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Admissions and Academic Coordination Office for International Students

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DEMO version of Chemistry admission test

The Chemistry admission test consists of two parts: 1 and 2.

Part 1 includes 14 test questions, which require choosing a correct answer (or several correct answers) from the list of variants. Depending on the difficulty, each question is worth from 2 to 6 points. The candidate can get total of 62 points for this part.

Part 2 includes 6 tasks which require to fill in the answer. Depending on the difficulty, each question is worth from 6 to 10 points. The candidate can get total of 48 points for this part.

The maximum number of points for two parts (1 and 2) – 100.

The minimum number of points required to pass the exam successfully – 39.

The candidate has 60 minutes to complete all the tasks.

Part 1

Select one or more correct answer:

1.	Chlorine has the degree of oxidation +5 in the compound:	1) HClO ₄ 2) HClO ₃ 3) HClO ₂ 4) HCl
2.	Choose correct characteristics of the reactions: NaOH (solution) + HCl (solution) → NaCl (solution) + H ₂ O (liquid):	1) homogeneous; 2) heterogeneous; 3) redox; 4) exchange reaction; 5) substitution reaction.
3.	To increase the speed of the reaction N ₂ (gas) + O ₂ (gas) → 2NO (gas), it is necessary to:	1) increase the temperature; 2) reduce the temperature; 3) increase the nitrogen pressure; 4) reduce nitrogen pressure.
4.	The mass of the solute, which is contained in 200 grams of a 10% solution is:	1) 2 g; 2) 20 g;

		3) 200 g; 4) 2000 g.
5.	The number of moles of $\text{Ca}(\text{NO}_3)_2$ having the mass of 32.8 g is equal to:	1) 2.0 mol; 2) 0.2 mol; 3) 1.2 mol; 4) 5.0 mol;
6.	Thermal decomposition products of calcium carbonate (CaCO_3) are:	1) Ca and CO_2 ; 2) CaO and CO_2 ; 3) CaO and CO; 4) Calcium carbonate is not subject to thermal decomposition.
7.	Compounds with the general formula $\text{C}_n\text{H}_{2n-6}$ are called:	1) alkanes; 2) alkenes; 3) alkynes; 4) arenes
8.	The volume of gas (under standard conditions), which is released under the action of excess nitric acid solution on 15.36 g of copper in the reaction $8\text{HNO}_3 + 3\text{Cu} \rightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO}\uparrow + 4\text{H}_2\text{O}$, is equal to:	1) 5.38 l; 2) 3.58 l; 3) 8.06 l; 4) 8.96 l
9.	According to the thermochemical equation of the reaction $4\text{Al}_{(\text{solid})} + 3\text{O}_{2(\text{gas})} = 2\text{Al}_2\text{O}_{3(\text{solid})} + 3352 \text{ kJ}$ the amount of heat generated by the combustion of 270 g of aluminium is equal to:	1) 6704 kJ 2) 1340.8 kJ 3) 8380 kJ 4) 838 kJ
10.	The number of electrons in a carbon atom is:	1) 2; 2) 4; 3) 6; 4) 12.
11.	In the scheme of transformations $\text{C}_2\text{H}_6 \xrightarrow{+\text{X}_1} \text{C}_2\text{H}_5\text{Cl} \xrightarrow{+\text{X}_2} \text{C}_2\text{H}_5\text{OH}$ substances X_1 and X_2 are respectively:	1) HCl and NaOH 2) HCl and NaCl 3) Cl_2 and Na 4) Cl_2 and NaOH
12.	The amount of sodium hydroxide (NaOH) substance weighing 10.0 g is equal to:	1) 1 mole; 2) 2 moles; 3) 0.5 mole; 4) 0.25 mole.
13.	Chemical bonding in the substance NaCl is:	1) covalent non-polar; 2) covalent polar; 3) ionic; 4) metallic.
14.	The right part of the equation of barium	1) $\rightarrow \text{Ba}^{2+} + (\text{OH})_2^-$;

hydroxide dissociation is:	2) $\rightarrow \text{Ba}^{2+} + \text{OH}^{2-}$; 3) $\rightarrow \text{Ba}^{2+} + 2\text{OH}^-$; 4) $\rightarrow 2\text{Ba}^{2+} + 2\text{OH}^-$.
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Part 2

Write the correct answer:

1. An organic substance has a molar mass of 46 g/mol and contains 52.2% carbon, 13.0% hydrogen and 34.8% oxygen. Give the chemical formula of the substance.

2. Establish the correspondence between the formula of the substance and the class to which it belongs. For each position marked with a letter, choose the appropriate number:

- | | |
|---------------------------------------|-----------------|
| A) BaOHCl | 1) acid |
| B) Ba(OH) ₂ | 2) base; |
| C) Ba(HSO ₃) ₂ | 3) acidic salt; |
| | 4) basic salt; |
| | 5) medium salt. |

3. Establish the correspondence between the functional group and the class of organic compounds where this group makes part of molecules.

- | FUNCTIONAL GROUP | CLASS OF ORGANIC COMPOUNDS |
|---------------------|----------------------------|
| A) -CO-NH- | 1) proteins (peptides) |
| B) -COOH | 2) aldehydes |
| C) -COO- | 3) complex esters |
| D) -NH ₂ | 4) carbonic acids |
| | 5) amines |

4. Establish the correspondence between the initial substances and the products that are predominantly obtained as a result of their interaction.

- | INITIAL SUBSTANCES | REACTION PRODUCTS |
|--|--|
| A) $\text{CH}_2\text{Cl} - \text{CH}_3 + \text{NaOH}$ (in alcohol) \rightarrow | 1) $\text{CH}_3 - \text{CH}_2 - \text{OH} + \text{NaCl}$ |
| B) $\text{CH}_2\text{Cl} - \text{CH}_3 + \text{NaOH}$ (in water) \rightarrow | 2) $\text{CH}_2\text{Cl} - \text{CH}_2\text{Cl} + \text{NaCl}$ |
| C) $\text{CH}_2\text{Cl} - \text{CH}_3 + \text{Na} \rightarrow$ | 3) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 + \text{NaCl}$ |
| | 4) $\text{CH}_3 - \text{CH}_2\text{Na} + \text{Cl}_2$ |
| | 5) $\text{CH}_2 = \text{CH}_2 + \text{NaCl} + \text{H}_2\text{O}$ |
| | 6) $\text{CH}_2\text{Cl} - \text{CH}_2\text{Cl} + \text{HCl}$ |

5. Establish the correspondence between the class of substances and their general formula:

- | | |
|-------------|----------------------------------|
| Substance: | Class: |
| A) alkanes; | 1) $\text{C}_n\text{H}_{2n-6}$; |
| B) alkenes; | 2) $\text{C}_n\text{H}_{2n-2}$; |
| C) alkynes; | 3) C_nH_{2n} ; |
| D) arenes | 4) $\text{C}_n\text{H}_{2n+2}$. |

6. Establish the correspondence between substances and their classes:

Substance:	Class:
A) NaOH	1) acid;
B) H ₂ SO ₄	2) base;
C) SO ₃	3) salt;
D) KI	4) oxide.

Topics and Questions for Chemistry admission test

1. CHEMISTRY: GENERAL ISSUES

The subject of chemistry. Role and tasks of chemistry.

Basic concepts and laws of chemistry. Atomic-molecular doctrine. Symbolism of chemistry. Basic stoichiometric laws. Stoichiometric calculations. Ideal gases and their mixtures. Gas laws and calculations with their use.

Structure of the substance. Structure of atomic nuclei and electron shells of atoms.

D.I. Mendeleev's periodic law and periodic system of chemical elements. Basics of the theory of chemical bonding.

Solutions. Basics of the theory about solutions. Calculations using concentrations of solutions. The theory of electrolytic dissociation.

Regularities of chemical reactions. Classification of chemical reactions. Compiling equations of chemical reactions. Basics of thermochemistry. Thermochemical calculations. Chemical equilibrium. The theory about the rate of chemical reactions and catalysis. Chemical reactions in electrolyte solutions. Chemistry and electric current.

2. BASICS OF INORGANIC CHEMISTRY

Classification of inorganic substances. General overview of simple substances.

General methods for obtaining complex substances of different classes and their main chemical properties.

Chemistry of non-metals. Hydrogen, oxygen, elements of fluorine, sulphur, nitrogen and carbon subgroups. Obtaining, structure, properties and application of the most important simple and complex substances formed from these elements.

Chemistry of metals. Alkaline and alkali-earth metals. Aluminium. Some representatives of transition elements: chromium, manganese, iron, copper, zinc.

Obtaining, structure, properties and application of simple and complex substances formed from these elements.

3. BASICS OF ORGANIC CHEMISTRY

Theoretical foundations of organic chemistry. Theory of chemical structure.

Electronic structure of organic compounds. Intermediate particles in reactions involving organic compounds. Classification of reagents and reactions with participation of organic compounds. Classification of organic compounds.

Chemistry of hydrocarbons and their derivatives. Saturated hydrocarbons, ethylene, diene, acetylene and aromatic hydrocarbons. Halogen derivatives of hydrocarbons.

Alcohols and phenols. Aldehydes. Carboxylic acids and their derivatives. Nitrogen-containing compounds. Organic compounds with several functional groups.

Obtaining, structure, properties and application of organic substances of these classes.

General concepts of high-molecular compounds.

Main strategies of organic synthesis.

4. APPLIED SECTIONS OF CHEMISTRY

Basics of chemical technology. Production of the most important inorganic substances. General overview of metallurgical processes. Mineral fertilizers. Natural sources of organic compounds and their processing. Industrial synthesis of the most important organic substances.

Basics of qualitative analysis of substances.

Chemistry and the environment. Water hardness. Corrosion of metals.