

“Nicolae Testemitanu” State University of Medicine and Pharmacy

Syllabus for entrance examination. Chemistry

INTRODUCTION

The knowledge of chemistry is necessary to find out the basic concepts regarding structure and function of inorganic and organic substances and the action mechanism of those substances, as well as for further study of Bioorganic chemistry and Biochemistry courses, which are included in the curriculum of our University. The chemistry course leads to the foundation of knowledge about the laws governing chemical behavior of the most important classes of natural organic compounds, establishing the reciprocal connection between the structure, reactivity and biological and chemical function.

The curriculum of the General Chemistry and Organic Chemistry courses includes structure, isomerism, classification and nomenclature of inorganic and organic compounds.

The primary aim of the program:

- ✓ To give the pupils an opportunity to understand the requirements which are necessary for examination on Chemistry and for future successful completion of the Bioorganic Chemistry and Biochemistry courses in the State University of Medicine and Pharmacy "Nicolae Testemitanu"

Part I

General Chemistry

FUNDAMENTAL CHEMICAL LAWS. STRUCTURE OF MOLECULES. DALTON ATOMIC THEORY. THE PERIODIC TABLE OF D. MENDELEEV. HYBRIDIZATION OF ELECTRONS AND DIFFERENT CHEMICAL BONDS

1. Fundamental Chemical Laws (law of conservation of mass, the law of the constant composition of compounds).
2. Daltons Atomic Theory: each element is made up of tiny particles called atoms, the atoms of identical element are identical, combining of atoms gives chemical compound, reorganization of the atoms in chemical reactions.
3. The modern View of Atomic Structure. Subatomic Particles: electrons, protons, neutrons. The Nucleus and the Atom.
4. Atomic Number, Mass Number, and Isotopes. Elemental Symbols.

5. Molecules and ions: cations and anions. Formulas of Ionic Compounds. Names of Ionic Compounds. The nature of Acids and Bases. The pH scale. Base properties of Salts and Oxides.
6. Weights of Atoms, Molecules, and Ionic Compounds. Formula Weight. Percent Composition. The Mole. Avogadro's hypothesis about the volumes of different gases, which contain the same number of particles. Practice in Balancing Equations. Stoichiometry and the Balanced Equation. The Mole. Ratio. Mole – Mole Stoichiometry Problems. Mass – Mass Stoichiometry Problems.
7. The Periodic Table of the Elements (D. Mendeleev): different various of the Periodic Table. The Periodic Law.
8. Distribution of elements into vertical columns, or Groups and horizontal rows Periods. Electron configuration and the Periodic Table. To describe the shapes of orbitals designated by s, p, d, and f.
9. To show general trends in ionization energy, electron affinity, and atomic radius in the periodic table. To know the most chemically reactive metals which are found on the lower left hand portion of the table, where the ionization energies are smallest and nonmetals, which found on the right side of the table, and have the ability to gain electrons to form anions. Electronegativity.
10. Naming compounds. To demonstrate how to name compounds given their formulas, and to write formulas given their names.
11. The Chemical Bond. Ionic Bonds. Covalent Bonds. Polar Covalent Bond. Oxidation Number.
12. Molecular Geometries. Multiple Bonds and Hybrid Orbitals.
13. Solutions. Dilute and concentrated solutions. Percent Concentration. Molarity. Electrolytes and Nonelectrolytes.
14. Different types of Chemical Reactions. Acid – Base Reactions. Oxidation-Reduction Reactions. Reactions of Substitution. Reactions of joining,. Reactions of disintegration. Chemical Equilibrium and Le Chateller s Principle.
15. Acids and Bases. Sulfuric Acid. Hydrochloric Acid. Nitric Acid. Phosphoric Acid. Acetic Acid. Carbonic Acid. Sodium Hydroxide. Ammonia. Amphoterism. The pH scale.

Part II

Inorganic Chemistry

STRUCTURE AND CHEMICAL ABILITY OF INORGANIC COMPOUNDS

1. Reactions of alkali metals with water. The oxides and hydroxides of alkali metals. Production and uses of hydrogen.
2. General chemical properties of the alkaline earth metals.
3. Chemistry of carbon and carbon oxides. Nonmetals: nitrogen and phosphorus. Ammonia, the most important nitrogen hydride. Nitric acid HNO_3 is an important strong acid. Phosphorus exists in three elemental forms. Oxide of phosphorus. Phosphoric acid H_3PO_4 .
4. Oxygen O_2 and O_3 . Sulfur oxides. Sulfuric Acid.
5. The group of halogens. Halides HX strong acid in water.
6. General properties of Transition metals. To introduce the 3d and 4d transition series.

Part III

STRUCTURE AND CHEMICAL ABILITY OF ORGANIC COMPOUNDS

1. Space structure of organic compounds. The fundamental thesis of stereochemistry – configuration of carbon atom and conformation of carbon atoms' chain.
2. Alkanes – Saturated Hydrocarbons. Nomenclature of Alkanes. Reactions of Alkanes: Oxidation, Halogenations. Conformation of open chains (ethane, n-butane). Isomers of Alkanes.
3. Types of Unsaturated Hydrocarbons. Nomenclature of Alkenes and Alkynes. Reactions of Alkenes and Alkynes. Stereoisomerism of organic compounds. Optical activity. Compounds with double bonds. Addition Reactions of Alkenes. Polymerization of Alkenes.
4. Conformation of cyclic compounds. Nomenclature of Aromatic Hydrocarbons. Benzene.
5. Hydrocarbon Derivatives. Alcohols. Common Alcohols. Methanol. Ethanol. Reactions of Alcohols: Reaction with Active Metals. Substitution Reactions. Oxidation of Alcohols. Formation of Esters. Phenols.
6. Aldehydes and Ketones. Reduction of Carbonyl Compounds. Addition of Water.
7. Carboxylic Acids and Esters. Nomenclature of Carboxylic Acids. Formic Acid. Acetic Acid. Propionic Acid. Nomenclature of Esters. Hydrolysis of Esters. Saponification of Esters.
8. Conjugate system with open chain; diene 1,3 (butadiene, isoprene). Aromatization of benzene compounds (benzene) and heterocyclic ones (pyrrole, pyridine, purine).
9. Amines. Basicity of Amines.
10. Biological compounds: Lipids, Proteins, Carbohydrates.
11. Hydrolyzable lipids. Glycerides. Fatty acids (palmitic, stearic).
12. Alfa-aminoacids that compose protein chain. Structure, classification and nomenclature of aminoacids. Acido-bases, properties of aminoacids.

13. Peptides stabilization of first structure. Composition and structure of proteins. Hydrolysis of proteins.
14. Classification and nomenclature of Carbohydrates. Glucose: typical monosaccharide. Structure of glucose.

Samples of tests. Chemistry

- In polar covalent bonds, valence electrons are:
 - equally shared
 - unequally shared
 - transferred
 - destroyed
 - not shared
- The nucleus of most atoms is made up of:
 - protons and electrons
 - protons and neutrons
 - neutrons and electrons
 - only protons
 - only neutrons
- The most active metals are located in the:
 - lower left hand corner of the periodic table
 - upper left hand corner of the periodic table
 - lower right hand corner of the periodic table
 - upper right hand corner of the periodic table
 - central part of the periodic table
- When the synthesis reaction for iron(III) oxide $Fe + O_2 \rightarrow Fe_2O_3$ is balanced, the coefficient on elemental iron is:
 - 5
 - 4
 - 3
 - 2
 - 1
- Which statement is true?
 - Acids are nonelectrolytes. Bases are electrolytes.
 - Acids and bases are electrolytes.
 - Acids are electrolytes. Bases are nonelectrolytes.
 - Acids and bases are nonelectrolytes.
 - Acids and bases can form ions.
- Calculate the concentration of the following solution in units of percent composition: 25 grams of KCl is dissolved in 5.00 L of solution (solution density ≈ 1 g/mL)
 - 5%
 - 0.2%
 - 0.5%
 - 50%
 - 3%
- Water can be decomposed to produce hydrogen and oxygen gases. $2H_2O \rightarrow 2H_2 + O_2$ What volume (L) of hydrogen can be collected from the decomposition of 54 grams of water?
 - 6.0

- B. 44.8
C. 67.2
D. 22.4
E. 11.2
8. Which of the following would have the largest atomic radii?
A. Cl
B. At
C. Br
D. I
E. F
9. The correct name for the compound $\text{Cr}_2(\text{SO}_4)_3$ is:
A. Chromium (II) sulfide
B. Chromium (II) sulfate
C. Chromium (II) sulfite
D. Chromium (III) sulfate
E. Chromium (III) sulfite
10. Indicate the reactions which run with the change of oxidation number of elements:
A. $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$
B. $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
C. $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{SO}_2 + 2\text{H}_2\text{O}$
D. $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
E. $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
11. Methanol, CH_3OH , is the simplest:
A. fatty acid
B. amino acid
C. carboxylic acid
D. alcohol
E. aldehyde
12. The general formula shown below is for a(n): R-OH
A. alkane
B. carboxylic acid
C. alcohol
D. amine
E. aldehyde
F.
13. A compound with a composition of 87.5 % N and 12.5 % H was recently discovered. What is the empirical formula for this compound?
A. NH_2
B. N_2H_3
C. NH
D. N_2H_2
E. N_2H
14. What is the name of C_2H_4 ?
A. ethylene

- B. ethane
 - C. ethanal
 - D. ethyne
 - E. ethanol
15. Which of the following combinations of names and formulas are incorrect?
- A. $\text{CH}_3\text{CH}_2\text{COOH}$ – Propionic acid
 - B. C_2H_2 – Acetylene
 - C. CH_3COOH – Carbonic acid
 - D. $\text{CH}_2\text{Cl}-\text{CH}_2-\text{CH}_2-\text{CH}_3$ – 1-chlorobutane
 - E. C_3H_6 – ethane
16. The mixture of ethane and ethylene with volume of 200 ml decolorized 25 g of bromine water. The mass percentage of bromine in water is 3.2%. Calculate the volume percentage of ethylene in the mixture:
- A. 40 %
 - B. 65 %
 - C. 56 %
 - D. 36 %
 - E. 25 %
17. Hydroxyl functional group is:
- A. -OH
 - B. -COOH
 - C. -NH₂
 - D. -NO₂
 - E. -COH
18. Which statements are true?
- A. Benzene is an acyclic compound.
 - B. Benzene molecule is composed of 6 carbon atoms joined in a ring.
 - C. The most common reactions of benzene involve substitution of a proton by other groups.
 - D. The compound with the formula C_6H_{12} is benzene.
 - E. Benzene is an aromatic hydrocarbon.
19. Which of the following substances interact with KOH:
- A. C_6H_6
 - B. CH_3COOH
 - C. C_2H_6
 - D. $\text{C}_6\text{H}_5\text{OH}$
 - E. $\text{C}_2\text{H}_5\text{Br}$
20. Heptane is an alkane with:
- A. 9 carbon atoms
 - B. 8 carbon atoms
 - C. 7 carbon atoms
 - D. 6 carbon atoms
 - E. 5 carbon atoms