NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of General, Organic and Physical Chemistry

"**APPROVED** "
Dean of the faculty
of Construction and design
_____(Ruzhylo Z.V.)
"_____"_____2020.

REVIEWED AND APPROVED
at the meeting of the department of
General, Organic and Physical chemistry
Protocol № 10 from 22. 05. 2020
Head of the Department
_____(Kovshun L.O.)

SYLLABUS
Academic Course "CHEMISTRY"

Speciality	133 – Sectoral engineering
Educational and professional program	Sectoral engineering
Faculty	Construction and design
Developer	Senior Assistant Professor, PhD Kravchenko Olha

Kyiv – 2020

1.Description of the course

Chemistry is a fundamental discipline, which provides engineering students with a background in important concepts and principles of chemistry. Some of the most important objectives, though, are more ―global‖ in nature. Emphasis will be placed on those areas considered most relevant in an engineering context, and practical applications in engineering and technology will be examined. These goals deal with the overall relationship between chemistry (or science in general) and engineering rather than with the details of any particular chemical principle.

Field of knowledge, direction, specialty, education and qualification level		
Education and qualification level	Bachelor	
Specialty	133 – Sectoral engineering	
Educational and professional program	Sectoral engineering	
Characteristics of training programme		
Type	Obligatory	
The total number of academic hours	90	
Number of ECTS credits	3	
Number of modules	3	
Forms of control	Test	
Indicators of academic discipline for full-time and part-time forms of training course		
	Full-time	**Part-time**
Year (course)	2020-2021	2020-2021
Semester	1	1
Lectures	30 hours	4
Laboratory sessions (activities)	30 hours	10
Self-study	30 hours	76
Individual study		
Number of hours a week Full-time leaning: auditorium own training −	 4 hours 2 hours	 1 4

2. Goal, objectives and competencies of academic discipline

The main goals– to provide a solid foundation in the study of matter and its changes and to understand and apply basic chemistry concepts in sectoral engineering.

Learning outcomes of course is the student's ability as a future specialist:

- outlines the historical development of major principles, concepts and ideas in chemistry;
- describes applications of chemistry which affect society or the environment;
- explains trends and relationships between elements in terms of atomic structure, the periodic table and bonding;
- describes chemical changes in terms of energy inputs and outputs;
- compiles the different chemical reaction, describes factors that influence the type and rate of chemical reactions;
- relates the uses of carbon to the unique nature of carbon chemistry;
- applies simple electrochemical processes;

Upon completion of this course:

Students will know:

- the nature and practice of chemistry,
- the implications of chemistry for society and environment,
- atomic structure, the periodic table and bonding,
- chemical reactions, including acid/base reactions and chemical equilibrium,
- carbon chemistry,
- electrochemical applications.

Student will be able to:

- planning investigations,
- conducting simple analysis**,**
- working with laboratory equipment**,**
- working with different chemical compound.

Acquisition of competencies:

General competencies (GC):

- Ability to evaluate, interpret and synthesize theoretical information and practical data in the field of chemistry;
- Ability to perform basic experimental work, summarize and systematize the results;
- Ability to determine the composition, structure and chemical properties of organic and inorganic compounds;

Professional (special) competencies (PC):

- Ability to applicate of structural materials, alloys, fuel and lubricants, taking into account their chemical properties.
- Ability to control chemical processes occurring during mechanical sectoral engineering

3. Program and structure of the course

Module 1. *The basics atomic-molecular theory of the matter structure.*

Lecture 1. The main concepts and laws of chemistry.

The place of chemistry among the natural science subjects. The subject and tasks of general chemistry. The historical stages of chemistry development. contribution of Ukrainian scientists in the development of chemical science. The role of chemistry in branch engineering. The main direction of chemicalization of mechanical engineering. Agroecological problem of chemicalization in Ukraine. Chemistry and environmental protection. The basic concepts of atomic-molecular theory: a molecule, atom, chemical element, simple and complex matter, relative atomic and molecular masses, mole, molar mass. The basic laws of chemistry: the law of conservation of mass and energy, the law of equivalents, the law of the constancy of the chemical compounds, Avogadro's law, their application in branch engineering. The modern principles of classification and nomenclature of inorganic compounds. The genetic link between the main classes of inorganic compounds.

Lecture 2. The atomic structure.

The main role of atomic structure in prediction of the physical and chemical properties of elements and their compounds. Modern ideas about the structure of the atom. The structure and dimensions of the nucleus, the electron. The wave nature of the electron. Quantum numbers. The concept of orbital, energy of levels, sublevels and their value. The principles of filling orbitals by electrons. Electron and graphic formulas.

Lecture 3. The periodic law and Mendeleev's periodic table of chemical elements.

The modern formulation of periodic law. Mendeleev's periodic system of elements. The concept of group, sub-group, period., s-, p-, d-elements. The main patterns of the periodic system: metal and non-metal, acid-basic, redox properties of elements. The concept of atom radius, ionization energy, electron affinity, electronegativity and their changes in periods and groups of the periodic system.

Lecture 4. The chemical bond and the structure of molecules.

The modern concepts about the nature of the chemical bond. The main types and features of chemical bonds. Covalent bond. Exchange and donor-acceptor mechanism of formation of a covalent bond. Method of valence bonds. Properties of covalent bond: saturation, frequency, orientation in space, polarity. Ionic bond. The nature of ionic bond, it's degree. The distinguish be-tween ionic and covalent bonds. Hydrogen bond. The mechanism of its formation, characteristics and role in the life processes of mechanical engineering.

The structure of molecules. The intermolecular interactions. The chemical bond and features of compounds.

Module 2. *The main patterns of chemical reactions.*

Lecture 1. Thermodynamic laws of chemical transformations.

The basic concepts of chemical kinetics. The rate of chemical reaction. The factors affecting to the rate of a chemical reaction. Law of mass action - basic law of chemical kinetics. The rate constant of a chemical reaction. The concept of activation energy, heat of reaction. Effect of tem-perature on the rate of reaction. Van't Hoff Rule. The concept of catalysis and its nature. Enzymes as catalysts of biochemical processes.

Lecture 2. The chemical equilibrium and conditions of its shift.

Reversible and irreversible reactions. The concept of chemical equilibrium. Constant of chemical equilibrium. The shift of chemical equilibrium. The influence of external factors on chemical equilibrium. Le Chatelier's principle. The concepts of chemical kinetics and chemical equilibrium within the meaning of chemical processes for production and processing of branch engineering.

Lecture 3. The solutions of electrolytes

The general idea about dispersion systems. The concept of the solutions and their role in the nutrition of plants and animals. The physical and chemical nature of the solutions. Hydrates. The concept of the crystalline. The solubility. Ways of expressing concentration of solutions.

The concept of electrolytes and non-electrolytes solutions and their properties. The main posi-tions of electrolytic dissociation theory.

The mechanism of electrolytic dissociation. The quantitative characteristics of the dissociation. Strong and weak electrolytes. The dissociation constant of weak electrolytes, it's connection with the degree of dissociation. Amphoteric electrolytes. Reactions in solutions of electrolytes. Ionic reactions.

Lecture 4. The solution of non-electrolytes.

The concept of heterogeneous systems. Colligative properties of solutions of non-electrolytes and their application in engineering. The disperse state of matter. The general idea of heterogeneous solutions (disperse systems, colloid solutions) and features of their properties. Surface phenomena at the interface. Sorption processes. Disperse systems in nature.

Lecture 5. The redox processes and their conditions.

The general concept of redox processes. The most important redox processes in living organisms, nature and technological processes. Degree of oxidation of the elements in the compounds. Typical oxidizing and reducing agents.. The compilation of redox equations. The classification of redox reactions. The influence of medium on redox reactions. The concept of redox potentials. The motion of redox reactions and determination of its direction. The redox processes in engineering and environment.

Lecture 6. Bases of electrochemistry.

The object and purpose of electrochemistry. The conversion of chemical energy into electrical energy. The mechanism of electrode potentials of metals. Standard electrode potentials. Several voltages metals. Nernst equation. Oxidative - reductive processes in electrolytic cells. Chemical current sources. Batteries. Fuel cells. The value of chemical power sources in engineering**.**

Lecture 7. Electrolysis of melts and solutions of electrolytes as oxidation - reduction process.

The conversion of electrical energy into chemical. Laws of of electrolysis of melts. Features electrolysis of aqueous solutions. The quantitative characteristics of the process of electrolysis Faraday laws. Directions practical use electrolysis: Electroplating, electrometallurgy, electrosynthesis. Value electrolysis to obtain some structural materials, their decoration and protection against corrosion.

Lecture 8. Corrosion processes and materials protection against corrosion.

Overview of corrosion processes. The types and mechanisms of corrosion. Corrosion of metals and alloys as oxidative – restorative process. Incompatibility metals in metal structures Methods for determining the rate of corrosion. Methods of protection of metals, alloys and other construction materials from corrosion. The concept of corrosion inhibitors**.**

Module 3. *Chemical elements and compounds of elements as the basis of inorganic and organic structural materials*

Lecture 1. Properties of non-metals and their compounds in materials and excipients engineering.

General characteristics of non-metals and their position in the Periodic System D.I.Mendelyeyeva. The dependence of the properties of the electronic structure of atoms of non-metals. The use of non-metal compounds for the production of polymers, CFCs and preservatives, wood, glass, fire-resistant paint, fiberglass, chemical power sources, corrosion inhibitors, detergents, and in welding work in lighting technology, the vulcanization of rubber, and others.

Lecture 2. Chemistry of metals.

Regulation metals in the Periodic System D.I.Mendelyeyeva, general characteristics of metals. Features of the electronic structure of atoms. The physical properties of metals, electrical conductivity, thermal conductivity, ductility. Methods of obtaining metals and alloys, special alloys properties, heat resistance, lightness, corrosion resistance, hardness etc. Properties metals side subgroups ability to form complexes. Water hardness. Application of metals and their compounds in batteries, for the manufacture of mirrors, white, glass, glaze, decoration, electrical wires, tubes, semiconductors. Environmental problems of heavy metals.

Lecture 3. Bases of organic chemical compounds.

Features compounds wildlife. The theory of chemical structure of organic compounds A. Butlerova. Classification, nomenclature and isomerism of organic compounds. Structure and properties of hydrocarbons. Natural sources of hydrocarbons. And functional-element compound. The physiologically active substances. The use of organic substances for the manufacture of detergents, varnishes, mastics, waxes, dyes, explosives, polymers, fuels, etc .

Lecture 4. Polymeric materials and their applications in engineering.

General characteristics of Macromolecular Compounds. Natural and synthetic polymers. The reactions of polymers: polymerization and polycondensation. Physical state and properties of polymers. Plastics and modified polymers. The destruction and curing polymers. Rubber and rubber. Polymeric construction materials, adhesives, synthetic fiber, plexiglass, Phenoplast, Latinas, paints, foam, skloplasty, poroplast and others. Advantages and disadvantages of plastic construction materials in comparison with others.

Fuel - lubricants. Oil and oil products. Distillation and cracking of petroleum. Detonation stability fuels. Availability of Ukraine energy. The search for alternative sources of fuel. Biodiesel and shale gas..

Structure of the course “Chemistry”

Modules and topics	Hours											
	Full time						Part time					
	total	included					total	included				
		L	P	Lab	Ind	Self work		L	P	Lab	Ind	Self work
1	2	3	4	5	6	7	8	9	10	11	12	13
Module 1. **The basics atomic-molecular theory of the matter structure**												
Topic 1. The main concepts and laws of chemistry	6	2		2		2	5,5	0,5				5
Topic 2. Atomic structure	6	2		2		2	6,5	0.5		1		5
Topic 3. The periodic law and Mendeleev’s periodic table of chemical elements	5	2		2		1	5					5
Topic 4. The chemical bond and the structure of molecules.	6	2		2		2	6,5	0.5		1		5
Total	23	8		8		7	23,5	1.5		2		20
Module 2. **The main patterns of chemical reactions**												
Topic 1. Thermodynamic laws of chemical transformations	6	2		2		2	5					5
Topic 2. The chemical equilibrium and conditions of its shift.	6	2		2		2	5					5
Topic 3. The solutions of electrolytes.	6	2		2		2	6,5	0.5		1		5
Topic 4. The solution of non-electrolytes..	6	2		2		2	5					5
Topic 5. The redox processes and their conditions..	6	2		2		2	5			1		4
Topic 6. Bases of electrochemistry.	6	2		2		2	5,5	0.5		1		4
Topic 7. Electrolysis of melts and solutions of electrolytes as oxidation - reduction process..	6	2		2		2	5,5	0.5		1		4
Topic 8. Corrosion processes and materials protection against corrosion.	5	2		2		1	5			1		4
Total	47	16		16		15	42,5	1,5		5		36

Module 3**. Chemical elements and compounds of elements as the basis of inorganic and organic structural materials**											
Topic 1. Properties of non-metals and their compounds in materials and excipients engineering	6	2		2		2	6			1		5
Topic 2. Chemistry of metals.	6	2		2		2	6,5	0,5		1		5
Topic 3. Bases of organic chemical compounds.	4	1		1		2	5					5
Topic 4. Polymeric materials and their applications in engineering	4	1		1		2	6,5	0,5		1		5
Total	20	6		6		8	24	1		3		20
Total hours of the course	90	30		30		30	90	4		10		76

4. Topics of seminars

№	Topic	Hours
1		
2		
...		

5. Topics of practical works

№	Topic	Hours
1		
2		
...		

6. Topics of laboratory works

№	Topic	Hours
1.	Introduction. Equipment and safety in chemical laboratory. Methods of chemical experiments.	1
2.	Bases of modern nomenclature and classification of inorganic compounds.	2(1)
3.	The structure of the atom and Mendeleev's periodic law	2
4.	Determination of the types of chemical bonds between atoms in compounds. The relative electronegativity of atoms.	2(1)
5.	Determination of the thermal effect of the neutralization and dissolution of anhydrous salts.	2
6.	Calculation of kinetic parameters of the reaction according to the experiment.	2

7.	Determination of the conductivity of electrolyte solutions. Indicator method of pH solutions calculation.	2(1)
8.	The preparation of solutions given concentration	2
9.	The properties of metals in redox reactions.	2(1)
10.	The dependence of electromotive force from galvanic cells of metals.	2(1)
11.	Investigation of electrolysis of aqueous solutions of electrolytes. The calculations of the aount of substances using Faraday's law.	2(1)
12.	Determination of corrosion mass index rate.	2(1)
13.	The chemical properties of non-metals and their compounds/	2(1)
14.	The chemical properties of metals and their compounds.	2(1)
15.	The genetic link between the classes of organic compounds, the methods of detection og organic compounds.	1
16	The properties of polymers. Introduction to methods of determining the quality of fuels.	2(1)

30hours (10hours)

7. Example of module tests

Module №1

«Atomic structure and chemical bond»

Variant № 1

1. The possible values of main(principal) quantum number are:

A.	integers from 0 to n-1;	B.	+½, - ½;
C.	integers from 1 to ∞;	D.	integers from + *l* to - *l* .

2. The total number of orbitals in an s-subshell is?….. :

(write right answer to the answer sheet)

3. Which electron configuration reprsents an atom Sb in the ground state:

A.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3$;	B.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2 5p^6 5d^{10}$;
C.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^8 5s^2 5p^5$;	D	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^1 5p^4$

4. To give the characteristics of elements:

№ 17, № 50

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of elements.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 30and 8, specify the type of chemical bond of obtained compound

6.Determine the types of chemical bonds for the following compounds:

manganese; potassium carbonate; phosphate acid; calcium hydroxide; ferrum (III) sulfate

Variant № 2

1. What's formula determine value of secondary(azimunthal) quantum number:

A.	$2l + 1$;	B.	$2n^2$;	C.	$2(2l + 1)$;	D.	$0 \div$ n-1.

2. Electronic structure of atom Manganese ….. :

(write right answer to the answer sheet)

3. The total number of shells (levels) of atom is equal to the number of..:

A.	Group ;	B.	Element;
C	Period;	D	Series.

4. To give the characteristics of elements:

№ 15, № 40

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 16 and 19, specify the type of chemical bond of obtained compound

6.Determine the types of chemical bonds for the following compounds:

steel; chrome (III) nitrate; silicate acid; carbon (IV) oxide; chlorine

Variant № 3

1. The total number of orbitals in an f-subshell is:

A.	7;	B.	3;	C.	5;	D.	1.

2. The orientation of an orbital inspace is specified by ……. quantum number:

(write only one word to the answer sheet)

3. Which electron configuration reprsents an atom Zr in the ground state:

А.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2 5p^2$;	В.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2 4p^6 5s^2 5p^4$;
Б.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^2 5s^2$;	Г	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^3 5s^1$

4. To give the characteristics of elements:

№ 7, № 23

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 7 and 8, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

barium chlorate; potassium carbonate; 2 molecule of fluoride acid; zinc hydroxide; scandium

Variant № 4

1. Which electron configuration reprsents an atom Ga in the ground state:

А.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2 4p^6$;	В.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^1$;
Б.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1 4p^2$;	Г	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2 4p^2$

2. The maximum number of electron in a d-subshell is?

(write right answer to the answer sheet)

3. The possible values of spin quantum number are:

А.	integers from 0 до n-1;	В.	+½, - ½;
Б.	integers from 0 до ∞;	Г	integers from + *l* до - *l* .

4. To give the characteristics of elements:

№ 9, № 49

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 19 and 53, specify the type of chemical bond of obtained compound

6.Determine the types of chemical bonds for the following compounds:

plumbum (II) nitrate; stibium; 2 molecule of ammoniac; zinc chlorate; nitrogen (V) oxide

Variant № 5

1. The common electronic structures of halogens are:

A.	$(n-1)p^5ns^2$;	B.	$(n-1)dns^1$;	C.	ns^2np^5;	D.	$ns^2(n-1)d$.

2. The general rules for electron formulas compilation are ….. :

(write right answer to the answer sheet)

3. Which electron configuration reprsents an atom Br in the ground state:

A.	$1s^22s^22p^63s^23p^63d^94s^24p^6$;	B.	$1s^22s^22p^63s^23p^63d^{10}4s^24p^5$;
C.	$1s^22s^22p^63s^23p^64s^24p^54d^{10}$;	D	$1s^22s^22p^63s^23p^63d^{10}4s^14p^6$;

To give the characteristics of elements:

№ 14, № 38

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 11 and 35, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

ferrum (III) oxide; silumin; radium phosphate; borate acid; 2 molecule of sulfide acid

Variant № 6

1. The total number of orbitals in an p-subshell is:

A.	6;	B.	3;	C.	5;	D.	1.

2. The possible values of spin quantum number for electrons in s-subshell are:

(write right answer to the answer sheet)

3. Which electron configuration reprsents an atom Mn in the ground state:

A.	$1s^22s^22p^63s^23p^64s^24p^5$;	B.	$1s^22s^22p^63s^23p^63d^54s^2$;
C.	$1s^22s^22p^63s^23p^64s^24d^5$;	D	$1s^22s^22p^63s^23p^63d^64s^1$;

To give the characteristics of elements:

№ 11, № 53

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 15 and 8, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

phosphorus(V) oxide; hydrogen; aluminium sulfite; chlorate acid; 3 molecules of water

Variant № 7

1. The total number of orbitals in an d-subshell is

A.	1;	B.	3;	C.	5;	D.	10

2. The spin quantum number is specified ….. :

(write right answer to the answer sheet)

3. Which electron configuration reprsents an atom I in the ground state:

A.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^9 5s^2 5p^6$	B.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^5$
C.	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^6 4d^{10} 5s^2 5p^5 5d^{10}$	D	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^1 5p^6$;

To give the characteristics of elements:

№ 34, № 40

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 15 and 8, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

stannum hydroxide; brass; ferrum(III) sulfate; phosphate acid; nitrogen

Variant № 8

1. The magnetic quantum number is specified:

A.	The energy of an electron in shell and the size of the orbital;	B.	The orientation of an orbital in space
C.	The energy of an electron in subshell and the shape of an orbital	D	The orientation of the spin axis

2. What is formula determine maximum quantity of electrons on the energy level :

(write right answer to the answer sheet)

3. Which electron configuration reprsents an atom Mn in the ground state:

A.	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^5$;	B.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$;
C.	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^5$;	Г	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^1$;

To give the characteristics of elements:

№ 15, № 48

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances obtained by elements with atomic number 7 and 8, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

barium nitrate iodine; cadmium phosphate; chlorate acid; 2 molecules of flouride acid

Variant № 9

1. The possible values of main(principal) quantum number are:

А.	integers from 0 до n-1;	В.	+½, - ½;
Б.	integers from 1 до ∞;	Г	integers from + *l* до - *l* .

2. How many valence electrons are found in an atom Cl….. :

(write right answer to the answer sheet)

3. Which electron configuration reprsents an atom Sb in the ground state:

А.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3$;	В.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2 5p^6 5d^{10}$;
Б.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^8 5s^2 5p^5$;	Г	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^1 5p^4$

4. To give the characteristics of elements:

№ 8, № 50

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances obtained by elements with atomic number 16 i 8, specify the type of chemical bond of obtained compound

6.Determine the types of chemical bonds for the following compounds:

molibden; nitrogen; phosphate acid; aluminium sufite; cobalt (III) nitrate

Variant № 10

1. Metallic properties across a period tend to

А.	decrease;	В.	don't change
Б.	increase;	D.	first increase and then decrease

2. Electronic structure of atom Sr ….. :

(write right answer to the answer sheet)

3. The total number of shells (levels) of atom is equal to the number of :

А.	Group ;	В.	Element;
С	Period;	D	Series.

4. To give the characteristics of elements:

№ 35, № 49

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances obtained by elements with atomic number 16 i 1, specify the type of chemical bond of obtained compound

6.Determine the types of chemical bonds for the following compounds:

silumin; ferrum (III) nitrate; sodium phosphate; sulfur (VI) oxide; borate acid

Variant № 11

1. The total number of orbitals in an d-subshell is:

A.	7;	B.	3;	C.	5;	D.	10.

2. The orientation of an orbital in space is specified by ....quantum number:

(write only one word to the answer sheet)

3. Which electron configuration reprsents an atom Ca in the ground state:

A.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$;	B.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^1$;
Б.	$1s^2 2s^2 2p^6 3s^2 3p^4 3d^2 4s^2$;	Г	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

4. To give the characteristics of elements:

№ 30, № 33

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances obtained by elements with atomic number 13 i 16, specify the type of chemical bond of obtained compound

6.Determine the types of chemical bonds for the following compounds:

cobalt chlorate; magnesium phosphate; 2 molecules of ammoniac; sulfite acid; bromine

Variant № 12

1. Which electron configuration reprsents an atom Rb in the ground state:

A.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^1$;	B.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^1$;
Б.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5 5s^2$;	Г	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2 4p^5 5s^2$

2. The spin quantum number determines….. :

(write right answer to the answer sheet)

3. The possible values of main(principal) quantum number are

A.	integers from 0 до n-1;	B.	+½, - ½;
Б.	integers from 1 до ∞;	Г	integers from + *l* до - *l* .

4. To give the characteristics of elements:

№ 52, № 19

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances obtained by elements with atomic number 15 i 8, specify the type of chemical bond of obtained compound

6.Determine the types of chemical bonds for the following compounds:

ferrum (III) sulfate; stannum hydroxide; silicate acid; zinc chlorate; brass

«The bases of electrochemistry»

Variant № 1

1. **Specify the number of lost or attached electrons according to the scheme $HNO_3 \rightarrow NH_3$:**
   A. +2, **B.** -2, **C.** -3, **D.** +8.
2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents.:**
   $Ba + H_2SO_{4\ conc.} \rightarrow$ $Mn + HNO_{3\ dil.} \rightarrow$
   $Cu + HCI \rightarrow$ $Na + H_2O \rightarrow$
   $Al + NaOH \rightarrow$ $Zn(CH_3COO)_2 + Mg \rightarrow$
3. **To calculate EMF for the Fe-Cu galvanic cell:**
   A. 1,92 V **B.** -1,92 V **C.** 2,8 V, **V.** -2,8 V
4. **Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of potassium sulfate and melt sodium chloride?**
5. **Calculate amount of Copper on the cathode during electrolysis of aqueous solution of nickel sulfate for 30 minutes at a current 2A??**
   A. 71,6 g **B.** 4,12 g, **C.** 2,38 g, **D.** 1,19 g.

Variant № 2

1. **Specify the number of lost or attached electrons according to the scheme $HNO_3 \rightarrow HNO_2$:**
   A. +2, **B.** -2, **C.** +1, **D.** +8.
2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents.:**
   $Ca + H_2SO_{4\ conc.} \rightarrow$ $Cu + HNO_{3\ dil.} \rightarrow$
   $Au + HCI \rightarrow$ $Ba + H_2O \rightarrow$
   $Cr + NaOH \rightarrow$ $Cu(CH_3COO)_2 + Zn \rightarrow$
3. **To calculate EMF for the Zn-Cu galvanic cell:**
   A. 0,1 V **B.** -0,78 V, **C.** 0,78 V, **D.** 1,1 V.
4. **Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of plumbum nitrate and melt of potassium chloride?**
5. **Calculate amount of Nickel on the cathode during electrolysis of aqueous solution of nickel sulfate for 80 minutes at a current 5A?**
   A. 1,83g **B.** 14,7 g, **C.** 7,3 g, **D.** 2,23 g.

Variant № 3

1. **Specify the number of lost or attached electrons according to the scheme $H_2SO_4 \rightarrow S^0$:**
   A. +2, **B.** +6, **C** -6, **D.** +8.
2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents.:**
   $Cu + H_2SO_{4conc.} \rightarrow$ $Fe + HNO_{3\ dil.} \rightarrow$
   $Fe + HCI \rightarrow$ $Li + H_2O \rightarrow$
   $Sn + NaOH \rightarrow$ $CaCl_2 + Zn \rightarrow$
3. **To calculate EMF for the Cd-Mn galvanic cell:**
   A. 1,96 V **B.** -1,96 V, **C.** 1,92 V, **D.** 2,76 V
4. **Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of cobalt sulfate and melt of calcium bromide?**

5. **Calculate amount of Mercury on the cathode during electrolysis of aqueous solution of nickel sulfate for 120 minutes at a current 10A?**

A. 59,7 g **B.** 74,6 g, **C.** 149,3 g, **D.** 29,9 g.

Variant № 4

1. **Specify the number of lost or attached electrons according to the scheme $HNO_3 \rightarrow NH_3$:**

A. +9, **B.** -2, **C.** -8, **D.** +8.

2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents.:**

$K + H_2SO_{4\ conc.} \rightarrow$ $Zn + HNO_{3\ dil.} \rightarrow$

$Ca + H_2SO_{4\ dil.} \rightarrow$ $Cr + H_2O \rightarrow$

$Al + NaOH \rightarrow$ $Zn(NO_3)_2 + Ag \rightarrow$

3. **To calculate EMF for the Fe-Ca galvanic cell:**

A. 3,31 V **B.** -1,96 V, **C.** 2,43 v, **D.** -3,31 v

4. **Make the circuit electrode processes that occur on cathode and anode during the electrolysis of aqueous solutions of sodium carbonate and melt of sodium sulfide??**
5. **Calculate amount of Copper on the cathode during electrolysis of aqueous solution of nickel sulfate for 150 minutes at a current 1,5A?**

A. 0,06 g **B.** 74,6 g, **C.** 3,58 g, **D.** 214,9 g.

Variant № 5

1. **Specify the number of lost or attached electrons according to the scheme $HMnO_4 \rightarrow Mn^{2+}$:**

A. +3, **B.** -3, **C.** -5, **D.** +5.

2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

$Zn + H_2SO_{4\ conc.} \rightarrow$ $Sn + HNO_{3\ dil.} \rightarrow$

$Pb + H_3PO_4 \rightarrow$ $Co + H_2O \rightarrow$

$Sb + LiOH \rightarrow$ $CuSO_4 + Fe \rightarrow$

3. **To calculate EMF for the Zn-Cu galvanic cell:**

A. 0,32 V **B.** -1,2 V **C.** 1,2 V, **D.** 2,8 V

4. **Make the circuit electrode processes that occur on cathode and anode during the electrolysis of aqueous solutions of mangane sulfate and melt of aluminium chloride?**
5. **Calculate amount of Nickel on the cathode during electrolysis of aqueous solution of nickel sulfate for 45 minutes at a current 5A?**

A. 7,49 g **B.** 15 g, **C.** 149,7 g, **D.** 29,9 g.

Variant № 6

1. **Specify the number of lost or attached electrons according to the scheme $Fe^0 \rightarrow Fe^{3+}$:**

A. +3, **B.** -3, **C.** +6, **D.** -1.

2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

$Ba + H_2SO_{4\ conc.} \rightarrow$ $Zn + HNO_{3\ dil.} \rightarrow$

$Ca + HCI \rightarrow$ $Na + H_2O \rightarrow$

$K + NaOH \rightarrow$ $Zn(CH_3COO)_2 + Sr \rightarrow$

3. **To calculate EMF for the Fe-Cd galvanic cell:**

A. 0,74 V **B.** -0,74 V, **C.** 0,06 V, **D.** 2,53 V

4. **Make the circuit electrode processes that occur on cathode and anode during the electrolysis of aqueous solutions of zinc sulfate and melt of litium iodide?**
5. **Calculate amount of Aurum on the cathode during electrolysis of aqueous solution of nickel sulfate for 200 minutes at a current 10A?**

A. 183 g **B.** 367,5 g, **C.** 49,1 g **D.** 122,5 g.

Variant № 7

1. **Specify the number of lost or attached electrons according to the scheme $HMnO_4 \rightarrow H_2MnO_4$:**

A. +2, **B.** -2, **C.** +1, **D.** -1.

2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

$Cu + H_2SO_{4\ conc.} \rightarrow$ $Ba + HNO_{3\ dil.} \rightarrow$

$Al + HCI \rightarrow$ $Au + H_2O \rightarrow$

$Pb + NaOH \rightarrow$ $FeCl_2 + Zn \rightarrow$

3. **To calculate EMF for the Fe-Al galvanic cell::**

A. 1,22 V **B.** -1,22 V, **C.** 1,5 V, **D.** 2,1 V

4. **Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of stannum nitrate and melt of cobalt bromide?**
5. **Calculate how much time should pass through the electrolyte solution electric current 5A power to 1050 g of Copper?**

A. 83,75 h **B.** 23,5 h, **C.** 41,8 h, **D.** 120 h.

Variant № 8

1. **Specify the number of lost or attached electrons according to the scheme $H_2SO_4 \rightarrow S^0$:**

A. +6, **B.** -2, **C.** +8, **D.** -8.

2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

$Ag + H_2SO_{4\ conc.} \rightarrow$ $Zn + HNO_{3\ dil.} \rightarrow$

$Co + HCI \rightarrow$ $Al + H_2O \rightarrow$

$Be + NaOH \rightarrow$ $Mg(CH_3COO)_2 + Ca \rightarrow$

3. **To calculate EMF for the Fe-Cu galvanic cell:**

A. 0,47 V **B.** -0,47 V, **C.** 0,21 V, **D.** 2,1 V

4. **Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of potassium sulfate and melt of sodium chloride??**
5. **Calculate amount of Copper on the cathode during electrolysis of aqueous solution of nickel sulfate for 40 minutes at a current 2A?**

A. 51,6 g **B.** 23,8 g, **C.** 0,86 g, **D.** 12 g.

Variant № 9

1. **Specify the number of lost or attached electrons according to the scheme $H_2S \rightarrow SO_2$:**

A. +2, **B.** -2, **C.** +4, **D.** -6.

2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

$Cu + H_2SO_{4\ conc.} \rightarrow$ $Fe + HNO_{3dil.} \rightarrow$

$Mg + HCI \rightarrow$ $Ba + H_2O \rightarrow$

$Ca + LiOH \rightarrow$ $Cu(CH_3COO)_2 + Fe \rightarrow$

3. **To calculate EMF for the Ag-Cu galvanic cell::**

   A. 1,24 V **B.** -0,36 V**,** **C.** 0,36 V**,** **D.** 2,1 V

4. **Make the circuit electrode processes that occur on cathode and anode during the electrolysis of aqueous solutions of aluinium sulfate and melt of sodium bromide?**
5. **Calculate how much time should pass through the electrolyte solution electric current 1-10A power to receive 3 kg of Aurum?**

   A. 51,6 h **B.** 122,2 h**,** **C.** 40 h**,** **D.** 0,12 h.

Variant № 10

1. **Specify the number of lost or attached electrons according to the scheme $H_2SO_4 \rightarrow SO_2$:**

   A. +2**,** **B.** -2**,** **C.** +1**,** **D.** +4**.**

2. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

   $Ca + H_2SO_{4\ conc.} \rightarrow$ $Fe + HNO_{3\ dil.} \rightarrow$

   $Ag + HCI \rightarrow$ $Ba + H_2O \rightarrow$

   $Sb + NaOH \rightarrow$ $ZnCl_2 + Ca \rightarrow$

3. **To calculate EMF for the Fe-Co galvanic cell::**

   A. 0,62 V **B.** -0,47 V**,** **C.** 0,06 V**,** **D.** 0,74 V

4. **Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of aluminium sulfate and melt of lithium sulfide?**
5. **Calculate amount of Copper on the cathode during electrolysis of aqueous solution of nickel sulfate for 30 minutes at a current 2A?**

   A. 0,05 g **B.** 3,18 g**,** **C.** 0,86 g**,** **D.** 191 g.

«Electrolytic dissosciation. Chemistry of the elements»

Variant № 1

1. **Ions Al^{3+} are formed during dissociation in an aqueous solution of:**
   А. $Al(NO_3)_3$, **Б.** $Al(OH)_3$, **В.** Na_3AlO_3, **Г.** Al_2O_3.
2. **The main points of theory of electrolytic dissociation are:**
   A. electrolytic dissociation occurs during melting or dissolving of electrolyte;
   B. substance with ionic or covalent non-polar bonds undergo dissociation;
   C. dissociation – is an equilibrium process;
   D. ions are surrounded by hydration shell in aqueous solution.
3. **To write molecular, complete and net ionic equations:**
   $ZnCl_2 + K_3PO_4 \rightarrow$ $Ba(NO_3)_2 + H_2SO_4 \rightarrow$
   $K_2SiO_3 + HCl \rightarrow$ $Fe_2O_3 + HNO_3 \rightarrow$
   $Zn(OH)_2 + Ca(OH)_2 \rightarrow$ $(NH_4)_2SO_4 + NaOH \rightarrow$
4. **To write the dissociation equation for the ions of the following compounds:**
   ferrum (III) carbonate, itric acid, potassium hydroxide.
5. **Specify the number of lost or attached electrons according to the scheme $NO_3^- \rightarrow NH_3$:**
   А. +2, **Б.** -2, **В.** -3, **Г.** +8.
6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**
   $Ba + H_2SO_{4\ conc.} \rightarrow$ $Mn + HNO_{3\ dil.} \rightarrow$
   $Cu + HCI \rightarrow$ $Na + H_2O \rightarrow$
   $Al + NaOH \rightarrow$ $Zn(CH_3COO)_2 + Mg \rightarrow$

Variant № 2

1. **Ions Pb^{2+} are formed during dissociation in an aqueous solution of:**
   А. $PbCl_2$, **Б.** $Pb(OH)_2$, **В.** Na_2PbO_2, **Г.** $Pb(CH_3COO)_2$.
2. **Determinate strong electrolytes:**
   А. $CaCO_3$, Na_2CO_3, $Al_2(SO_4)_3$, **Б**. BaO, $Mn(CH_3COO)_2$, HBr,
   В. Na_3AlO_3, $(NH_4)_3PO_4$, $HClO_4$, **Г.** $CuCl_2$, HNO_2, $Ca(NO_3)_2$.
3. **To write molecular, complete and net ionic equations::**
   $CoCl_2 + Na_3PO_4 \rightarrow$ $BaCl_2 + H_2SO_4 \rightarrow$
   $K_2SO_3 + HNO_3 \rightarrow$ $NH_4NO_3 + NaOH \rightarrow$
   $Al(OH)_3 + NaOH \rightarrow$ $Cr_2O_3 + HClO_4 \rightarrow$
4. **To write the dissociation equation for the ions of the following compounds:**
   Aluminium hydroxide, mangane (II) chloride, sulfate acid.
5. **Specify the number of lost or attached electrons according to the scheme $NO_3^- \rightarrow NO_2$:**
   А. +2, **Б.** -2, **В.** +1, **Г.** +8.
6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**
   $Ca + H_2SO_{4\ conc.} \rightarrow$ $Cu + HNO_{3dil.} \rightarrow$
   $Au + HCI \rightarrow$ $Ba + H_2O \rightarrow$
   $Cr + NaOH \rightarrow$ $Cu(CH_3COO)_2 + Zn \rightarrow$

Variant № 3

1. **Ions Ca^{2+} are formed during dissociation in an aqueous solution of:**
   А. $Ca(NO_3)_2$, **Б.** $CaCO_3$, **В.** $Ca_3(AlO_3)_2$, **Г.** CaO.
2. **The main points of theory of electrolytic dissociation are:**

A. electrolytic dissociation occurs during melting or dissolving of electrolyte;
B. substance with ionic or covalent non-polar bonds undergo dissociation;
C. dissociation – is an equilibrium process;
D. ions are surrounded by hydration shell in aqueous solution.

3. **To write molecular, complete and net ionic equations:**
   $MgBr_2 + Na_3PO_4 \rightarrow$ $Pb(NO_3)_2 + H_2SO_4 \rightarrow$
   $Cu(CH_3COO)_2 + HNO_3 \rightarrow$ $AgNO_3 + NH_4Cl \rightarrow$
   $Be(OH)_2 + Ba(OH)_2 \rightarrow$ $Fe_2O_3 + HJ \rightarrow$
4. **To write the dissociation equation for the ions of the following compounds:**
   manganese phosphate, chlorate acid, cobalt hydroxide.
5. **Specify the number of lost or attached electrons according to the scheme $SO_4^{2-} \rightarrow S^0$:**
   А. +2, **Б.** +6, **В.** -6, **Г.** +8.
6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents**:
   $Cu + H_2SO_{4\ conc.} \rightarrow$ $Fe + HNO_{3\ dil.} \rightarrow$
   $Fe + HCI \rightarrow$ $Li + H_2O \rightarrow$
   $Sn + NaOH \rightarrow$ $CaCl_2 + Zn \rightarrow$

Variant № 4

1. **Ions Mn^{2+} are formed during dissociation in an aqueous solution of:**
   А. $MnBr_2$, **Б.** $Mn(OH)_2$, **В.** $MnCO_3$, **Г.** $Mn(CH_3COO)_2$.
2. **Determinate strong electrolytes:**
   А. H_2CO_3, Na_2SO_3, $Al_2(SO_4)_3$, **Б**. $Ba(OH)_2$, $Mn(CH_3COO)_2$, HBr,
   В. Na_3AlO_3, NH_4OH, LiOH, **Г.** HF, HNO_2, $Ca(NO_3)_2$.
3. **To write molecular, complete and net ionic equations:**
   $Mn(CH_3COO)_2 + HJ \rightarrow$ $Fe_2O_3 + H_2SO_4 \rightarrow$
   $K_2S + Cu(NO_3)_2 \rightarrow$ $K_2SO_4 + Ca(OH)_2 \rightarrow$
   $Zn(OH)_2 + KOH \rightarrow$ $Na_3PO_4 + H_2SO_3 \rightarrow$
4. **To write the dissociation equation for the ions of the following compounds:**
   zinc hydroxide, copper (II) silicate, sulfide acid.
5. **Specify the number of lost or attached electrons according to the scheme $NO_3^- \rightarrow NH_4^+$:**
   А. +9, **Б.** -2, **В.** -8, **Г.** +8.
6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents**:
   $K + H_2SO_{4\ conc.} \rightarrow$ $Zn + HNO_{3\ dil.} \rightarrow$
   $Ca + H_2SO_{4\ dil.} \rightarrow$ $Cr + H_2O \rightarrow$
   $Al + NaOH \rightarrow$ $Zn(NO_3)_2 + Ag \rightarrow$

Variant № 5

1. **Ions Fe^2 are formed during dissociation in an aqueous solution of::**
   А. $Fe(OH)_2$, **Б.** $FeCO_3$, **В.** $Fe_3(AlO_3)_2$, **Г.** $FeCl_2$.
2. **Acids are dissociated with forming of:**
   А. metal atoms (or ion NH_4^+) **В.** acid residue
   Б. hydroxyl group – OH^-. **Г.** Hydrogen atom
3. **To write molecular, complete and net ionic equations:**
   $Fe(NO_3)_2 + H_3PO_4 \rightarrow$ $Zn(CH_3COO)_2 + HNO_3 \rightarrow$
   $KOH + Cr(OH)_3 \rightarrow$ $NH_4Cl + Ba(OH)_2 \rightarrow$
   $ZnO + HJ \rightarrow$ $Na_2CO_3 + CaCl_2 \rightarrow$

4. **To write the dissociation equation for the ions of the following com-pounds:**
   calcium hydroxide, ferrum (III) nitrate, phosphate acid.
5. **Specify the number of lost or attached electrons according to the scheme**
   $MnO_4^- \rightarrow Mn^{2+}$:
   А. +3, **Б.** -3, **В.** -5, **Г.** +5.
6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**
   $Zn + H_2SO_{4\ conc.} \rightarrow$ $Sn + HNO_{3\ dil.} \rightarrow$
   $Pb + H_3PO_4 \rightarrow$ $Co + H_2O \rightarrow$
   $Sb + LiOH \rightarrow$ $CuSO_4 + Fe \rightarrow$

Variant № 6

1. **Ions PO_4^{3-} are formed during dissociation in an aqueous solution of:**
   А. H_3PO_4, **Б.** Na_3PO_4, **В.** $Mn_3(PO_4)_2$, **Г.** $Zn_3(PO_4)_2$.
2. **Determinate strong electrolytes:**
   А. H_2SO_3, H_2SiO_3, $Al_2(SO_4)_3$, **Б**. $Ba(OH)_2$, $BaSO_4$, HJ,
   В. NaCl, $(NH_4)_2SO_4$, LiOH, **Г.** HF, HNO_2, $Ca(NO_3)_2$.
3. **To write molecular, complete and net ionic equations:**
   $NaOH + (NH_4)_3PO_4 \rightarrow$ $CuS + H_2SO_4 \rightarrow$
   $FeSO_4 + Na_3PO_4 \rightarrow$ $NH_4NO_3 + Ca(OH)_2 \rightarrow$
   $Al(OH)_3 + NaOH \rightarrow$ $ZnO + HNO_3 \rightarrow$
4. **To write the dissociation equation for the ions of the following compounds:**
   copper (II) phosphate, stibium hydroxide, carbonate acid.
5. **Specify the number of lost or attached electrons according to the scheme**
   $Fe^0 \rightarrow Fe^{3+}$:
   А. +3, **Б.** -3, **В.** +6, **Г.** -1.
6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**
   $Ba + H_2SO_{4\ conc.} \rightarrow$ $Zn + HNO_{3\ dil.} \rightarrow$
   $Ca + HCI \rightarrow$ $Na + H_2O \rightarrow$
   $K + NaOH \rightarrow$ $Zn(CH_3COO)_2 + Sr \rightarrow$

Variant № 7

1. **Ions CO_3^{2-} are formed during dissociation in an aqueous solution of::**
   А. H_2CO_3 **Б.** $CaCO_3$, **В.** Na_2CO_3 **Г.** $NiCO_3$.
2. **Bases - are dissociated with forming of:**
   А. metal atoms (or ion NH_4^+) **В.** acid residue
   Б. hydroxyl group – OH^-. **Г.** Hydrogen atom
3. **To write molecular, complete and net ionic equations:**
   $CuCl_2 + Na_3PO_4 \rightarrow$ $BaCl_2 + H_2SO_4 \rightarrow$
   $Fe(CH_3COO)_2 + HNO_3 \rightarrow$ $Na_2CO_3 + Ca(OH)_2 \rightarrow$
   $Cr(OH)_3 + NaOH \rightarrow$ $CuO + HClO_4 \rightarrow$
4. **To write the dissociation equation for the ions of the following compounds:**
   plumbum (II) hydroxide, calcium nitrate, sulfuric acid.
5. **Specify the number of lost or attached electrons according to the scheme**
   $MnO_4^- \rightarrow MnO_4^{2-}$:
   А. +2, **Б.** -2, **В.** +1, **Г.** -1.
6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**
   $Cu + H_2SO_{4\ conc.} \rightarrow$ $Ba + HNO_{3\ dil.} \rightarrow$

$Al + HCI \rightarrow$ $Au + H_2O \rightarrow$

$Zn + NaOH \rightarrow$ $FeCl_2 + Zn \rightarrow$

Variant №8

1. **Ions Cr^{3+} are formed during dissociation in an aqueous solution of:**

   А. $CrBr_3$, **Б.** $Cr(OH)_3$, **В.** K_3CrO_3, **Г.** Cr_2O_3.

2. **Determinate weak electrolytes:**

   А. H_2CO_3, Na_2SO_3, $Al_2(SO_4)_3$, **Б**. $Ba(OH)_2$, $Mn(CH_3COO)_2$, HBr,

   В. Na_3AlO_3, NH_4OH, $Sr(OH)_2$, **Г.** HF, HNO_2, H_2CO_3.

3. **To write molecular, complete and net ionic equations:**

   $Ca(CH_3COO)_2 + HJ \rightarrow$ $MgCO_3 + HCl \rightarrow$

   $(NH_4)_2CO_3 + NaOH \rightarrow$ $(NH_4)_3PO_4 + Zn(NO_3)_2 \rightarrow$

   $Pb(OH)_2 + Ca(OH)_2 \rightarrow$ $CoO + H_2SO_4 \rightarrow$

4. **To write the dissociation equation for the ions of the following compounds:**

   beryllium hydroxide, ammonium carbonate, phosphate acid.

5. **Specify the number of lost or attached electrons according to the scheme $Cr^{2+} \rightarrow Cr^{3+}$:**

   А. +2, **Б.** -2, **В.** +1, **Г.** -1.

6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

   $Ag + H_2SO_{4\ conc.} \rightarrow$ $Zn + HNO_{3\ dil.} \rightarrow$

   $Co + HCI \rightarrow$ $Al + H_2O \rightarrow$

   $Be + NaOH \rightarrow$ $Mg(CH_3COO)_2 + Ca \rightarrow$

Variant № 9

1. **Ions SO_3^2 are formed during dissociation in an aqueous solution of::**

   А. H_2SO_3 **Б.** $CaSO_3$, **В.** Na_2SO_3 **Г.** $NiSO_3$.

2. **Salt are dissociated with forming of:**

   А.

   А. metal atoms (or ion NH_4^+) **В.** acid residue

   Б. hydroxyl group – OH^-. **Г.** Hydrogen atom

3. **To write molecular, complete and net ionic equations:**

   $CH_3COOH + Na_2CO_3 \rightarrow$ $CaCO_3 + HNO_3 \rightarrow$

   $Cu(OH)_2 + HCl \rightarrow$ $(NH_4)_2SO_4 + NaOH \rightarrow$

   $Sn(OH)_2 + NaOH \rightarrow$ $CoCl_2 + (NH_4)_3PO_4 \rightarrow$

4. **To write the dissociation equation for the ions of the following compounds:**

   chromium hydroxide, ammonium sulfate, carbonate acid.

5. **Specify the number of lost or attached electrons according to the scheme $H_2S \rightarrow SO_2$:**

   А. +2, **Б.** -2, **В.** +4, **Г.** -6.

6. **Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**

   $Cu + H_2SO_{4\ conc.} \rightarrow$ $Fe + HNO_{3\ dil} \rightarrow$

   $Mg + HCI \rightarrow$ $Ba + H_2O \rightarrow$

   $Ca + LiOH \rightarrow$ $Cu(CH_3COO)_2 + Fe \rightarrow$

Example of final test

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE			
Degree program «Bachelor» **Speciality** 133 Sectoral Engineering	**Department of General, organic and physical chemistry** 2020-2021 e.y	**EXAMINATION PAPER** **Variant № 1** of **"Chemistry"**	Head of department. (підпис) Ass.prof. Kovshun L.O 22 May 2020

Examination question

(maximum score of 10 points for an answer***)***

Polymeric materials and their applications in engineering. General characteristics of Macromolecular Compounds. Natural and synthetic polymers. Advantages and disadvantages of plastic construction materials in comparison with others.

Test tasks of different types

(maximum score of 20 points for an answers to test tasks***)***

1. To identify the simple compounds:

1.	CaO, H_2, Ag, HCl
2.	N_2, Cu, O_2, Cl_2
3.	$Fe(OH)_3$, Mn_2O_7, H_2O, Na
4.	H_2SO4, NaCl, $Ca(OH)_2$, H_2O

2. The amphoteric metals are: ..... :
(fill the answer with the chemical symbols of the metals)

3. How non-metallic properties of elements change along periods of Mendeleev's periodic system from left to right:

1.	increase	3.	decrease
2.	don't change	4.	first increase, then decrease

4. With the interaction of Cr $(OH)_3$ with sulfuric acid it is possible to obtain salt ..... (write the answer with the chemical formula of salt)**:…… .**

5. To find the correspondence between the types of oxides and their chemical formulas:

A.	basic oxides	1. SO_2	4. ZnO
B.	acidic oxides	2. N_2O_5	5. K_2O
C.	amphoteric oxides	3. MnO	6. Cr_2O_3

6. To identify the strong electrolytes:

1.	$Ca(OH)_2$	3.	NH_4OH
2.	FeS	4.	HNO_2

7. For preparation 0.5 L of 1 M solution, it is necessary to take Pb $(NO_3)_2$ (M = 331.2 g / mol) in the amount: (*To write solution in justification form***):**

1.	125,10 g;	3.	180,21 g;
2.	165,6 g;	4.	45,03 g.

8. Which of the metals do not react with water?

1.	Li	3	Pb
2.	Ca	4.	Cu

9. Determine the number of Oxidation of Sulfur in the compound K_2SO_3, Chlorine in - $HClO_3$, Manganese in - Na_2MnO_4: *(write the degree of oxidation through a coma)*

10. Determine the gas released by the interaction of silver with concentrated sulfuric acid *(to write corresponding chemical formula)*

11. Determine weak electrolyte which is formed as a result of the reaction $FeCl_2 + K_3PO4 \rightarrow$ ...: *(in the enter the formula of weak electrolyte,to write the equation in the justification form)*

12. To identify the processes of electrolysis of a solution of sodium chloride there are processes:			
1.	$2Cl^- - 2e \rightarrow Cl_2$	3.	$2H^+ + 2e \rightarrow H_2$;
2.	$Na^+ + e \rightarrow Na$	4.	$4OH^- - 4e \rightarrow 2H_2O + O_2$
13. The EMF of a nickel-magnesium galvanic element is ($E^\circ_{(Mg)}$= - 2,36 V, $E^\circ_{(Ni)}$= - 0,25V) *(enter the answers in V)*			
14. The maximum number of electrons at the p - sublevel is: (*write only the right number***):**			
15. Choose the reactions that occur when calcium-copper galvanic element works?			
1.	$Cu^{2+} + 2e \rightarrow Cu$;;	3.	$Ca - 2e \rightarrow Ca^{2+}$;
2.	$Cu - 2e \rightarrow Cu^{2+}$;	4.	$Ca^{2+} + 2e \rightarrow Ca$;
16. To find the correspondence between the compound and the type of chemical bonds in it:			
A.	Non-polar covalent	1.	NH_3
B.	Ionic bond	2.	KCl
C.	Covalent polar	3.	Cl_2
D.	Hydrogen bond	4.	Cu
E.	Metallic bond	5.	2 H_2S
17. Arrange the following compounds according to the classes			
A.	Oxide	1.	H_3PO_4
B.	Base	2.	$Ca_3(PO_4)_2$
C.	Acid	3.	H_2SO_4
D.	Salt	4.	$Ca(OH)_2$
18. Steel, brass, bronze - are…. *(to write right answer only with one word)*			
19. A substance that prevents or decreases the rate of a chemical reaction is called …: *(to write right answer only with one word)*			
20. **What is the mass of magnesium deposited on the cathode during electrolysis of the $MgCl_2$ with a force of 20 A for 48 hours?** (*to write the value in grams, in the justification form write the solution*)			

8. Methods of teaching

In conducting lectures appropriate to use verbal teaching methods: explanation, narration, discussion, educational debate, with a combination of visual learning methods: illustration, showing. In carrying out laboratory work should be used such as verbal learning method of instruction on the combination of visual learning methods of illustration and demonstration, the aspect of these studies is that they facilitate communication theory and practice. Laboratory work in the laboratory are equipped basic chemical and electrochemical equipments.

9. Forms of control

The main methods of control of knowledge and skills students have to study the subject "Remote sensing for land resources monitoring" are: oral examination, written and practical test, standardized control in the form of modular test papers, assessment for individual learning task, the final test. The total value of these methods is to make the best possible to ensure timely and comprehensive feedback between students and teachers, by which establishes how students perceive and learn the material. The purpose determines the choice of control methods, it should be borne in mind that these methods can be applied in all kinds of control - only complete applications allows regularly and objectively identify the dynamics of the formation of knowledge and skills of students. Each control method has its advantages and disadvantages, scope of application, none of them can not be the only one able to diagnose all aspects of the learning process. So: - to control the absorption of lectures: oral questioning, written modular test papers, current testing score for an individual learning task, the final test. - for the monitoring and evaluation of laboratory work: practical test and evaluation of each laboratory work.

10. Distribution of grades received by students during study.

Current testing			Rating of educational work $R_{НР}$	Rating of additional work $R_{ДР}$	Negative Rating $R_{ШТР}$	Final test	Total amount of scores
Module 1	Module 2	Module 3					
0-100	0-100	0-100	0-70	0-20	0-5	0-30	0-100

$$R_{НР} = \frac{0{,}7 \cdot (R^{(1)}_{ЗМ} \cdot К^{(1)}_{ЗМ} + \ldots + R^{(n)}_{ЗМ} \cdot К^{(n)}_{ЗМ})}{К_{ДИС}} + R_{ДР} - R_{ШТР},$$

де $R^{(1)}_{ЗМ}, \ldots R^{(n)}_{ЗМ}$ − rating of 1st, 2nd and 3d modules by 100 mark scale;

n – number of modules;

$К^{(1)}_{ЗМ}, \ldots К^{(n)}_{ЗМ}$ – credits ECTS;

$К_{ДИС} = К^{(1)}_{ЗМ} + \ldots + К^{(n)}_{ЗМ}$ – total amount of credits ECTS;

R ДР − rating of additional work;

R ШТР − penal rating.

A rating of discipline can be calculated by formula:

$$R_{НР} = \frac{0{,}7 \cdot (R^{(1)}_{ЗМ} + \ldots + R^{(n)}_{ЗМ})}{n} + R_{ДР} - R_{ШТР}.$$

Ratio between national and ECTS values and rating from the discipline

Grading is based on tests, homework assignments, quizzes and laboratory investigations by to the following table.

Rating, points	National value	
	Examination	Test
90 – 100	**Excellent**	passed
74-89	**Good**	
60-73	**Satisfactory**	
0-59	**Unsatisfactory**	not passed

Required and recommended literature

11. Methodical support

1. Антрапцева Н.М., Жила Р.С., Пономарьова І.Г. Лабораторний практикум (з основами теорії) для студентів напрямів: 6.050503 – "Машинобудування", 6.070101 – "Транспортні технології", 6.100102 – "Процеси, машини та обладнання агропромислового виробництва", 6. 060101 – "Будівництво". – К.: – НУБіП, 2015. - 194 с.
2.Антрапцева Н.М., Пономарьова І.Г. Хімія (з основами електрохімії). Лабораторний практикум. К.: - НУБіП. – 2012. – 193с.
3.Антрапцева Н.М., Пономарьова І.Г., Кочкодан О.Д. Загальна та неорганічна хімія. Збірник тестових завдань. К.: - 2007. – 92с.

12. Basic literature

1.Буря О.І., Повхан М.Ф., Чигвінцева О.П., Антрапцева Н.М. Загальна хімія. Дн.: наука і освіта. – 2002. – 306с.
2.Карнаухов О.І. Копілевич В.А., Мельничук Д.О. та ін.. Загальна хімія. – К. : Фенікс. – 2005. – 839с.
3.Григорьєва В.В., Самойленко В.М., Сич А.М. Загальна хімія. К.: Вища школа. – 1991. – 431с.
4.Романова Н.В. Загальна та неорганічна хімія. – К.: Вища школа. – 1988. – 430с.

Supplemental materials

1. .Хомченко Г.П., Цитович И.К. Неорганическая химия. – М.: Высшая школа. – 1987. - 464с.
2.Егоров А. А. Общая и неорганическая химия. – Ростов на Дону.: - 1997. – 673с.

13. IT resources

1. 1. http://www.chemnet.ru/
2. http://www.hemi.nsu.ru/
3. http://www.hij.ru/
4. http://n-t.ru/ri/ps/
5. http://www.physchem.chimfak.rsu.ru/Sources.html
6. http://him.1september.ru/
7. http://www.alhimik.ru/
8. http://all-met.narod.ru/
9. http://www.chemistry.ru/
10. http://simplescience.ru/video/about:chemistry/
11. http://chemistry-chemists.com/Video.html
12. http://www.chemicum.com/ru/
13. https://www.youtube.com/channel/UCD2fRmgV93G8ZUxZTGLbScA