarrow$. Name the coordination compound. Write an expression for the instability constant.
116. Perform the conversion: $Cu \rightarrow CuSO_4 \rightarrow (CuOH)_2SO_4 \rightarrow [Cu(NH_3)_4]SO_4 \rightarrow CuS$
117. Write the equation for the reaction of the dissolution of gold in selenate acid, potassium cyanide in the presence of air oxygen, a mixture of nitric and hydrochloric acids. In the reaction equations, select the coefficients using the half-reaction method.
118. Elements of the Zinc subgroup. Electronic formula, valence electrons. Possible degrees of oxidation and examples of compounds in which they are realized.
119. Zinc. Chemical activity. Amphotericity of oxide and hydroxide, complex compounds of zinc.
120. Hydrolysis of zinc salts, equilibrium shift in hydrolyzed systems. The use of zinc preparations in medical practice.

12. Recommended literature

Basic

1. Levitin E. Ya., Bryzytska A. M., Klyueva R. G. General and inorganic chemistry. – Kh.: National Institute of Medical Sciences; Golden Pages, 2017. – 512 p.
2. General and inorganic chemistry. Laboratory workshop: educational method. manual for students pharmacy universities and pharmacies. faculty honey. universities of the III-IV level of accreditation / E.Ya. Levitin, I.O. Vedernikova, O.V. Antonenko and others; according to general ed. E. Ya. Levitin. - Kharkiv, 2020. - 132 p.

Additional:

1. General and inorganic chemistry: In 2 hours/O.M. Stepanenko, L.H. Reiter, V.M. Ledovskikh, S.V. Ivanov. - K.: Ped. Press, 2002.– Part I.– 520 p.;– Part II.–
2. General and inorganic chemistry / Levitin Ye.Ya. Vedernikova IA – Kharkiv: Publishing House of NUPh: Golden Pages, 2009. – 360 p.
3. Romanova N.V. General and inorganic chemistry/ Textbook for university students. education institutions - Kyiv; Irpin: VTF "Perun", 1998. - 480 p.
4. Skopenko V.V., Hryhor'eva V.V. The most important classes of inorganic compounds. - K.: Lybid, 1996. - 152 p.
5. Inorganic chemistry. Laboratory practice /E. Ya. Levitin, O.V. Antonenko, A.M. Bryzytska and others. - Kh.: National Institute of Scientific Research: Golden Pages, 2012. - 148 p.
6. General chemistry / V. V. Grigor'eva, V. M. Samiylenko, A. M. Sych, O. A. Golub - K.: Vyshcha Shk., 2009. - 471 p.
7. Nedilko S. A. General and inorganic chemistry: problems and exercises: Education. manual / S. A. Nedilko, P. P. Popel. - K.: Lybid, 2001. - 400 p.

13. Information resources:

1. Methodical guidelines on general and inorganic chemistry for independent and classroom work of students of the faculty of pharmacy (Content module 1. General chemistry).
   Access method:http://meduniv.lviv.ua/files/kafedry/bioneorgan/1_Navchalno-org_robota/Metodychne_zabezpechennaj/Metod_Inorganic_chem_1_pharm_M-1.pdf
2. Guidelines for general and inorganic chemistry for independent and classroom work of students of the faculty of pharmacy (Content module 2. Inorganic chemistry).
   Access method:http://meduniv.lviv.ua/files/kafedry/bioneorgan/1_Navchalno-org_robota/Metodychne_zabezpechennaj/Metod_Inorganic_chem_1_pharm_M-2.pdf
3. Methodological guidelines for general and inorganic chemistry for the independent work of students of the Faculty of Pharmacy in the correspondence form of study.
   Access method:http://meduniv.lviv.ua/files/kafedry/bioneorgan/1_Navchalno-org_robota/Metodychne_zabezpechennaj/metod_1_pharm_zaoch.pdf
4. A collection of test tasks in general and inorganic chemistry for students of the Faculty of Pharmacy.
   Access method:http://meduniv.lviv.ua/uploads/repository/bioneorgan/1_Navchalno-org_robota/Tests/Neorgan_Chem_Tests.pdf
5. http://chemistry.inf.ua