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**CHEMISTRY IN MULTIPLE
CHOICE QUESTIONS**

Minsk BSMU 2016

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
КАФЕДРА ОБЩЕЙ ХИМИИ

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**ХИМИЯ: ВОПРОСЫ
С МНОЖЕСТВЕННЫМИ ВАРИАНТАМИ
ОТВЕТОВ**

**CHEMISTRY IN MULTIPLE
CHOICE QUESTIONS**

Тесты



Минск БГМУ 2016

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ББК 24.1 (81.2 Англ-923)
Х95

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Содержит тесты по основным разделам общей, неорганической и органической химии. Представлены 20 тем, каждая из которых разбита на 2 варианта тестового задания, каждый вариант включает 10 вопросов с множественными вариантами ответов.

Предназначены для иностранных студентов подготовительного отделения, обучающихся на английском языке.

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PREFACE

This book contains 400 multiple choice questions on 20 topics of pre-university chemistry. Multiple choice questions may have from 1 to 3 correct answers. For each topic we did 2 variants with 10 questions in each. The second variant is usually harder than the first one. The answers to these questions can be found: 1) in the text of three books written by the same authors («Introduction to General Chemistry»; «Introduction to Inorganic Chemistry»; «Introduction to Organic Chemistry»), 2) in any other relevant source of knowledge; 3) most answers are hidden in other questions from this book. Finally, all those questions must be answered during corresponding lessons. The main purpose of this book is to make foreign attendees familiar with the style of questions from the entrance exam. The authors are looking forward to receive any feedback regarding this book from both attendees and colleagues.

Please, be aware that some chemical terms have different meanings in English and Russian. For example, “chemical element” is defined in the IUPAC Gold Book as both: 1) all atoms with the same number of protons in the atomic nucleus, and 2) a pure chemical substance composed of atoms with the same number of protons in the atomic nucleus. In Russian just the first meaning of the term “chemical element” is used, while the second meaning has its own expression which can be translated as “simple substance”. Moreover, the term “compound” is used in English to refer to substances composed of atoms from different chemical elements, while in Russian it refers to any substance. In this book we use English terminology and not literal translation from Russian. Such trivial English names of substances as “lime water”, “sodium bicarbonate”, “carbon dioxide”, etc. are also used in this book.

THE STRUCTURE OF MATTER

VARIANT 1

1. Choose physical processes:
 - a) the melting of the ice;
 - b) the boiling of water;
 - c) the burning of wood;
 - d) the oxidation of sulfur.
2. Choose chemical processes:
 - a) production of ammonia from nitrogen and hydrogen;
 - b) the dissolving of glucose in water;
 - c) the dissolving of calcium carbide in water;
 - d) the dissolving of sodium bicarbonate in acetic acid.
3. Choose pure chemical elements:
 - a) chlorine gas;
 - b) iron;
 - c) steel;
 - d) sodium chloride.
4. Choose compounds:
 - a) sulfur dioxide;
 - b) white phosphorus;
 - c) methane;
 - d) oxygen.
5. Choose allotropic modifications of carbon:
 - a) graphite;
 - b) diamond;
 - c) propane;
 - d) carbon dioxide.
6. Choose oxygen containing compounds:
 - a) CaO;
 - b) O₂;
 - c) O₃;
 - d) H₂SO₄.
7. Choose chemical elements which have absolutely different names in English and Latin:
 - a) Ag;
 - b) Ni;
 - c) K;
 - d) Fe.
8. Choose chemical elements which have similar names in English and Latin:
 - a) B;
 - b) W;
 - c) N;
 - d) Pb.
9. Which compounds are composed of three atoms?
 - a) NO₂;
 - b) HCN;
 - c) HNO₃;
 - d) N₂O₅.
10. Which compounds are made from atoms of two chemical elements?
 - a) SO₃
 - b) N₂;
 - c) P₂O₅;
 - d) H₂SiO₃.

VARIANT 2

- Choose physical processes:
 - the mixing of flour with sugar;
 - condensation of water;
 - the burning of magnesium in CO_2 ;
 - the rusting of iron.
- Choose chemical processes:
 - production of the distilled water;
 - the dissolving of sodium chloride in water;
 - the dissolving of sodium sulfide in water;
 - the dissolving of aluminum chloride in water.
- Choose pure chemical elements:
 - lime water;
 - marble;
 - nitrogen;
 - mercury.
- Choose compounds:
 - pyrite;
 - gold;
 - silver;
 - bronze.
- Choose allotropic modifications of oxygen:
 - oxide;
 - ozone;
 - oxygen;
 - ozonide.
- Choose phosphorus containing compounds:
 - F_2 ;
 - NaF ;
 - P_4 ;
 - H_3PO_4 .
- Choose chemical elements which have absolutely different names in English and Latin:
 - Au ;
 - Pt ;
 - Na ;
 - F .
- Choose chemical elements which have similar names in English and Latin:
 - Br ;
 - I ;
 - Sn ;
 - Sb .
- Which compounds are composed of four atoms?
 - H_2O_2 ;
 - MnO_2 ;
 - H_3O^+ ;
 - P_4 .
- Which compounds are made from atoms of three chemical elements?
 - CCl_4 ;
 - O_2 ;
 - H_3PO_4 ;
 - KCN .

VALENCE

VARIANT 1

1. What is the valence of carbon in carbon dioxide?
a) II; b) III; c) IV; d) V.
2. In which compounds the valence of phosphorus is equal to V?
a) P_2O_5 ; b) P_2O_3 ; c) H_3PO_4 ; d) PCl_5 .
3. Calculate the sum of all coefficients in the following chemical reaction:
 $Zn + HCl \rightarrow ZnCl_2 + H_2$
a) 4; b) 5; c) 6; d) 7.
4. Calculate the sum of coefficients before reactants in the following chemical reaction: $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
a) 2; b) 3; c) 4; d) 5.
5. Calculate the sum of coefficients before products in the following chemical reaction: $Al + HCl \rightarrow AlCl_3 + H_2$
a) 3; b) 4; c) 5; d) 6.
6. In which molecules there are three single or a single triple covalent bond?
a) O_2 ; b) H_2O ; c) CO ; d) H_2O_2 .
7. Calculate the sum of all coefficients in the following chemical reaction:
 $Ca + H_2O \rightarrow Ca(OH)_2 + ?$
a) 3; b) 4; c) 5; d) 6.
8. Calculate the sum of coefficients before reactants in the following chemical reaction: $AgNO_3 + ? \rightarrow AgCl + KNO_3$
a) 2; b) 3; c) 4; d) 5.
9. Calculate the sum of coefficients before products in the following chemical reaction: $Ca(OH)_2 + H_3PO_4 \rightarrow Ca_3(PO_4)_2 + ?$
a) 1; b) 3; c) 5; d) 7.
10. How many atoms are connected to the nitrogen atom in HNO_2 molecule?
a) 0; b) 1; c) 2; d) 3.

VARIANT 2

- What is the valence of sulfur in sulfur trioxide?
a) II; b) III; c) IV; d) VI.
- In which compounds the valence of silicon is equal to IV?
a) SiO₂; b) H₂SiO₃; c) K₂SiO₃; d) SiO.
- Calculate the sum of all coefficients in the following chemical reaction:
 $\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$
a) 4; b) 5; c) 6; d) 7.
- Calculate the sum of coefficients before reactants in the following chemical reaction: $\text{Al}(\text{OH})_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$
a) 2; b) 3; c) 4; d) 5.
- Calculate the sum of coefficients before products in the following chemical reaction: $\text{Fe}_2\text{O}_3 + \text{HNO}_3 \rightarrow \text{Fe}(\text{NO}_3)_3 + \text{H}_2\text{O}$
a) 3; b) 4; c) 5; d) 6.
- In which molecules there are four single or two double covalent bonds?
a) C₂H₂; b) NH₃; c) SO₂; d) CH₄.
- Calculate the sum of all coefficients in the following chemical reaction:
 $\text{K} + \text{H}_2\text{O} \rightarrow ? + \text{H}_2$
a) 4; b) 5; c) 6; d) 7.
- Calculate the sum of coefficients before reactants in the following chemical reaction: $\text{CaCO}_3 + ? \rightarrow \text{CaSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$
a) 2; b) 3; c) 4; d) 5.
- Calculate the sum of coefficients before products in the following chemical reaction: $\text{Ca}(\text{OH})_2 + \text{HNO}_3 \rightarrow ? + \text{H}_2\text{O}$
a) 1; b) 3; c) 5; d) 7.
- How many atoms are connected to the chlorine atom in HClO₄ molecule?
a) 2; b) 3; c) 4; d) 5.

THE PERIODIC TABLE

VARIANT 1

1. Metallic properties of chemical elements from A subgroups increase from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
2. Nonmetallic properties of chemical elements from A subgroups increase from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
3. Atomic radii of chemical elements from A subgroups increase from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
4. Electronegativity of chemical elements from A subgroups increases from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
5. Ionization energy of chemical elements from A subgroups increases from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
6. Choose s-elements:
 - a) Na;
 - b) Sr;
 - c) Al;
 - d) Sc.
7. Choose p-elements:
 - a) Cu;
 - b) Sb;
 - c) Cl;
 - d) He.
8. Choose d-elements:
 - a) Ba;
 - b) Fe;
 - c) Si;
 - d) Mn.
9. Which properties are usually identical for elements from the same subgroup?
 - a) number of protons;
 - b) highest valence;
 - c) number of electrons on the outer layer;
 - d) electronegativity.
10. Which properties are identical for elements from the same period?
 - a) atomic radius;
 - b) ionization energy;
 - c) the number of electron layers;
 - d) chemical properties.

VARIANT 2

1. Metallic properties of chemical elements from A subgroups decrease from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
2. Nonmetallic properties of chemical elements from A subgroups decrease from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
3. Atomic radii of chemical elements from A subgroups decrease from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
4. Electronegativity of chemical elements from A subgroups decreases from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
5. Ionization energy of chemical elements from A subgroups decreases from:
 - a) left to right;
 - b) right to left;
 - c) top to bottom;
 - d) bottom to top.
6. Choose s-elements:
 - a) He;
 - b) Cl;
 - c) H;
 - d) Ar.
7. Choose p-elements:
 - a) Al;
 - b) S;
 - c) Hg;
 - d) C.
8. Choose d-elements:
 - a) Be;
 - b) Co;
 - c) Ni;
 - d) Mg.
9. Which properties are usually identical for elements from the same subgroup?
 - a) the formula of the highest oxide;
 - b) atomic radius;
 - c) the formula of the pure chemical element;
 - d) the formula of the binary compound with hydrogen.
10. Which properties are identical for elements from the same period?
 - a) electronegativity;
 - b) molecular mass;
 - c) the line in the Periodic table;
 - d) the column in the Periodic table.

ELECTRON CONFIGURATIONS

VARIANT 1

- How many energetic sublevels are there on the 4th energetic level?
a) 1; b) 2; c) 3; d) 4.
- How many electron orbitals are there on the p-sublevel?
a) 1; b) 2; c) 3; d) 4.
- What is the maximal number of electrons which can occupy all orbitals of the same d-sublevel?
a) 2; b) 6; c) 10; d) 14.
- How many unpaired electrons are there in the nitrogen atom (in its normal state)?
a) 1; b) 2; c) 3; d) 4.
- What is the number of electrons on the outer shell (level) of the chlorine atom:
a) 17; b) 8; c) 18; d) 7.
- What is the maximal number of electrons on the same orbital?
a) 1; b) 2; c) 6; d) 10.
- Choose the correct order of electron orbitals fulfillment:
a) 1s/2s/2p/3s/3d;
b) 1s/2s/3p/3s/3d;
c) 1s/2s/3s/2p/3d;
d) 1s/2s/2p/3s/3p.
- Choose the electron configuration of the nitrogen atom (in its normal state):
a) $1s^2 2s^2 2p^3$;
b) $1s^2 2s^1 2p^4$;
c) $1s^2 2s^3 2p^2$;
d) $1s^1 2s^2 2p^4$.
- What element has the following electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^1$
a) Na; b) Mg; c) Al; d) Si.
- Choose possible electron configurations (in both normal and excited states) for the carbon atom:
a) $1s^2 2s^2 2p^2$;
b) $1s^2 2s^1 2p^3$;
c) $1s^3 2s^2 2p^1$;
d) $1s^2 2s^2 2p^1$.

VARIANT 2

- How many energetic sublevels are there on the 3rd energetic level?
a) 1; b) 2; c) 3; d) 4.
- How many electron orbitals are there on the d-sublevel?
a) 1; b) 3; c) 5; d) 7.
- What is the maximal number of electrons which can occupy all orbitals of the same f-sublevel?
a) 2; b) 6; c) 10; d) 14.
- How many unpaired electrons are there in the oxygen atom (in its normal state)?
a) 1; b) 2; c) 3; d) 4.
- What is the number of electrons on the outer shell (level) of the copper atom:
a) 1; b) 2; c) 8; d) 18.
- How many electrons are there on the 3d sublevel of the chrome atom (in its normal state)?
a) 1; b) 3; c) 4; d) 5.
- Choose the correct order of electron orbitals fulfillment:
a) ...3s/3p/4s/3d;
b) ...3s/3d/3p/4s;
c) ...3s/3d/3p/4s;
d) ...3p/3d/3s/4s.
- Choose the electron configuration of the zinc atom (in its normal state):
a) [Ar]4s²4p⁶;
b) [Ar]4s²3d¹⁰;
c) [Ar]4s¹4d¹⁰;
d) [Kr]5s²5d¹⁰.
- What element has the following electron configuration: [Ne]3s²3p⁴
a) S; b) P; c) Cl; d) Ar.
- Choose possible electron configurations (in both normal and excited states) for the nitrogen atom:
a) 1s²2s²2p³;
b) 1s²2s¹2p⁴;
c) 1s³2s²2p²;
d) 1s²2s³2p².

CHEMICAL BONDS

VARIANT 1

- Choose binary compounds with ionic bonds:
a) CCl_4 ; b) KCl ; c) ZnO ; d) SiO .
- Choose compounds with ionic and covalent polar bonds:
a) NaCl ; b) KNO_3 ; c) NO_2 ; d) KOH .
- Choose binary compounds with covalent polar bonds:
a) PCl_3 ; b) Na_3N ; c) K_2O ; d) KH .
- In which compounds one can find at least one covalent nonpolar bond?
a) H_2 ; b) C_2H_6 ; c) H_2O_2 ; d) H_2O .
- Choose substances with the metallic bonding:
a) AgCl ; b) KAlO_2 ; c) AgAu ; d) Cu_9Zn .
- In which compounds there are just sigma covalent bonds?
a) CH_4 ; b) C_2H_2 ; c) C_2H_4 ; d) C_5H_{12} .
- Which compounds contain a double bond?
a) O_2 ; b) N_2 ; c) H_2 ; d) C_2H_4 .
- Which compounds contain a triple bond?
a) C_2H_2 ; b) CO ; c) N_2 ; d) O_3 .
- Choose a compound with the most polar covalent bond:
a) NaF ; b) HF ; c) H_2O ; d) H_2S .
- Indicate the possible schemes of hydrogen bond formation:
a) $\text{N-H}\cdots\text{O}$;
b) $\text{O-H}\cdots\text{N}$;
c) $\text{F-H}\cdots\text{F}$;
d) $\text{N-H}\cdots\text{C}$.

VARIANT 2

1. Choose compounds with ionic bonds:
a) $\text{Ba}(\text{OH})_2$; b) H_2SO_4 ; c) KNO_3 ; d) SiO_2 .
2. Choose compounds with covalent polar bonds:
a) Cl_2 ; b) ZnSO_4 ; c) NH_3 ; d) ZnO .
3. Choose binary compounds with covalent nonpolar bonds:
a) P_4 ; b) N_2 ; c) O_2 ; d) S_8 .
4. In which compounds one can find at least one covalent polar bond?
a) Br_2 ; b) CH_3Cl ; c) N_2O ; d) LiCl .
5. Choose substances with metallic bonding:
a) NaH ; b) SnCu_4 ; c) K_2ZnO_2 ; d) KNa .
6. In which compounds there are pi-bonds?
a) C_3H_8 ; b) C_3H_4 ; c) C_2H_4 ; d) O_2 .
7. Which compounds contain a double bond?
a) I_2 ; b) P_4 ; c) SO_2 ; d) SO_3 .
8. Which compounds contain a triple bond?
a) CaC_2 ; b) CO_2 ; c) KCN ; d) S_8 .
9. Choose a compound with the most polar bond:
a) KCl ; b) LiF ; c) HF ; d) BF_3 .
10. Indicate the possible schemes of hydrogen bond formation:
a) $\text{N-H}\cdots\text{F}$;
b) $\text{S-H}\cdots\text{N}$;
c) $\text{O-H}\cdots\text{O}$;
d) $\text{N-H}\cdots\text{N}$.

OXIDATION STATE

VARIANT 1

- Determine the oxidation state of phosphorus in H_3PO_4 :
a) +5; b) +3; c) +1; d) -3.
- Choose compounds in which the oxidation state of nitrogen is equal to +3:
a) NH_3 ; b) NaNO_3 ; c) N_2O_3 ; d) HNO_2 .
- Choose anions in which the oxidation state of phosphorus is equal to +5:
a) PO_4^{3-} ; b) HPO_4^{2-} ; c) H_2PO_4^- ; d) H_2PO_3^- .
- Calculate the charge of the anion made from three oxygen atoms and one silicon atom in its maximal oxidation state:
a) -2; b) +2; c) -3; d) +3.
- Choose oxidation states possible for hydrogen atoms:
a) +1; b) -1; c) +2; d) 0.
- For which compounds the term "oxidation state" is more applicable than the term "valence"?
a) K_2O ; b) NaCl ; c) PH_3 ; d) SiH_4 .
- For which compounds the term "valence" is more applicable than the term "oxidation state"?
a) PCl_3 ; b) N_2 ; c) LiF ; d) C_3H_8 .
- Choose the minimal oxidation state for sulfur:
a) 0; b) +6; c) +4; d) -2.
- Choose the maximal oxidation state for chlorine:
a) -1; b) +1; c) +3; d) +7.
- Which chemical elements demonstrate a single possible oxidation state in compounds?
a) H; b) K; c) F; d) O.

VARIANT 2

- Determine the oxidation state of sulfur in H_2SO_4 :
a) +4; b) +6; c) 0; d) -2.
- Choose compounds in which the oxidation state of oxygen is equal to -2:
a) NO; b) K_2O ; c) K_2O_2 ; d) KO_2 .
- Choose anions in which the oxidation state of carbon is equal to +4:
a) CO_3^{2-} ; b) HCOO^- ; c) HCO_3^- ; d) $\text{C}_2\text{O}_4^{2-}$.
- Calculate the charge of the anion made from four oxygen atoms and one phosphorus atom in its maximal oxidation state:
a) -2; b) +2; c) -3; d) +3.
- Choose oxidation states possible for nitrogen atoms:
a) +1; b) +3; c) +5; d) +7.
- For which compounds the term "oxidation state" is more applicable than the term "valence"?
a) NaBr; b) Cl_2 ; c) CH_4 ; d) CaO.
- For which compounds the term "valence" is more applicable than the term "oxidation state"?
a) NH_3 ; b) BaO; c) NaF; d) H_2S .
- Choose the minimal oxidation state for carbon:
a) 0; b) -6; c) -4; d) -2.
- Choose the maximal oxidation state for manganese:
a) -1; b) +1; c) +3; d) +7.
- Which chemical elements demonstrate a single possible oxidation state in compounds?
a) Ca; b) Zn; c) Cr; d) Mn.

TYPES OF CHEMICAL REACTIONS

VARIANT 1

- Choose composition reactions:
 - $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$;
 - $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$;
 - $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$;
 - $\text{Zn} + \text{S} \rightarrow \text{ZnS}$.
- Choose decomposition reactions:
 - $\text{NH}_3 + \text{HCl} \rightarrow \text{NH}_4\text{Cl}$;
 - $2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2$;
 - $\text{N}_2\text{O}_4 \rightarrow 2\text{NO}_2$;
 - $2\text{Ag}_2\text{O} \rightarrow 4\text{Ag} + \text{O}_2$.
- Choose single replacement reactions:
 - $2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{H}_2$;
 - $2\text{Al} + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2$;
 - $\text{KCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{KNO}_3$;
 - $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$.
- Choose double replacement reactions:
 - $2\text{KOH} + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$;
 - $\text{CaO} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O}$;
 - $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$;
 - $\text{ZnCl}_2 + 2\text{AgNO}_3 \rightarrow 2\text{AgCl} + \text{Zn}(\text{NO}_3)_2$.
- Choose combustion reactions:
 - $4\text{NH}_3 + 3\text{O}_2 \rightarrow 2\text{N}_2 + 6\text{H}_2\text{O}$;
 - $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$;
 - $\text{Mg} + \text{S} \rightarrow \text{MgS}$;
 - $2\text{Fe} + \text{O}_2 \rightarrow 2\text{FeO}$.
- Which of the equations written below represent reduction-oxidation (redox) reactions?
 - $2\text{HNO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$;
 - $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{SO}_2 + 2\text{H}_2\text{O}$;
 - $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HClO}$;
 - $3\text{CaO} + \text{P}_2\text{O}_5 \rightarrow \text{Ca}_3(\text{PO}_4)_2$.
- In which reactions hydrogen atoms act as reducers?
 - $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$;
 - $\text{H}_2 + 2\text{K} \rightarrow 2\text{KH}$;
 - $2\text{HCl} + \text{Zn} \rightarrow \text{ZnCl}_2 + \text{H}_2$;
 - $\text{HCl} + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl}$.
- In which reactions sulfur atoms act as oxidizers:
 - $\text{H}_2 + \text{S} \rightarrow \text{H}_2\text{S}$;
 - $\text{Ca} + \text{S} \rightarrow \text{CaS}$;
 - $\text{H}_2\text{SO}_4 (\text{dilute}) + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{H}_2$;
 - $2\text{H}_2\text{SO}_4 (\text{concentrated}) + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$.
- What is the coefficient before KMnO_4 in the following reaction:
 $\text{KMnO}_4 + \text{H}_2\text{S} + \text{H}_2\text{SO}_4 \rightarrow \text{MnSO}_4 + \text{S} + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$
 - 2;
 - 5;
 - 4;
 - 10.
- What part of the total H_2SO_4 amount participated in the following reaction really acted as an oxidizer?
 $\text{Cu} + \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{SO}_2 + \text{H}_2\text{O}$
 - 3/4;
 - 1/2;
 - 1/4;
 - 1/8.

VARIANT 2

1. Choose composition reactions:

a) $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$;	c) $\text{CO}_2 + \text{H}_2\text{O} + \text{CaCO}_3 \rightarrow \text{Ca}(\text{HCO}_3)_2$;
b) $\text{CaS} + 3\text{O}_2 \rightarrow 2\text{CaO} + 2\text{SO}_2$;	d) $\text{Zn} + \text{H}_2\text{S} \rightarrow \text{ZnS} + \text{H}_2$.
2. Choose decomposition reactions:

a) $\text{NH}_4\text{OH} \rightarrow \text{NH}_3 + \text{H}_2\text{O}$;	c) $2\text{CH}_4 \rightarrow \text{C}_2\text{H}_2 + 3\text{H}_2$;
b) $\text{Ba}(\text{OH})_2 \rightarrow \text{BaO} + \text{H}_2\text{O}$;	d) $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$.
3. Choose single replacement reactions:
 - a) $\text{SiO}_2 + \text{CaCO}_3 \rightarrow \text{CaSiO}_3 + \text{CO}_2$;
 - b) $\text{Cl}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KCl}$;
 - c) $\text{Mg} + \text{H}_2\text{O} (\text{t}^\circ) \rightarrow \text{MgO} + \text{H}_2$;
 - d) $\text{Al}(\text{OH})_3 + \text{KOH} (\text{t}^\circ) \rightarrow \text{KAlO}_2 + 2\text{H}_2\text{O}$.
4. Choose double replacement reactions:
 - a) $\text{NaCl}_{(\text{solid})} + \text{H}_2\text{SO}_{4(\text{concentrated})} \rightarrow \text{NaHSO}_4 + \text{HCl}$;
 - b) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$;
 - c) $\text{I}_2 + \text{H}_2 \rightarrow 2\text{HI}$;
 - d) $\text{Zn}(\text{OH})_2 + \text{HCl} \rightarrow \text{ZnOHCl} + \text{H}_2\text{O}$.
5. Choose combustion reactions:

a) $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$;	c) $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$;
b) $2\text{Mg} + \text{CO}_2 \rightarrow 2\text{MgO} + \text{C}$;	d) $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$.
6. Which of the equations written below represent reduction-oxidation (redox) reactions?
 - a) $\text{H}_2\text{SO}_3 \rightarrow \text{SO}_2 + \text{H}_2\text{O}$;
 - b) $4\text{HNO}_3 \rightarrow 4\text{NO}_2 + \text{O}_2 + 2\text{H}_2\text{O}$;
 - c) $\text{K}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{KOH}$;
 - d) $2\text{NO}_2 + 2\text{KOH} \rightarrow \text{KNO}_2 + \text{KNO}_3 + \text{H}_2\text{O}$.
7. In which reactions Nitrogen atoms act as reducers?
 - a) $3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3$;
 - b) $4\text{NH}_3 + 5\text{O}_2 (\text{catalyst}) \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$;
 - c) $\text{NH}_3 + \text{HNO}_3 \rightarrow \text{NH}_4\text{NO}_3$;
 - d) $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 (\text{t}^\circ) \rightarrow \text{N}_2 + 4\text{H}_2\text{O} + \text{Cr}_2\text{O}_3$.
8. In which reactions Oxygen atoms act as oxidizers:

a) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$;	c) $\text{K}_2\text{Cr}_2\text{O}_7 + 2\text{KOH} \rightarrow 2\text{K}_2\text{CrO}_4 + \text{H}_2\text{O}$;
b) $3\text{O}_2 \rightarrow 2\text{O}_3$;	d) $2\text{H}_2\text{O}_2 + \text{S} \rightarrow \text{SO}_2 + 2\text{H}_2\text{O}$.
9. What is the coefficient before $\text{K}_2\text{Cr}_2\text{O}_7$ in the following reaction:

$$\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{S} + \text{H}_2\text{SO}_4 \rightarrow \text{Cr}_2(\text{SO}_4)_3 + \text{S} + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$$

a) 1;	b) 2;	c) 3;	d) 4.
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10. What part of the total HNO_3 participated in the following reaction really acted as an oxidizer?

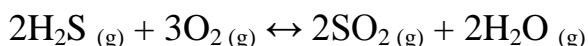
$$\text{Cu} + \text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{NO}_2 + \text{H}_2\text{O}$$

a) 3/4;	b) 1/2;	c) 1/4;	d) 1/8.
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CHEMICAL KINETICS

VARIANT 1

1. Which actions can shift the equilibrium of the following process towards reactants?



- a) pressure increase; c) addition of SO_2 ;
b) addition of O_2 ; d) volume decrease.
2. The increase of pressure will shift the equilibrium of $\text{N}_2_{(g)} + \text{O}_2_{(g)} \leftrightarrow 2\text{NO}_{(g)}$ reaction:
a) towards reactants; c) it will not affect the equilibrium.
b) towards products;
3. The decrease of the volume of the gas container will shift the equilibrium of $2\text{NO}_{(g)} + \text{O}_2_{(g)} \leftrightarrow 2\text{NO}_2$ process:
a) towards reactants; c) it will not affect the equilibrium.
b) towards products;
4. How many times the velocity of $\text{CO}_2_{(g)} + \text{CaO}_{(s)} \leftrightarrow \text{CaCO}_3_{(s)}$ forward reaction will grow in case of 3 times increase in CO_2 concentration?
a) 2; b) 3; c) 4; d) 9.
5. Indicate the change of the velocity of $2\text{CO}_{(g)} + \text{O}_2_{(g)} \leftrightarrow 2\text{CO}_2_{(g)}$ forward reaction in case of 3 times increase in CO concentration:
a) 3 times increase; c) 3 times decrease;
b) 9 times increase; d) 9 times decrease.
6. The velocity of endothermic reaction increases in case of:
a) increase in temperature; c) decrease in temperature;
b) increase in pressure; d) decrease in pressure.
7. The velocity of the reaction has become 4 times higher due to the growth of temperature from 30 to 50°C. Find out the Q_{10} coefficient.
a) 2; b) 3; c) 4; d) 5
8. How the velocity of the forward reaction $\text{C}_2\text{H}_2_{(g)} + 2\text{H}_2_{(g)} \rightarrow \text{C}_2\text{H}_6_{(g)}$ will change in case of 2 times decrease in reactants concentration:
a) decrease 2 times; c) increase 16 times;
b) increase 4 times; d) decrease 8 times.
9. How the velocity of the forward reaction $\text{N}_2_{(g)} + 6\text{Li}_{(s)} \rightarrow 2\text{Li}_3\text{N}_{(s)}$ will change in case of 3 times increase in pressure:
a) increase 3 times; c) increase 2187 times;
b) decrease 3 times; d) decrease 2187 times.
10. How the velocity of the forward reaction $2\text{P}_{(s)} + 3\text{Cl}_2_{(g)} \rightarrow 2\text{PCl}_3_{(g)}$ will change in case of 3 times increase of the volume of the gas container?
a) increase 3 times; c) increase 27 times;
b) decrease 3 times; d) decrease 27 times.

VARIANT 2

- Which actions can shift the equilibrium of the following process towards products?
 $2\text{H}_2\text{S}_{(g)} + \text{O}_{2(g)} \leftrightarrow 2\text{S}_{(s)} + 2\text{H}_2\text{O}_{(g)}$
a) pressure decrease; c) addition of H_2S ;
b) addition of O_2 ; d) volume decrease.
- The decrease of pressure will shift the equilibrium of $2\text{N}_2\text{O}_{(g)} + \text{O}_{2(g)} \leftrightarrow 4\text{NO}_{(g)}$ reaction:
a) towards reactants; c) it will not affect the equilibrium.
b) towards products;
- The decrease of the volume of the gas container will shift the equilibrium of $\text{P}_{4(l)} + 6\text{Cl}_{2(g)} \leftrightarrow 4\text{PCl}_{3(l)}$ process:
a) towards reactants; c) it will not affect the equilibrium.
b) towards products;
- How many times the velocity of $\text{PCl}_{3(g)} + \text{Cl}_{2(g)} \leftrightarrow \text{PCl}_{5(g)}$ forward reaction will grow in case of 3 times increase in Cl_2 concentration?
a) 2; b) 3; c) 4; d) 9.
- Indicate the change of the velocity of $2\text{P}_{(s)} + 5\text{O}_{2(g)} \leftrightarrow 2\text{P}_2\text{O}_{5(s)}$ forward reaction in case of 2 times decrease in O_2 concentration:
a) 4 times increase; c) 32 times increase;
b) 4 times decrease; d) 32 times decrease.
- The velocity of exothermic reaction increases in case of:
a) increase in temperature; c) decrease in temperature;
b) increase in pressure; d) decrease in pressure.
- The velocity of the reaction has become 9 times higher due to the growth of temperature from 37 to 57°C. Find out the Q_{10} coefficient.
a) 2; b) 3; c) 4; d) 5.
- How the velocity of the forward reaction $2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightarrow 2\text{SO}_{3(g)}$ will change in case of 3 times increase in reactants concentration:
a) decrease 8 times; c) increase 27 times;
b) increase 9 times; d) decrease 4 times.
- How the velocity of the forward reaction $\text{F}_{2(g)} + \text{H}_{2(g)} \rightarrow 2\text{HF}_{(g)}$ will change in case of 2 times increase in pressure:
a) increase 2 times; c) increase 4 times;
b) decrease 2 times; d) decrease 4 times.
- How the velocity of the forward reaction $\text{CO}_{(g)} + \text{Cl}_{2(g)} \rightarrow \text{COCl}_{2(g)}$ will change in case of 2 times increase of the volume of the gas container?
a) increase 4 times; c) increase 2 times;
b) decrease 4 times; d) decrease 2 times.

MAIN TYPES OF INORGANIC COMPOUNDS

VARIANT 1

1. Choose basic oxides:
a) SiO_2 ; b) K_2O ; c) ZnO ; d) SrO .
2. Choose acidic oxides:
a) CO ; b) CO_2 ; c) BaO ; d) SO_2 .
3. Choose amphoteric oxides:
a) Al_2O_3 ; b) ZnO ; c) SiO ; d) Cr_2O_3 .
4. Choose neutral oxides (those which cannot form salts):
a) NO ; b) SiO_2 ; c) MgO ; d) N_2O .
5. Choose strong acids:
a) HCl ; b) HBr ; c) HI ; d) HF .
6. Choose strong bases:
a) $\text{Be}(\text{OH})_2$; b) $\text{Sr}(\text{OH})_2$; c) KOH ; d) LiOH .
7. Choose acidic salts:
a) NH_4NO_3 ; b) $\text{NH}_4\text{H}_2\text{PO}_4$; c) KHCO_3 ; d) $(\text{MgOH})_2\text{CO}_3$.
8. Choose bases which cannot be formed in the reaction between corresponding oxide and water:
a) $\text{Al}(\text{OH})_3$; b) NaOH ; c) KOH ; d) $\text{Zn}(\text{OH})_2$.
9. Choose salts which can react with the acid containing the same anion:
a) KNO_3 ; b) Na_2SO_3 ; c) K_3PO_4 ; d) KH_2PO_4 .
10. Choose salts which can react with alkali:
a) NaCl ; b) KBr ; c) MgCl_2 ; d) AlPO_4 .

VARIANT 2

1. Choose basic oxides:
a) CaO; b) Mn₂O₇; c) CrO₃; d) Cs₂O.
2. Choose acidic oxides:
a) SO₂; b) BeO; c) N₂O₅; d) H₂O₂.
3. Choose amphoteric oxides:
a) Fe₂O₃; b) MnO₂; c) P₂O₃; d) Na₂O.
4. Choose neutral oxides (those which cannot form salts):
a) CO; b) SiO; c) CaO; d) SrO.
5. Choose weak acids:
a) H₂SO₄; b) HNO₃; c) HNO₂; d) H₂SO₃.
6. Choose weak bases:
a) Fe(OH)₂; b) Cu(OH)₂; c) NaOH; d) NH₄OH.
7. Choose basic salts:
a) CaOHCl; b) (MgOH)₂SO₄; c) K[Al(OH)₄]; d) FeCl₃.
8. Choose bases which cannot be formed in the reaction between corresponding oxide and water:
a) Fe(OH)₃; b) LiOH; c) CsOH; d) Fe(OH)₂.
9. Choose salts which can react with the acid containing the same anion:
a) KCl; b) NaHCO₃; c) K₃PO₄; d) K₂HPO₄.
10. Choose salts which can react with alkali:
a) NH₄Cl; b) ZnBr₂; c) NaCl; d) BaCl₂.

WATER SOLUTIONS

VARIANT 1

- Choose insoluble (solubility < 0.1 g per 100 g of H_2O) salts:
a) KCl ; b) Na_2SO_4 ; c) CaCO_3 ; d) BaSO_4 .
- Choose soluble (solubility > 1 g per 100 g of H_2O) salts:
a) NaI ; b) $\text{Zn}(\text{NO}_3)_2$; c) AgCl ; d) $\text{Zn}_3(\text{PO}_4)_2$.
- Slightly soluble salt (with solubility between 0.1 and 1 g per 100 g of H_2O) is considered to be insoluble in the written form of chemical reaction:
a) if it is a reactant;
b) if it is a product;
c) always;
d) never.
- Will there be a precipitate if we put 0.5 mg or 0.05 mg of CaCO_3 in 200 g of water (CaCO_3 solubility is 0.0006 g per 100 g of H_2O)?
a) Yes / Yes; b) Yes / No; c) No / Yes; d) No / No.
- Which substances demonstrate good solubility in water?
a) O_2 ; b) $\text{C}_2\text{H}_5\text{OH}$; c) N_2 ; d) HCl .
- Which substances demonstrate good solubility in benzene?
a) CH_4 ; b) C_7H_8 ; c) H_2O ; d) C_6H_{14} .
- How can we dissolve a precipitate in water solution?
a) increase the temperature;
b) decrease the temperature;
c) add more water;
d) add a substance which reacts with that precipitate.
- Molarity is the ratio between:
a) the mass of a solute and the mass of a solution;
b) the number of moles of a solute and the mass of a solvent;
c) the number of moles of a solute and the volume of a solution;
d) the volume of a solute and the volume of a solution.
- Mass percentage is the ratio between:
a) the mass of a solute and the mass of a solvent;
b) the number of moles of a solute and the mass of a solution;
c) the mass of a solute and the mass of a solution;
d) the number of moles of a solute and the volume of a solution.
- Choose true statements about saturated solution:
a) saturated solution exists upon the precipitate;
b) saturated solution cannot dissolve more solute;
c) saturated solution is always considered as concentrated solution;
d) saturated solution may have rather low concentration.

VARIANT 2

- Choose insoluble (solubility < 0.1 g per 100 g of H_2O) salts:
a) MgSO_4 ; b) $(\text{NH}_4)_2\text{SO}_4$; c) SrCO_3 ; d) H_2SiO_3 .
- Choose soluble (solubility > 1 g per 100 g of H_2O) salts:
a) BaCl_2 ; b) HNO_3 ; c) NiCl_2 ; d) KOH .
- Slightly soluble salt (with solubility between 0.1 and 1 g per 100 g of H_2O) is considered to be soluble in the written form of chemical reaction:
a) if it is a reactant; c) always;
b) if it is a product; d) never.
- Will there be a precipitate if we put 100 g or 10 g of KBr in 100 g of water (KBr solubility is 70.7 g per 100 g of H_2O)?
a) Yes / Yes; b) Yes / No; c) No / Yes; d) No / No.
- Which substances demonstrate low solubility in water?
a) H_2 ; b) CH_3COOH ; c) HCOOH ; d) H_2SiO_3 .
- Which substances demonstrate low solubility in benzene?
a) C_2H_2 ; b) NaOH ; c) $\text{Mg}(\text{OH})_2$; d) C_4H_8 .
- How can we produce a precipitate in water solution?
a) increase the temperature, dissolve high amount of solute, then cool down the solution;
b) increase the temperature and wait until sufficient amount of water will be evaporated, then cool down the solution;
c) add more water;
d) add a substance which produces precipitate in reaction with a given solute.
- Molality is the ratio between:
a) the mass of a solute and the mass of a solvent;
b) the number of moles of a solute and the mass of a solvent;
c) the number of moles of a solute and the mass of a solution;
d) the mass of a solute and the volume of a solution.
- Mole fraction is the ratio between:
a) the mass of a solute and the mass of a solvent;
b) the number of moles of a solute and the number of moles of all substances in a solution;
c) the volume of a solute and the mass of a solution;
d) the number of moles of a solute and the mass of a solution.
- Choose true statements about unsaturated solution:
a) unsaturated solution always have rather low concentration;
b) unsaturated solution can dissolve more solute;
c) unsaturated solution can dissolve more solvent;
d) unsaturated solution may become saturated at lower temperature.

ELECTROLYTIC DISSOCIATION

VARIANT 1

- Which ions are present in NaH_2PO_4 solution?
a) Na^+ ; b) H_2PO_4^- ; c) HPO_4^{2-} ; d) NaH_2^{3+} .
- Choose strong electrolytes:
a) NaCl ; b) KNO_2 ; c) $\text{C}_6\text{H}_{12}\text{O}_6$; d) HNO_2 .
- Choose weak electrolytes:
a) $\text{C}_2\text{H}_5\text{OH}$; b) CH_3COOH ; c) AgNO_3 ; d) $\text{Zn}(\text{OH})_2$.
- Which reactions can be expressed by the same ionic equation?
a) $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$;
b) $\text{Na}_2\text{O} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$;
c) $2\text{Na}_3\text{PO}_4 + 3\text{Li}_2\text{SO}_4 \rightarrow 3\text{Na}_2\text{SO}_4 + 2\text{Li}_3\text{PO}_4$;
d) $\text{KOH} + \text{HNO}_3 \rightarrow \text{KNO}_3 + \text{H}_2\text{O}$.
- Choose the correct ionic equation for the following reaction:
 $\text{Na}_2\text{CO}_3 + \text{Ca}(\text{OH})_2 \rightarrow \text{CaCO}_3 + 2\text{NaOH}$
a) $\text{CO}_3^{2-} + \text{Ca}(\text{OH})_2 \rightarrow \text{CaCO}_3 + 2\text{OH}^-$;
b) $\text{CO}_3^{2-} + \text{Ca}^{2+} \rightarrow \text{CaCO}_3$;
c) $\text{Na}^+ + \text{OH}^- \rightarrow \text{NaOH}$;
d) $\text{Na}_2\text{CO}_3 + \text{Ca}^{2+} \rightarrow \text{CaCO}_3 + 2\text{Na}^+$.
- In water solutions of which substances there is acidic medium ($\text{pH} < 7$)?
a) HCl ; b) H_2S ; c) ZnCl_2 ; d) KCl .
- In water solutions of which substances there is basic medium ($\text{pH} > 7$)?
a) H_2SO_4 ; b) K_3PO_4 ; c) NH_3 ; d) NH_4Cl .
- What substances will be formed if we mix solutions of K_2S and AlCl_3 together?
a) H_2S ; b) Cl_2 ; c) Al_2S_3 ; d) $\text{Al}(\text{OH})_3$.
- Dissolving HCl in water includes such steps, as:
a) ionization and dissociation;
b) just dissociation;
c) just ionization;
d) neither ionization, nor dissociation.
- Dissolving ZnCl_2 in water includes such steps, as:
a) ionization and dissociation;
b) dissociation and partial hydrolysis;
c) just dissociation;
d) just complete hydrolysis.

VARIANT 2

- Which ions are present in NH_4Cl solution?
a) N^{3+} ; b) NH_4^+ ; c) H^+ ; d) Cl^- .
- Choose strong electrolytes:
a) NaOH ; b) NO_2 ; c) HClO_4 ; d) H_2O_2 .
- Choose weak electrolytes:
a) $\text{C}_3\text{H}_7\text{OH}$; b) CH_3NH_2 ; c) HI ; d) $\text{Ca}(\text{OH})_2$.
- Which reactions can be expressed by the same ionic equation?
a) $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O}$;
b) $\text{Ba} + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{H}_2$;
c) $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$;
d) $\text{Ba}(\text{NO}_3)_2 + \text{K}_2\text{SO}_4 \rightarrow 2\text{KNO}_3 + \text{BaSO}_4$.
- Choose the correct ionic equation for the following reaction:
 $\text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{H}_2\text{O}$;
a) $\text{HCl} + \text{OH}^- \rightarrow \text{Cl}^- + \text{H}_2\text{O}$;
b) $\text{K}^+ + \text{Cl}^- \rightarrow \text{KCl}$;
c) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$;
d) $\text{KOH} + \text{H}^+ \rightarrow \text{K}^+ + \text{H}_2\text{O}$.
- In water solutions of which substances there is acidic medium ($\text{pH} < 7$)?
a) CO_2 ; b) AlCl_3 ; c) FeBr_2 ; d) K_2SO_3 .
- In water solutions of which substances there is basic medium ($\text{pH} > 7$)?
a) NO_2 ; b) KNO_2 ; c) Na_2SiO_3 ; d) NaCl .
- What substances will be formed if we mix solutions of Na_2SO_3 and CrCl_3 together?
a) SO_2 ; b) Cr ; c) $\text{Cr}(\text{OH})_3$; d) NaCl .
- Dissolving NaCl in water includes such steps, as:
a) ionization and dissociation;
b) just dissociation;
c) just ionization;
d) neither ionization, nor dissociation.
- Dissolving Na_3PO_4 in water includes such steps, as:
a) ionization and dissociation;
b) dissociation and partial hydrolysis;
c) just dissociation;
d) just complete hydrolysis.

HYDROGEN AND HALOGENS

VARIANT 1

- In which reactions hydrogen atoms act as reducers?
 - $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$;
 - $2\text{K} + \text{H}_2 \rightarrow 2\text{KH}$;
 - $\text{CuCl}_2 + \text{H}_2 \rightarrow \text{Cu} + 2\text{HCl}$;
 - $3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$.
- In which reactions hydrogen atoms act as oxidizers?
 - $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$;
 - $2\text{CH}_4 + \text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2$;
 - $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$;
 - $3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3$.
- In which reactions hydrogen gas is released?
 - $\text{H}_2\text{O} + \text{K} \rightarrow$;
 - $\text{HCl} + \text{Zn} \rightarrow$;
 - $\text{H}_2\text{SO}_4 + \text{Cu} \rightarrow$;
 - $\text{HNO}_3 + \text{Fe} \rightarrow$.
- Choose ions represented as H^+ in ionic equations:
 - H_3O^+ ;
 - H_3O_2^- ;
 - H_5O_2^+ ;
 - OH^- .
- Bromine (Br_2) in normal conditions is a:
 - gas;
 - liquid;
 - solid substance;
 - plasma.
- Which substance is used in qualitative analysis of solutions for the presence of halogens anions?
 - NaNO_3 ;
 - H_2SO_4 ;
 - AgNO_3 ;
 - KOH .
- Which reactions are possible?
 - $\text{KI} + \text{Cl}_2 \rightarrow$;
 - $\text{KBr} + \text{I}_2 \rightarrow$;
 - $\text{NaBr} + \text{Cl}_2 \rightarrow$;
 - $\text{NaCl} + \text{I}_2 \rightarrow$.
- Calculate the sum of all coefficients in the redox reaction:
 $\text{LiOH} + \text{Cl}_2 (\text{t}^\circ) \rightarrow \text{LiCl} + \text{LiClO}_3 + \text{H}_2\text{O}$
 - 9;
 - 10;
 - 17;
 - 18.
- Which reactions can be expressed by the ionic equation: $\text{Ca} + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{H}_2$
 - $\text{Ca} + 2\text{HF} \rightarrow \text{CaF}_2 + \text{H}_2$;
 - $\text{Ca} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2$;
 - $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$;
 - $\text{Ca} + \text{H}_2 \rightarrow \text{CaH}_2$.
- Choose formulas of hydrates:
 - BaH_2 ;
 - NaOH ;
 - $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$;
 - $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$.

VARIANT 2

- In which reactions chlorine atoms act as oxidizers?
 - $\text{KOH} + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O}$;
 - $3\text{Cl}_2 + 2\text{P} \rightarrow 2\text{PCl}_3$;
 - $\text{KCl} + \text{AgNO}_3 \rightarrow \text{KNO}_3 + \text{AgCl}$;
 - $3\text{Cl}_2 + 2\text{Fe} \rightarrow 2\text{FeCl}_3$.
- In which reactions iodine atoms act as reducers?
 - $2\text{KI} + \text{Cl}_2 \rightarrow 2\text{KCl} + \text{I}_2$;
 - $\text{I}_2 + \text{H}_2 \rightarrow 2\text{HI}$;
 - $2\text{Na} + \text{I}_2 \rightarrow 2\text{NaI}$;
 - $6\text{KI} + 2\text{KMnO}_4 + 4\text{H}_2\text{O} \rightarrow 3\text{I}_2 + 2\text{MnO}_2 + 8\text{KOH}$.
- In which reactions chlorine gas is released?
 - $\text{MnO}_2 + \text{HCl} \rightarrow$;
 - $\text{KMnO}_4 + \text{HCl} \rightarrow$;
 - $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow$;
 - $\text{FeCl}_3 + \text{H}_2\text{O} \rightarrow$.
- Choose ions formed in water solution of I_2 in the presence of KI:
 - I_3^- ;
 - I_2^- ;
 - I_3^{3-} ;
 - I_2^{2-} .
- Iodine (I_2) in normal conditions is a:
 - gas;
 - liquid;
 - solid substance;
 - plasma.
- Indicate the colors of AgCl, AgBr and AgI:
 - white / yellow / red;
 - white / pale yellow / yellow;
 - yellow / pale yellow / white;
 - red / yellow / white.
- Which reactions are possible?
 - $\text{NaBr} + \text{Cl}_2 \rightarrow$;
 - $\text{NaBr} + \text{I}_2 \rightarrow$;
 - $\text{HBr} + \text{Cl}_2 \rightarrow$;
 - $\text{NaCl} + \text{I}_2 \rightarrow$.
- Calculate the sum of all coefficients in the redox reaction:
 $\text{KI} + \text{CO}_2 + \text{O}_2 \rightarrow \text{K}_2\text{CO}_3 + \text{I}_2$
 - 11;
 - 10;
 - 9;
 - 8.
- Which reactions can be expressed by the ionic equation:
 $2\text{Br}^- + \text{Cl}_2 \rightarrow 2\text{Cl}^- + \text{Br}_2$
 - $2\text{AgBr} + \text{CaCl}_2 \rightarrow \text{CaBr}_2 + 2\text{AgCl}$;
 - $2\text{HBr} + \text{Cl}_2 \rightarrow 2\text{HCl} + \text{Br}_2$;
 - $2\text{NaBr} + \text{CaCl}_2 \rightarrow \text{CaBr}_2 + 2\text{NaCl}$;
 - $2\text{KBr} + \text{Cl}_2 \rightarrow 2\text{KCl} + \text{Br}_2$.
- Choose formulas of hydrides:
 - CaH_2 ;
 - LiH ;
 - $\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$;
 - $\text{H}_2\text{C}_2\text{O}_4$.

OXYGEN AND SULFUR

VARIANT 1

- Choose formulas of oxides:
a) H_2O ; b) H_2O_2 ; c) BaO ; d) BaO_2 .
- Choose formulas of peroxides:
a) K_2O ; b) K_2O_2 ; c) KO_2 ; d) CaO_2 .
- Choose formulas of superoxides:
a) Na_2O ; b) NaO_2 ; c) PbO_2 ; d) KO_2 .
- Oxygen will be released in reactions:
a) $\text{Na} + \text{H}_2\text{O} \rightarrow$;
b) $\text{NaNO}_3 \text{ (t}^\circ\text{)} \rightarrow$;
c) $\text{KClO}_3 \text{ (t}^\circ\text{)} \rightarrow$;
d) $\text{CaCO}_3 \text{ (t}^\circ\text{)} \rightarrow$.
- In which reactions sulfur atoms act as reducers:
a) $\text{Na}_2\text{S} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{S}$;
b) $2\text{H}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{SO}_2 + 2\text{H}_2\text{O}$;
c) $2\text{H}_2\text{S} + \text{O}_2 \rightarrow 2\text{S} + 2\text{H}_2\text{O}$;
d) $\text{Cu} + \text{S} \rightarrow \text{CuS}$.
- Choose substances which react with concentrated H_2SO_4 :
a) NaCl (solid);
b) KCl (water solution);
c) Ag ;
d) Au .
- Which reactions are possible?
a) $\text{Fe} + \text{H}_2\text{SO}_4 \text{ (dilute)} \rightarrow$;
b) $\text{Fe} + \text{H}_2\text{SO}_4 \text{ (concentrated / low temperature)} \rightarrow$;
c) $\text{Al} + \text{H}_2\text{SO}_4 \text{ (concentrated / high temperature)} \rightarrow$;
d) $\text{Pt} + \text{H}_2\text{SO}_4 \rightarrow$.
- Calculate the sum of all coefficients in the redox reaction:
 $\text{C} + \text{H}_2\text{SO}_4 \text{ (concentrated)} \rightarrow \text{CO}_2 + \text{SO}_2 + \text{H}_2\text{O}$
a) 5; b) 6; c) 7; d) 8.
- Which reactions can be expressed by the following ionic equation:
 $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$
a) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl}$;
b) $\text{Ba} + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{H}_2$;
c) $\text{Ba}(\text{NO}_3)_2 + \text{K}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{KNO}_3$;
d) $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O}$.
- Choose formulas of sulfites:
a) BaS ; b) K_2S ; c) K_2SO_3 ; d) Na_2SO_3 .

VARIANT 2

- Choose formula of iron sulfide used in industrial sulfuric acid production:
a) FeS; b) Fe₂S₃; c) FeS₂; d) Fe₃S₄.
- Choose correct statements about hydrogen sulfide (H₂S):
a) it has an odor of rotten eggs;
b) it is solid in normal conditions;
c) it is weak electrolyte;
d) its water solution is acidic.
- Choose substances which cannot react with dilute sulfuric acid (H₂SO₄):
a) NaOH; b) NaCl (solid); c) Cu; d) CuO.
- Oxygen will be released in reactions:
a) H₂O₂ (t°) →;
b) AgNO₃ (t°) →;
c) NaOH (t°) →;
d) Ca(OH)₂ (t°) →.
- In which reactions sulfur atoms act as oxidizers:
a) SO₂ + C → CO₂ + S;
b) 2H₂SO₃ + O₂ → 2H₂SO₄;
c) 5SO₃ + 2P → 5SO₂ + P₂O₅;
d) Mg + S → MgS.
- Choose substances which react with concentrated H₂SO₄:
a) BaCl₂ (solid); c) Pt;
b) BaCl₂ (water solution); d) P.
- Which reactions are possible?
a) FeSO₃ + H₂SO₄ →;
b) Al₂S₃ + H₂O →;
c) C + H₂SO₄ →;
d) Na₂SO₄ + K₂S →.
- Calculate the sum of all coefficients in the redox reaction:
S + H₂SO₄ (concentrated) → SO₂ + H₂O
a) 5; b) 6; c) 7; d) 8.
- Which reactions can be expressed by the following ionic equation:
2H⁺ + S²⁻ → H₂S
a) 2HCl + K₂S → 2KCl + H₂S;
b) H₂SO₄ + BaS → BaSO₄ + H₂S;
c) 2HNO₃ + Na₂S → 2NaNO₃ + H₂S;
d) H₂ + S → H₂S.
- Choose formulas of sulfides:
a) ZnS; b) Na₂S; c) K₂S; d) Na₂SO₃.

NITROGEN AND PHOSPHORUS

VARIANT 1

- Choose formulas of compounds in which nitrogen has negative oxidation state:
a) Na_3N ; b) NaN_3 ; c) NH_4Br ; d) NO_2 .
- During NH_4^+ cation formation nitrogen atom behaves as:
a) electron pair donor; c) proton donor;
b) electron pair acceptor; d) proton acceptor.
- Choose redox reactions:
a) $\text{N}_2\text{O}_3 + \text{H}_2\text{O} \rightarrow$;
b) $\text{NO}_2 + \text{H}_2\text{O} \rightarrow$;
c) $\text{N}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow$;
d) $\text{NH}_3 + \text{O}_2 \rightarrow$.
- NO_2 will be released in reactions:
a) $\text{KNO}_3 (t^\circ) \rightarrow$; c) $\text{AgNO}_3 (t^\circ) \rightarrow$;
b) $\text{Zn}(\text{NO}_3)_2 (t^\circ) \rightarrow$; d) $\text{Cu} + \text{HNO}_3 (\text{concentrated}) \rightarrow$.
- Which substances react with HNO_3 :
a) Hg; b) KOH; c) KCl; d) Au.
- Choose molecular compounds:
a) white phosphorus; c) ammonia;
b) red phosphorus; d) ammonium chloride.
- Gas will be released in the reaction:
a) $\text{Fe} + \text{HNO}_3 \rightarrow$; c) $\text{FeO} + \text{HNO}_3 \rightarrow$;
b) $\text{NH}_4\text{Cl} + \text{H}_2\text{SO}_4 \rightarrow$; d) $\text{NH}_4\text{NO}_3 (t^\circ) \rightarrow$.
- Calculate the sum of all coefficients in the redox reaction:
 $\text{Zn} + \text{HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{N}_2\text{O} + \text{H}_2\text{O}$
a) 10; b) 13; c) 23; d) 20.
- Which reactions can be expressed by the following ionic equation:
 $3\text{Ca}^{2+} + 2\text{PO}_4^{3-} \rightarrow \text{Ca}_3(\text{PO}_4)_2$
a) $3\text{CaCl}_2 + 2\text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6\text{HCl}$;
b) $3\text{CaCl}_2 + 2\text{Na}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6\text{NaCl}$;
c) $3\text{CaSO}_4 + 2\text{K}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 3\text{K}_2\text{SO}_4$;
d) $3\text{Ca} + 2\text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2$.
- Dihydrogen phosphate will be produced in the reaction between:
a) 2 mol NaOH and 1 mol H_3PO_4 ;
b) 1 mol NaOH and 1 mol H_3PO_4 ;
c) 3 mol NaOH and 1 mol H_3PO_4 ;
d) 1 mol NaOH and 3 mol H_3PO_4 .

VARIANT 2

- Choose formulas of compounds in which nitrogen has positive oxidation state:
a) NaNO_3 ; b) NaNO_2 ; c) NH_3 ; d) N_2 .
- Describe pH level in the water solution of ammonia?
a) slightly acidic; c) strongly acidic;
b) slightly basic; d) strongly basic.
- Choose redox reactions:
a) $\text{NH}_3 + \text{HCl} \rightarrow$; c) $\text{NO} + \text{O}_2 \rightarrow$;
b) $\text{N}_2 + \text{H}_2 \rightarrow$; d) $\text{AgNO}_3 + \text{KCl} \rightarrow$.
- O_2 will be released in reactions:
a) $\text{NaNO}_3 (t^\circ) \rightarrow$; c) $\text{NH}_4\text{NO}_3 (t^\circ) \rightarrow$;
b) $\text{Cu}(\text{NO}_3)_2 (t^\circ) \rightarrow$; d) $\text{NH}_4\text{NO}_2 (t^\circ) \rightarrow$.
- Which substances react with AgNO_3 :
a) KF ; b) KCl ; c) KBr ; d) KI .
- Choose ionic compounds:
a) phosphine;
b) phosphorus (III) chloride;
c) ammonium phosphate;
d) potassium dihydrogen phosphate.
- Water will be produced in the reaction:
a) $\text{Zn} + \text{HNO}_3 \rightarrow$; c) $\text{CuO} + \text{HNO}_3 \rightarrow$;
b) $\text{NH}_4\text{Cl} + \text{H}_3\text{PO}_4 \rightarrow$; d) $\text{NH}_4\text{Cl} + \text{KOH} \rightarrow$.
- Calculate the sum of all coefficients in the redox reaction:
 $\text{Ca} + \text{HNO}_3 \rightarrow \text{Ca}(\text{NO}_3)_2 + \text{N}_2 + \text{H}_2\text{O}$
a) 12; b) 17; c) 27; d) 29.
- Which reactions can be expressed by the ionic equation:
 $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$
a) $\text{NH}_4\text{NO}_3 + \text{LiOH} \rightarrow \text{LiNO}_3 + \text{NH}_3 + \text{H}_2\text{O}$;
b) $(\text{NH}_4)_2\text{SO}_4 + \text{Ba}(\text{OH})_2 \rightarrow \text{BaSO}_4 + 2\text{NH}_3 + 2\text{H}_2\text{O}$;
c) $\text{NH}_4\text{Cl} + \text{NaOH} \rightarrow \text{NaCl} + \text{NH}_3 + \text{H}_2\text{O}$;
d) $\text{NH}_4\text{H}_2\text{PO}_4 + 3\text{KOH} \rightarrow \text{K}_3\text{PO}_4 + \text{NH}_3 + 3\text{H}_2\text{O}$.
- Monohydrogen phosphate will be produced in the reaction between:
a) 2 mol NaOH and 1 mol H_3PO_4 ;
b) 1 mol NaOH and 2 mol H_3PO_4 ;
c) 4 mol NaOH and 1 mol H_3PO_4 ;
d) 1 mol NaOH and 3 mol H_3PO_4 .

CARBON AND SILICON

VARIANT 1

- In which kind of hybridization electron orbitals of the outer shell of carbon atoms exist in diamond?
a) sp ; b) sp^2 ; c) sp^3 ; d) no hybridization.
- In which kind of hybridization electron orbitals of the outer shell of carbon atoms exist in graphite?
a) sp ; b) sp^2 ; c) sp^3 ; d) no hybridization.
- Which substances should we add to $CaCO_3$ precipitate in water solution to dissolve it?
a) HCl ; b) KOH ; c) CO_2 ; d) HNO_3 .
- What gas is produced in CaC_2 hydrolysis reaction?
a) CO_2 ; b) O_2 ; c) C_2H_2 ; d) H_2 .
- What gas is produced in Al_4C_3 hydrolysis reaction?
a) H_2 ; b) CH_4 ; c) CO_2 ; d) H_2S .
- In which reactions precipitate is formed?
a) $Ca(OH)_2 + HCl \rightarrow$;
b) $CaCl_2 + Na_2CO_3 \rightarrow$;
c) $Na_2SiO_3 + HCl \rightarrow$;
d) $KHCO_3 + HCl \rightarrow$.
- Which reactions are possible?
a) $K_2SiO_3 + CO_2 \rightarrow$;
b) $Mg_2Si + HCl \rightarrow$;
c) $K_2CO_3 + SiO_2 \rightarrow$;
d) $Na_2SiO_3 + K_2CO_3 \rightarrow$.
- Calculate the sum of all coefficients in the redox reaction:
 $SiH_4 + NaOH + H_2O \rightarrow Na_2SiO_3 + H_2$
a) 9; b) 10; c) 11; d) 12.
- In which reactions a gas is formed:
a) $CaCO_3 + HCl \rightarrow$;
b) $CaCO_3 + CO_2 + H_2O \rightarrow$;
c) $Ca(HCO_3)_2 + H_2SO_4 \rightarrow$;
d) $Ca(HCO_3)_2 (t^\circ) \rightarrow$.
- In which reactions carbon atoms behave as oxidizers?
a) $C + CuO \rightarrow Cu + CO$;
b) $C + 4HNO_3 \text{ (concentrated)} \rightarrow CO_2 + 4NO_2 + 2H_2O$;
c) $C_2H_2 + H_2 \rightarrow C_2H_4$;
d) $2C + Ca \rightarrow CaC_2$.

VARIANT 2

1. What is the type of crystal structure for SiO_2 in normal conditions?
a) molecular; b) ionic; c) atomic; d) metallic.
2. With which chemical element hydrogen atoms form the most stable compounds?
a) B; b) Si; c) C; d) P.
3. Which substances should we add to $\text{Ca}(\text{OH})_2$ water solution to cause precipitation?
a) HNO_3 ; b) K_2CO_3 ; c) excess of CO_2 ; d) limited CO_2 .
4. Choose carbonates which cannot be decomposed at high temperature:
a) Na_2CO_3 ; b) K_2CO_3 ; c) CaCO_3 ; d) MgCO_3 .
5. Choose formulas of bicarbonates:
a) NaHCO_3 ; b) KHCO_3 ; c) $\text{Ca}(\text{HCO}_3)_2$; d) $(\text{MgOH})_2\text{CO}_3$.
6. In which reactions precipitate is formed?
a) $\text{Ca}(\text{HCO}_3)_2 + \text{HCl} \rightarrow$;
b) $\text{Ca}(\text{HCO}_3)_2 + \text{KOH} \rightarrow$;
c) $\text{KHSiO}_3 + \text{HCl} \rightarrow$;
d) $\text{KHSiO}_3 + \text{KOH} \rightarrow$.
7. Which reactions are possible?
a) $\text{SiO}_2 + \text{H}_2\text{O} \rightarrow$;
b) $\text{Si} + \text{NaOH} + \text{H}_2\text{O} \rightarrow$;
c) $\text{CaCO}_3 + \text{SiO}_2 \rightarrow$;
d) $\text{Na}_2\text{SO}_4 + \text{K}_2\text{CO}_3 \rightarrow$.
8. Calculate the sum of all coefficients in the redox reaction:
 $\text{Ca}_2\text{Si} + \text{HCl} \rightarrow \text{CaCl}_2 + \text{SiH}_4$
a) 6; b) 7; c) 8; d) 9.
9. In which reactions a gas is formed:
a) $\text{CaC}_2 + \text{HCl} \rightarrow$;
b) $\text{K}_2\text{SiO}_3 + \text{CO}_2 \rightarrow$;
c) $\text{Li}_2\text{CO}_3 (t^\circ) \rightarrow$;
d) $\text{NaHCO}_3 (t^\circ) \rightarrow$.
10. In which reactions Carbon atoms behave as reducers?
a) $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$;
b) $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$;
c) $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$;
d) $3\text{C} + 4\text{Al} \rightarrow \text{Al}_4\text{C}_3$.

METALS

VARIANT 1

- Choose metals which react with water at normal temperature and produce alkali:
a) Li; b) Na; c) Zn; d) Al.
- Choose hydroxides which can be decomposed at high temperature:
a) $\text{Ca}(\text{OH})_2$; b) KOH; c) LiOH; d) NaOH.
- Which cations are responsible of water hardness?
a) Mg^{2+} ; b) Ca^{2+} ; c) Na^+ ; d) K^+ .
- Choose compound that will be formed in the reaction between AlCl_3 and the excess of KOH water solution?
a) $\text{Al}(\text{OH})_3$; c) $\text{K}_3[\text{Al}(\text{OH})_6]$;
b) $\text{K}[\text{Al}(\text{OH})_4]$; d) KAlO_2 .
- In which reactions iron is oxidized to Fe^{3+} ?
a) $\text{Fe} + \text{HCl} \rightarrow$; c) $\text{Fe} + \text{H}_2\text{SO}_4 \text{ (dilute)} \rightarrow$;
b) $\text{Fe} + \text{Cl}_2 \rightarrow$; d) $\text{Fe} + \text{H}_2\text{O} + \text{O}_2 \rightarrow$.
- Which reactions are possible?
a) $\text{CuCl}_2 + \text{Zn} \rightarrow$;
b) $\text{ZnCl}_2 + \text{Cu} \rightarrow$;
c) $\text{Al}_2\text{O}_3 + \text{H}_2\text{O} \rightarrow$;
d) $\text{Al}_2\text{O}_3 + \text{NaOH} + \text{H}_2\text{O} \rightarrow$.
- Which reactions can be described by the following ionic equation?
 $\text{Al}^{3+} + 4\text{OH}^- \rightarrow [\text{Al}(\text{OH})_4]^-$
a) $\text{Al}(\text{OH})_3 + \text{KOH} \rightarrow \text{K}[\text{Al}(\text{OH})_4]$;
b) $\text{AlCl}_3 + 4\text{KOH} \rightarrow \text{K}[\text{Al}(\text{OH})_4] + 3\text{KCl}$;
c) $\text{AlCl}_3 + 6\text{KOH} \rightarrow \text{K}_3[\text{Al}(\text{OH})_6] + 3\text{KCl}$;
d) $\text{Al}(\text{NO}_3)_3 + 4\text{NaOH} \rightarrow \text{Na}[\text{Al}(\text{OH})_4] + 3\text{NaNO}_3$.
- Calculate the sum of all coefficients in the redox reaction:
 $\text{K} + \text{KNO}_3 \rightarrow \text{K}_2\text{O} + \text{N}_2$
a) 12; b) 18; c) 19; d) 20.
- Which metals have a color different from gray?
a) gold; b) copper; c) silver; d) cesium.
- In which reactions Aluminum atoms behave as reducers?
a) $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$;
b) $2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$;
c) $\text{AlCl}_3 + 3\text{NaOH} \rightarrow \text{Al}(\text{OH})_3 + 3\text{NaCl}$;
d) $2\text{Al}(\text{OH})_3 \text{ (t}^\circ\text{)} \rightarrow \text{Al}_2\text{O}_3 + 3\text{H}_2\text{O}$.

VARIANT 2

- Choose metals which react with water at high temperature and produce oxide:
a) Mg; b) Na; c) Fe; d) K.
- Choose reactions in which metal melts before the completion:
a) $\text{Li} + \text{H}_2\text{O} \rightarrow$; c) $\text{K} + \text{H}_2\text{O} \rightarrow$;
b) $\text{Na} + \text{H}_2\text{O} \rightarrow$; d) $\text{Cs} + \text{H}_2\text{O} \rightarrow$.
- Which salts are associated with temporary water hardness?
a) MgCl_2 ; c) $\text{Mg}(\text{HCO}_3)_2$;
b) $\text{Ca}(\text{HCO}_3)_2$; d) K_2SO_4 .
- Choose compound that will be formed in the reaction between solid AlCl_3 and solid NaOH at high temperature:
a) $\text{Al}(\text{OH})_3$; c) $\text{Na}_3[\text{Al}(\text{OH})_6]$;
b) $\text{Na}[\text{Al}(\text{OH})_4]$; d) NaAlO_2 .
- In which conditions iron turns to rust?
a) in the presence of water;
b) in the presence of oxygen;
c) in the presence of water and oxygen;
d) in the presence of water and nitrogen.
- Which reactions are possible?
a) $\text{NaCl} + \text{KOH} \rightarrow$; c) $\text{KOH} + \text{HCl} \rightarrow$;
b) $\text{NaCl} + \text{AgNO}_3 \rightarrow$; d) $\text{FeCl}_2 + \text{Cl}_2 \rightarrow$.
- Which reactions can be described by the following ionic equation?
 $\text{Al}^{3+} + 6\text{OH}^- \rightarrow [\text{Al}(\text{OH})_6]^{3-}$
a) $\text{Al}(\text{OH})_3 + \text{NaOH} \rightarrow \text{Na}[\text{Al}(\text{OH})_4]$;
b) $\text{AlCl}_3 + 4\text{NaOH} \rightarrow \text{Na}[\text{Al}(\text{OH})_4] + 3\text{KCl}$;
c) $\text{AlCl}_3 + 6\text{LiOH} \rightarrow \text{Li}_3[\text{Al}(\text{OH})_6] + 3\text{LiCl}$;
d) $\text{Al}_2(\text{SO}_4)_3 + 12\text{NaOH} \rightarrow 2\text{Na}_3[\text{Al}(\text{OH})_6] + 3\text{Na}_2\text{SO}_4$.
- Calculate the sum of all coefficients in the redox reaction:
 $\text{CaSO}_4 (t^\circ) \rightarrow \text{CaO} + \text{SO}_2 + \text{O}_2$
a) 5; b) 6; c) 7; d) 8.
- What particles can be found in metallic solids?
a) neutral atoms; c) anions;
b) cations; d) free electrons.
- In which reactions Iron atoms behave as reducers?
a) $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$;
b) $2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$;
c) $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$;
d) $\text{Fe}(\text{OH})_3 + 3\text{HCl} \rightarrow \text{FeCl}_3 + 3\text{H}_2\text{O}$.

ALKANES

VARIANT 1

1. What is the valence of carbon in all organic compounds?
a) I; b) II; c) III; d) IV.
2. Choose the common formula for alkanes:
a) C_nH_{2n-2} ; b) C_nH_{2n} ; c) C_nH_{2n+2} ; d) C_nH_{2n-6} .
3. How many isomers can you suggest for butane molecule?
a) 1; b) 2; c) 3; d) 4.
4. Choose isomers which can be described by the same C_5H_{12} formula:
a) 2-methyl-butane;
b) 3-methyl-pentane;
c) 2,2-dimethyl-propane;
d) 2,2-dimethyl-pentane.
5. Choose alkanes existing in gaseous state in normal conditions:
a) C_2H_6 ; b) CH_4 ; c) C_6H_{12} ; d) C_3H_8 .
6. Describe the type of chemical reaction between C_2H_6 and Cl_2 :
a) addition;
b) substitution;
c) decomposition;
d) composition.
7. Which reactants can be used to synthesize $C_{10}H_{22}$ from $C_5H_{11}Cl$?
a) potassium;
b) potassium chloride;
c) sodium;
d) sodium hydroxide.
8. Calculate the sum of all coefficients in the redox reaction:
 $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$
a) 6; b) 10; c) 7; d) 13.
9. Choose the final products of C_4H_{10} combustion in the excess of oxygen:
a) CO_2 and H_2O ;
b) CO and H_2O ;
c) C_2H_6 and C_2H_4 ;
d) C_4H_9OH .
10. Which substances can be produced in the reaction between three substances:
 C_2H_5Cl , C_3H_7Cl and Na ?
a) C_4H_{10} ; b) C_6H_{14} ; c) C_5H_{12} ; d) C_7H_{16}

VARIANT 2

- Choose the type of hybridization state for outer shell electron orbitals of each carbon atom in saturated hydrocarbons?
a) sp ; b) sp^2 ; c) sp^3 ; d) no hybridization.
- Cracking of alkanes results in formation of:
a) shorter alkanes;
b) shorter alkenes;
c) longer alkanes;
d) longer alkenes.
- How many isomers can you suggest for pentane molecule?
a) 1; b) 2; c) 3; d) 4.
- Choose isomers which can be described by the same C_6H_{14} formula:
a) 2-methyl-butane;
b) 2-methyl-pentane;
c) 3-methyl-pentane;
d) 2,3-dimethyl-pentane.
- Choose alkanes existing in solid state in normal conditions
a) C_5H_{12} ; b) C_6H_{14} ; c) $C_{16}H_{34}$; d) $C_{23}H_{48}$.
- Describe the type of the following chemical reaction: $2CH_4 (t^\circ) \rightarrow C_2H_2 + 3H_2$
a) composition;
b) dehydration;
c) decomposition;
d) dehydrogenation.
- Which reactants can be used to synthesize $C_{12}H_{24}$ from $C_6H_{13}Br$?
a) potassium;
b) potassium carbonate;
c) lithium;
d) potassium permanganate.
- Calculate the sum of all coefficients in the redox reaction:
 $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$
a) 15; b) 18; c) 25; d) 33.
- Choose the products of the reaction between HNO_3 and C_4H_{10} :
a) $C_4H_9NO_2$ and H_2O ;
b) $C_4H_9NH_3$ and H_2O ;
c) $C_3H_9NO_2$ and H_2O ;
d) $C_4H_{11}NO_3$.
- Which substances can be produced in the reaction between three substances:
 C_3H_7Br , C_4H_9Br and K ?
a) C_8H_{18} ; b) C_6H_{14} ; c) C_5H_{12} ; d) C_7H_{16} .

UNSATURATED HYDROCARBONS

VARIANT 1

- Which reactant can be used to distinguish unsaturated hydrocarbons from saturated ones?
 - Tollen's reagent;
 - Fehling's solution;
 - Bromine water;
 - Silver nitrate;
- Choose the common formula for alkenes and cyclic alkanes:
 - C_nH_{2n-2} ;
 - C_nH_{2n} ;
 - C_nH_{2n+2} ;
 - C_nH_{2n-6} .
- Are there cis- and trans- isomers for 1-butane and 2-butane, respectively?
 - yes / no;
 - no / yes;
 - yes / yes;
 - no / no.
- Choose the product of acetylene trimerization:
 - vinyl acetylene;
 - benzene;
 - methane;
 - toluene.
- Choose the most abundant product of 1-propene reaction with HCl:
 - 1-chloropropane;
 - 2-chloropropane;
 - propyne;
 - propane.
- Describe the type of chemical reaction between C_2H_4 and Br_2 :
 - addition;
 - substitution;
 - decomposition;
 - composition;
- Choose the formula of polyvinylchloride:
 - $[-CHCl=CH_2-]_n$;
 - $[-CH_2-CH_2-]_n$;
 - $[-CHCl-CH_2-]_n$;
 - $[-CHCl=CHCl-]_n$.
- Calculate the sum of all coefficients in the redox reaction:
 $C_5H_{10} + O_2 \rightarrow CO_2 + H_2O$
 - 17;
 - 20;
 - 37;
 - 48.
- Choose the hybridization state of outer shell electron orbitals in Carbon atoms from benzene:
 - sp;
 - sp²;
 - sp³;
 - no hybridization.
- What type of compound is produced in alkene hydration reaction?
 - alkane;
 - diene;
 - aldehyde;
 - alcohol.

VARIANT 2

- Choose formulas of benzene homologues (arenes)?
a) C_6H_6 ; b) C_8H_{10} ; c) C_8H_{18} ; d) C_2H_2 .
- Choose the common formula for alkynes and dienes:
a) C_nH_{2n-2} ; b) C_nH_{2n} ; c) C_nH_{2n+2} ; d) C_nH_{2n-6} .
- Are there cis- and trans- isomers for 2-propene and 2-propyne, respectively?
a) yes / no; b) no / yes; c) yes / yes; d) no / no.
- Choose the product of acetylene dimerization:
a) toluene; c) methane;
b) benzene; d) vinyl acetylene.
- Choose the most abundant product of 2-propanol dehydration at temperature higher than $170\text{ }^\circ\text{C}$ in the presence of H_2SO_4 :
a) 1-propene; c) 2-propyne;
b) 2-propene; d) propane.
- Describe the type of chemical reaction between C_2H_2 and H_2O :
a) addition;
b) redox reaction;
c) composition;
d) one step reaction.
- Choose the formula of polyethylene:
a) $[-CHCl=CH_2-]_n$;
b) $[-CH_2-CH_2-]_n$;
c) $[-CHCl-CH_2-]_n$;
d) $[-CHCl=CHCl-]_n$.
- Calculate the sum of all coefficients in the redox reaction:
 $C_4H_6 + O_2 \rightarrow CO_2 + H_2O$
a) 13; b) 14; c) 27; d) 30.
- Choose correct statements about benzene molecule:
a) it is prone to substitution reactions more than to addition reactions;
b) it is prone to addition reactions more than to substitution reactions;
c) three bonds between Carbon atoms in the molecule are shorter than three other bonds;
d) lengths of all six bonds between Carbon atoms are equal to each other.
- Choose the most abundant product of $CH_2=CH-CH=CH_2 + H_2$ reaction?
The molar ration between reactants is 1:1.
a) 1-butene ;
b) 2-butene ;
c) butane ;
d) 1,2-butadiene.

OXYGEN CONTAINING ORGANIC COMPOUNDS

VARIANT 1

- Esters may be described as products of the reaction between:
 - alcohols and aldehydes ;
 - carboxylic acids and aldehydes;
 - carboxylic acids and alcohols;
 - alcohols and alkanes.
- Choose the common formula for monoatomic saturated alcohols:
 - $C_nH_{2n-1}OH$;
 - $C_nH_{2n}OH$;
 - $C_nH_{2n+2}OH$;
 - $C_nH_{2n+1}OH$.
- Ethers are isomers of:
 - esters;
 - aldehydes;
 - alcohols;
 - carboxylic acids.
- Choose the product of 1-propanol dehydration reaction at the temperature lower than 140°C in the presence of H_2SO_4 :
 - propanal ;
 - propene;
 - dipropyl ether;
 - ethyl acetate.
- Acetic acid reacts with:
 - K;
 - KOH;
 - KCl;
 - Cl_2 .
- Fat can be described as:
 - ether;
 - ester;
 - aldehyde;
 - carboxylic acid.
- Silver mirror test (reaction with Ag_2O) can be used to approve the presence of:
 - aldehyde;
 - ketone;
 - glucose;
 - fructose.
- Calculate the sum of all coefficients in the reaction between formic acid aldehyde (H_2CO) and the excess of Tollen's reactant (Ag_2O):
 - 9;
 - 5;
 - 10;
 - 4.
- How many isomers can you suggest for butanol molecule?
 - 2;
 - 3;
 - 4;
 - 5.
- Which products may be formed in the process of ethanol oxidation (consider different oxidizers and conditions)?
 - CO_2 ;
 - CH_3CHO ;
 - CH_3COOH ;
 - C_2H_6 .

VARIANT 2

- Ethers may be described as products of the reaction between:
 - alcohols;
 - carboxylic acids and alcohols;
 - carboxylic acids;
 - alkenes.
- Choose the common formula for monoprotic saturated carboxylic acids:
 - $C_nH_{2n+1}COOH$;
 - $C_nH_{2n+2}O_2$;
 - $C_nH_{2n+2}COOH$;
 - $C_nH_{2n-1}COOH$.
- Ethers are isomers of:
 - esters;
 - aldehydes;
 - alcohols;
 - carboxylic acids.
- Which substances react with both phenol and ethanol?
 - NaOH;
 - Na;
 - HCl;
 - H₂.
- Choose the final products of glucose alcoholic fermentation:
 - H₂O;
 - CO₂;
 - C₂H₅OH;
 - CH₃COOH.
- Fat can be described as:
 - ether;
 - ester;
 - aldehyde;
 - carboxylic acid.
- Reaction with Fehling's solution (usually written as Cu(OH)₂) can be used to approve the presence of:
 - aldehyde;
 - glycerol;
 - glucose;
 - fructose.
- Calculate the sum of all coefficients in the reaction between acetaldehyde (CH₃CHO) and the excess of Fehling's solution (Cu(OH)₂):
 - 6;
 - 7;
 - 8;
 - 9.
- How many isomers can you suggest for butanal molecule?
 - 2;
 - 3;
 - 4;
 - 5.
- Choose the product of propanal reduction by hydrogen:
 - propane;
 - propene;
 - propyne;
 - propanol.

BIOPOLYMERS

VARIANT 1

1. What is the difference between polymerization and polycondensation?
 - a) there are no subproducts of polycondensation;
 - b) there are no subproducts of polymerization;
 - c) polymerization and polycondensation are synonyms;
 - d) synthesis of a polysaccharide is polycondensation, synthesis of polyethylene is polymerization.
2. Nucleotide is a monomer of:
 - a) RNA;
 - b) protein;
 - c) glycogen;
 - d) DNA.
3. What is the difference between cellulose and starch?
 - a) in starch molecules of glucose are connected by $\alpha(1\rightarrow4)$ and $\alpha(1\rightarrow6)$ bonds, while in cellulose they are connected by $\beta(1\rightarrow4)$ bonds;
 - b) cellulose is unbranched, while starch is branched;
 - c) starch is unbranched, while cellulose is branched;
 - d) in starch molecules of glucose are connected by $\alpha(1\rightarrow4)$ bonds, while in cellulose they are connected by $\beta(1\rightarrow4)$ and $\beta(1\rightarrow6)$ bonds.
4. Choose the pathway to synthesize alanine from CH_3COOH :
 - a) $+\text{Cl}_2 / +\text{NH}_3$;
 - b) $+\text{NH}_3 / +\text{H}_2\text{O}$;
 - c) $+\text{Br}_2 / +\text{NH}_3$;
 - d) $+\text{H}_2 / +\text{N}_2$.
5. Amino acids in proteins are connected with each other by:
 - a) ionic bonds;
 - b) covalent bonds;
 - c) peptide bonds;
 - d) hydrogen bonds.
6. Choose the products of glycine combustion:
 - a) CO_2 ;
 - b) H_2O ;
 - c) N_2 ;
 - d) H_2 .
7. How many atoms are connected to the nitrogen atom of serine in the state of zwitterion?
 - a) 1;
 - b) 2;
 - c) 3;
 - d) 4.
8. Two strands of DNA are connected together by:
 - a) covalent bonds;
 - b) ionic bonds;
 - c) peptide bonds;
 - d) hydrogen bonds.
9. DNA molecule is made from the following chemical elements:
 - a) C, N, O, P;
 - b) C, N, O, S;
 - c) C, N, O;
 - d) C, N, O, P, S.
10. Human proteins are made from the following chemical elements (ignore posttranslational modifications):
 - a) C, N, O;
 - b) C, N, O, P;
 - c) C, N, O, S;
 - d) C, N, O, P, S.

VARIANT 2

1. Choose amino acids with hydrophilic side chains:
 - a) alanine;
 - b) aspartic acid;
 - c) glutamic acid;
 - d) glycine.
2. Glucose is a monomer of:
 - a) starch;
 - b) cellulose;
 - c) glycogen;
 - d) DNA.
3. What is the difference between DNA and RNA?
 - a) nucleotides of DNA contain deoxyribose, while nucleotides of RNA contain ribose;
 - b) uracil is normally included in RNA, but not in DNA;
 - c) RNA is more stable than DNA;
 - d) in all forms of life, except some types of viruses, DNA and not RNA is used for the storage of genetic information.
4. Choose the pathway to synthesize ethyl amine from C_2H_6 :
 - a) $+ Cl_2 / + NH_3$;
 - b) $+ HNO_3 / + H_2$;
 - c) $+ Br_2 / + NH_3$;
 - d) $+ HNO_3 / + O_2$.
5. Nucleotides in a single strand of DNA or RNA are connected with each other by:
 - a) ionic bonds;
 - b) hydrogen bonds;
 - c) phosphodiester bonds;
 - d) covalent bonds.
6. Choose the products of methylamine chloride reaction with alkali:
 - a) CO_2 ;
 - b) H_2O ;
 - c) N_2 ;
 - d) CH_3NH_2 .
7. How many atoms are connected to the carbon atom of carboxylic group?
 - a) 1;
 - b) 2;
 - c) 3;
 - d) 4.
8. Amino acids can react with:
 - a) alkalis;
 - b) acids;
 - c) oxygen;
 - d) nitrogen.
9. Glycogen is made from the following chemical elements:
 - a) C, N, O, P;
 - b) C, N, O, S;
 - c) C, N, O;
 - d) C, N, O, P, S.
10. Human proteins are made from the following chemical elements (consider the possibility of posttranslational modifications):
 - a) C, N, O;
 - b) C, N, O, P;
 - c) C, N, O, S;
 - d) C, N, O, P, S.

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PERIODIC TABLE OF THE ELEMENTS

<http://www.ktf-split.br/periodni/en/>

GROUP	1	2	RELATIVE ATOMIC MASS (1)										GROUP IUPAC						ELEMENT NAME																	
PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.0079 H HYDROGEN	4.0026 He HELIUM																																		
2	6.941 Li LITHIUM	9.0122 Be BERYLLIUM																																		
3	22.990 Na SODIUM	24.305 Mg MAGNESIUM	13 B BORON	14 C CARBON	15 N NITROGEN	16 O OXYGEN	17 F FLUORINE	18 Ne NEON																												
4	39.098 K POTASSIUM	40.078 Ca CALCIUM	31 Al ALUMINIUM	32 Si SILICON	33 P PHOSPHORUS	34 S SULPHUR	35 Cl CHLORINE	36 Ar ARGON																												
5	85.468 Rb RUBIDIUM	87.62 Sr STRONTIUM	47 V VANADIUM	48 Cr CHROMIUM	49 Mn MANGANESE	50 Fe IRON	51 Co COBALT	52 Ni NICKEL	53 Cu COPPER	54 Zn ZINC	55 Ga GALLIUM	56 Ge GERMANIUM	57 As ARSENIC	58 Se SELENIUM	59 Br BROMINE	60 Kr KRYPTON																				
6	132.91 Cs CAESIUM	137.33 Ba BARIUM	72 Zr ZIRCONIUM	73 Nb NIOBIUM	74 Mo MOLYBDENUM	75 Tc TECHNETIUM	76 Ru RUTHENIUM	77 Rh RHODIUM	78 Pd PALLADIUM	79 Ag SILVER	80 Cd CADMIUM	81 In INDIUM	82 Sn TIN	83 Sb ANTIMONY	84 Te TELLESIUM	85 I IODINE	86 Xe XENON																			
7	223 Fr FRANCIUM	226 Ra RADIUM	87 La-Lu Lanthanide	88 Ac-Lr Actinide																																
57	138.91 La LANTHANUM	140.12 Ce CERIUM	58 Pr PRASEODYMIUM	59 Nd NEODYMIUM	60 Pm PROMETHIUM	61 Sm SAMARIUM	62 Eu EUROPIUM	63 Gd GADOLINIUM	64 Tb TERBIUM	65 Dy DYSPROSIUM	66 Ho HOLMIUM	67 Er ERBIUM	68 Tm THULIUM	69 Yb YTTERBIUM	70 Lu LUTETIUM																					
89	227 Ac ACTINIUM	232.04 Th THORIUM	90 Pa PROTACTINIUM	91 U URANIUM	92 Np NEPTUNIUM	93 Pu PLUTONIUM	94 Au AMERICIUM	95 Cm CURIUM	96 Bk BERKELIUM	97 Cf CALIFORNIUM	98 Es EINSTEINIUM	99 Fm FERMIUM	100 Md MENDELEVIUM	101 No NOBELIUM	102 Lr LAWRENCIUM																					

Legend:

- Metal
- Semimetal
- Nonmetal
- Alkali metal
- Alkaline earth metal
- Transition metals
- Lanthanide
- Actinide
- Chalcogens element
- Halogens element
- Noble gas

STANDARD STATE (25 °C, 101 kPa):

- Ne - gas
- Ga - liquid
- Tc - synthetic

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(1) Pure Appl. Chem., 73, No. 4, 687-683 (2001)
Relative atomic mass is shown with five significant figures. For elements having no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.

However three such elements (Th, Pa and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.

Editor: Aditya Varshana (atv@netlinx.com)

SOLUBILITY CHART

S soluble (more than 1 g per 100 g of water)
 M marginally soluble (0,1 g - 1 g per 100 g of water)
 I insoluble (less than 0,1 g per 100 g of water)
 D decomposes in water
 U compound doesn't exist or is unstable

cation anion	H ⁺	Li ⁺	K ⁺	Na ⁺	NH ₄ ⁺	Ba ²⁺	Ca ²⁺	Mg ²⁺	Sr ²⁺	Al ³⁺	Cr ³⁺	Fe ²⁺	Fe ³⁺	Ni ²⁺	Co ²⁺	Mn ²⁺	Zn ²⁺	Ag ⁺	Hg ²⁺	Pb ²⁺	Sn ²⁺	Cu ²⁺
OH ⁻		S	S	S	S	S	M	I	M	I	I	I	I	I	I	I	I	D	D	I	I	I
F ⁻	S	S	S	S	S	M	I	I	M	S	I	I	I	S	S	M	S	S	M	I	S	S
Cl ⁻	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	I	S	M	S	S
Br ⁻	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	I	M	M	S	S
I ⁻	S	S	S	S	S	S	S	S	S	S	U	S	U	S	S	S	S	I	I	I	M	S
S ²⁻	S	S	S	S	S	S	D	D	S	D	D	I	D	I	I	I	I	I	I	I	I	I
HS ⁻	S	S	S	S	S	S	S	S	S	U	U	U	U	U	I	U	U	U	U	U	U	U
SO ₃ ²⁻	S	S	S	S	S	M	M	M	I	U	D	M	U	I	I	U	M	I	I	I	U	U
HSO ₃ ⁻	S	U	S	S	S	S	S	S	S	U	U	U	U	U	U	U	U	U	U	U	U	U
SO ₄ ²⁻	S	S	S	S	S	I	M	S	I	S	S	S	S	S	S	S	S	M	D	I	S	S
HSO ₄ ⁻	S	S	S	S	S	U	U	U	D	U	U	U	U	U	U	U	U	U	U	I	U	U
NO ₃ ⁻	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	D	S
NO ₂ ⁻	S	S	S	S	S	S	S	S	S	U	U	U	U	S	M	U	U	M	U	U	U	U
PO ₄ ³⁻	S	I	S	S	D	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
HPO ₄ ²⁻	S	U	S	S	S	I	I	M	I	U	U	I	U	U	U	I	U	U	U	M	I	U
H ₂ PO ₄ ⁻	S	S	S	S	S	S	S	S	S	U	U	S	U	U	U	S	S	S	U	D	U	U
CO ₃ ²⁻	S	S	S	S	S	I	I	I	I	U	U	I	U	I	I	I	I	I	U	I	U	I
HCO ₃ ⁻	S	S	S	S	S	S	S	S	S	U	U	S	U	U	U	U	U	U	U	S	U	U
CH ₃ COO ⁻	S	S	S	S	S	S	S	S	S	D	S	S	D	S	S	S	S	S	S	S	D	S
SiO ₃ ²⁻	I	S	S	S	U	I	I	I	I	U	U	I	U	U	U	I	I	U	U	I	U	U

REACTIVITY SERIES OF METALS

<i>Active metals – those which react with water (at normal t°) and acids</i>											
Cs	Rb	K	Na	Li	Ba	Sr	Ca				
<i>Metals which react with acids and produce salts and H₂</i>											
Mg	Al	Mn	Zn	Cr	Fe	Cd	Co	Ni	Sn	Pb	
<i>Metals which react with H₂SO_{4 conc.} and HNO₃ and don't produce H₂</i>											
Sb	Bi	Cu	Hg	Ag							
<i>Metals which cannot react even with H₂SO_{4 conc.} and HNO₃</i>											
Au	Pt										

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**ХИМИЯ: ВОПРОСЫ С МНОЖЕСТВЕННЫМИ
ВАРИАНТАМИ ОТВЕТОВ**

CHEMISTRY IN MULTIPLE CHOICE QUESTIONS

Тесты

На английском языке

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