ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ

ҚАЗАҚ МЕМЛЕКЕТТІК ҚЫЗДАР ПЕДОГОГИКАЛЫҚ УНИВЕРСИТЕТІ

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«Professionally-oriented foreign language (chemistry)»

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CHAPTER 1

1. Chemistry as science. Subject and methods of research of chemistry. The major opening in the field of chemistry

Chemistry as science

Under the influence of the new empirical methods propounded by Sir Francis Bacon and others, a group of chemists at Oxford, Robert Boyle,Robert Hooke and John Mayow began to reshape the old alchemical traditions into a scientific discipline. Boyle in particular is regarded as the founding father of chemistry due to his most important work, the classic chemistry text *The Sceptical Chymist* where the differentiation is made between the claims of alchemy and the empirical scientific discoveries of the new chemistry He formulated Boyle's law, rejected the classical "four elements" and proposed a mechanistic alternative of atoms and chemical reactions that could be subject to rigorous experiment.

Antoine-Laurent de Lavoisier is considered the "Father of Modern Chemistry".

The theory of phlogiston (a substance at the root of all combustion) was propounded by the German Georg Ernst Stahl in the early 18th century and was only overturned by the end of the century by the French chemist Antoine Lavoisier, the chemical analogue of Newton in physics; who did more than any other to establish the new science on proper theoretical footing, by elucidating the principle of conservation of mass and developing a new system of chemical nomenclature used to this day.

Prior to his work, though, many important discoveries had been made, specifically relating to the nature of 'air' which was discovered to be composed of many different gases. The Scottish chemist Joseph Black (the first experimental chemist) and the Dutchman J. B. van Helmontdiscovered carbon dioxide, or what Black called 'fixed air' in 1754; Henry Cavendish discovered hydrogen and elucidated its properties andJoseph Priestley and, independently, Carl Wilhelm Scheele isolated pure oxygen.

English scientist John Dalton proposed the modern theory of atoms; that all substances are composed of indivisible 'atoms' of matter and that different atoms have varying atomic weights.

The development of the electrochemical theory of chemical combinations occurred in the early 19th century as the result of the work of two scientists in particular, J. J. Berzelius and Humphry Davy, made possible by the prior invention of the voltaic pile by Alessandro Volta. Davy discovered nine new elements including the alkali metals by extracting them from their oxides with electric current.

British William Prout first proposed ordering all the elements by their atomic weight as all atoms had a weight that was an exact multiple of the atomic weight of hydrogen. J. A. R. Newlands devised an early table of elements, which was then developed into the modern periodic table of elements by the German Julius Lothar Meyer and the Russian Dmitri Mendeleev in the 1860s. The inert gases, later called the noble gases were discovered by William Ramsay in collaboration with Lord Rayleigh at the end of the century, thereby filling in the basic structure of the table.

Organic chemistry was developed by Justus von Liebig and others, following Friedrich Wöhler's synthesis of urea which proved that living organisms were, in theory, reducible to chemistry. Other crucial 19th century advances were; an understanding of valence bonding (Edward Frankland in 1852) and the application of thermodynamics to chemistry (J. W. Gibbs and Svante Arrhenius in the 1870s).

Studying of the nature makes a problem of natural sciences to which also the chemistry belongs. The chemistry — is science about elements and the obkrazuyemykh them connections, science about a structure, properties and chemical transformations of these connections.

Education and destruction of chemical compounds, izmekneny their structure and structure is connected by a chemical form of the movement of a matter. The chemistry is engaged in studying of a chemical form of the movement of a matter, interrelation and mutually transitions between it and other forms of the movement of a matter. From this it follows that the chemistry is closely connected with physics, biology, a geoklogiya and other sciences. It reflects one of basic provisions of dialectic materialism about general communication and interaction of the phenomena in the nature and society.

The chemistry plays huge role in life of a modern obkshchestvo. The chemistry interferes in all areas of science, equipment, production, agriculture, life, bringing transformation revolution to habitual processes and methods, economy of work, means, time and materials, increasing national wealth. Now especially words of the great Russian scientist M. V. Lomonosov are confirmed: «Widely the chemistry spreads the hands in affairs human».

Teaching chemistry in higher educational institutions has the task not only to tell to the student a certain complex of chemical knowledge and to prepare it for studying of a number of special disciplines, but also promoted development in the student of dialektiko-materialistic outlook.

The chemistry is not only general education, but also all-technical science. The engineer working in any industry has to own fundamentals of chemical science.

The chemistry forms a theoretical basis of receiving mineral fertilizers, ammonia of acids, salts, semiconductor materials, alloys of metals and other numerous products.

In development of inorganic chemistry of Kazakhstan domestic scientists - Bekturov A.B. made a huge contribution., Beremzhanov B. A., Usapovich M. I., Sanguine O. A. Serazetdinov D.Z., Ilyasova A.K., Nurakhmetov N. N., Ospanov X.K.

The chemistry plays huge role in expansion of the most actual problems of modern society. Carry to their number:

a) synthesis of the new substances and compositions necessary for the solution of technical tasks;

b) increase in efficiency of artificial fertilizers for increase of productivity of crops;

c) synthesis of food from nonagricultural raw materials (artificial food);
d) development and creation of new power sources;
e) environmental protection;.
e) clarification of the mechanism of the major biochemical processes;
g) development of huge oceanic sources of raw materials.

Studying properties of substances, the chemistry isn't limited to studying only of their external qualitative or quantitative characteristics (temperatures of melting and boiling, density, etc.). The main task of chemistry - identification and the description of chemical properties of substances thanks to which there is possible a transformation of one substances into others as a result of chemical reactions.

The knowledge of the nature of substances allows to understand transformations of these substances from a position of basic laws to which these transformations submit. At last, having got acquainted with the basic concepts and laws of chemistry, it is possible to explain and even to try to predict the principles and operating conditions of modern chemical productions.

The profound knowledge of chemistry is absolutely necessary for specialists of all branches of a national economy. Along with physics and mathematics it makes a basis of vocational training of qualified professionals.

The most important opening in the field of chemistry

Here the list of the major opening in the field of chemistry which influenced development of humanity in general, gave an impetus to development of other sciences, and also to development of technical devices. Traditionally it is represented or TOP5 or TOP10 of opening, but this list inseparable, it is impossible to remove something from it, then it will be unfair and the list of opening will be not full, so all at the moment in the list of 13 greatest opening in the field of chemistry.

1. Discovery of oxygen (1770). Joseph Priestley found oxygen, and later, Antoine Lavoisier describes the nature of elements. Priestley uses oxygen in experiments, and describes its role in processes of burning and breath of living beings. Then, by dissolution of compressed air in water, it thinks out sparkling water. Priestley, without paying attention to importance of the opening, calls new gas "deflogistirovanny air". Lavoisier gives oxygen the name and correctly describes its role in the course of burning. Lavoisier then deepens researches in this area and systematizes the obtained data.

2. Nuclear theory (1808). John Dalton gives the chance of coordination of invisible atoms with the measured sizes, such as the volume of gas or mass of a mineral. Its nuclear theory claims that all substances consist of the smallest particles called by atoms. Thus, the pure element consists of identical atoms, all with the same weight, and connections of substances consist of atoms of various elements in a combination with each other.

3. Atoms connect in molecules (1811 and further). The Italian chemist Amedeo Avogadro opened the fact of that atoms of elements unite in molecules. Avogadro proved that equal volumes of gases under identical conditions of temperature and pressure the identical number of molecules contains.

4. Synthesis of urea (1828). Friedrich Voeller incidentally synthesizes urea from inorganic materials, proving that live substances can be reproduced from lifeless substances. Till 1828 was considered that organic substances could only be created by means of "the vital force" which is present at animals and plants.

5. Chemical structure (1850). Friedrich Kekule defines chemical structure of benzene therefore studying of molecular structure of substance moves to the forefront in the field of chemistry. He writes that after many years of studying of the nature of carbon communications, he opened a ring form of a molecule of benzene as the snake bites own tail. Unusual structure of a molecule answer a question how atoms of carbon can be connected with four other atoms at the same time.

6. Periodic table of elements (1860 - 1870). Dmitry Mendeleyev proves that if all of 63 elements, known for that time, to arrange in ascending order of atomic masses, their properties repeat according to certain periodic cycles. He creates periodic table of elements and predicts existence of elements which weren't found yet. Rub from these elements openly during his life: gallium, scandium and germaniye.

7. The electricity transforms chemicals (1807 - 1810). Hemfri Davy proved that the electric power changes chemical substances. It used the battery for division of salts, now this process is known as electrolysis.

8. Electron (1897). J.J.Thomson learns that negatively the charged particles which are let out by electron beam tubes it is even less, than atoms. That is the essence of opening consisted that the matter consists of smaller particles, than atoms. For it Thomson got the Nobel Prize on physics in 1906.

9. Electrons in chemical bonds (1913 and further). Niels Bohr published the model of a structure of atom in which electrons move in certain orbits round a kernel, and chemical properties of an element substantially is defined by quantity of electrons its atom. It opened a way to understanding of how electrons participate in chemical bonds.

10. Atoms have a code of light (1850). Gustav Kirchhoff and Robert Bunsen found out that each element absorbs or radiates light in certain lengths of waves, creating a certain range.

11. Radioactivity (1890 - 1900). Maria and Pierre Curie found and extracted radioactive materials. After chemical extraction of uranium from uranium ore, Maria notes that residual material is more "active", than pure uranium. She comes to a conclusion that ore contains, besides uranium, new elements which also are radioactive. It leads polonium and radium to opening of an element.

12. Plastic (1869 and 1900). John Wesley Hyatt makes celluloid for use as replacement of an ivory at production of billiard balls. Celluloid is the first material of synthetic plastic and is used as replacement of expensive natural materials, such as an ivory, amber, horns and a tortoise armor. Later Leo Beekelend invents the strengthened plastic known as Bakelitovaya mastic, the substance began to be used for production of phonograph records, for isolation in electronics.

13. Fullerena (1985). Robert Kerl, Harold Kroto and Ric Smolli find absolutely new class of carbon connections with openwork hollow structure. Further these connections began to call fullerenam. Molecules consist only of carbon and have a form of the hollow sphere, an ellipsoid, a tube or a ring, now they can be received only by means of artificial synthesis.

2. *Technology of transfer of chemical texts. Work with the dictionary. Studying of computer programs: "SOCRATES", "PROMT", "ABBYY LINGVA 12". Instructions for use program. Training on elementary lexical material and texts on chemistry. Rules of drawing up and use of the individual dictionary of chemical terms*

Socrates Personalny 5.0 - system of machine translation from English into Russian and vice versa, intended for work with rather small texts of the general subject.

Low system requirements, intuitively clear ways of use, the convenient interface and flexible settings - here only the small list of its advantages. Various options of input of the text. Socrates Personalny 5.0 allows users переводитьтекст gathered with an own window, being in a clipboard or the file. Translation of post messages.

The program has plug-in for MS Outlook allowing to translate messages directly in this e-mail client. Translation standard Help-ov of other programs. If the icon "Socrates Personalny 5.0" already is on the panel of problems of Windows, having opened help system of any program, you will see the button or point of the Translate menu on the top panel. Having clicked on the button you get the transfer of contents of the current page of help system. Access to a translation service from other appendices. To translate the text or the word from almost any MS Windows appendix, it is enough to allocate of it and, using a combination of 'hot' keys, to cause a translation service. The translated text will appear in a popup window. Call of the interactive dictionary. At desire simply find out value of any word you can click on an icon "Socrates Personalny 5.0" the right button of a mouse.

Having typed the word in an input window, you automatically get its transfer.

PROMT Professional 9.5 – the decision on the translation of texts for small and medium business. PROMT Professional 9.5 allows to translate quickly and qualitatively the document, the site, the letter or the message. With this program it isn't necessary to spend time for search of a proper word in dictionaries, it is possible to load the text entirely and to get smooth translation of the text, and also the full reference by separate words and phrases. The program works and without Internet access.

We recommend PROMT Professional 9.5 for the fast translation.

Documents in Microsoft Office applications 2000-2010 (Word, Excel, Outlook, PowerPoint) and Adobe (Adobe Acrobat, Adobe Professional).

Web - pages in Internet Explorer, Mozilla FireFox, Opera and Google Chrome browsers.

Messages in ICQ, Skype, QIP, Windows Live Messenger.

The texts containing specialized or branch lexicon and terminology.

ABBYY Lingvo — family of electronic dictionaries. It is created by the Russian company ABBYY. On August 26, 2014 there was a latest version of x6 (X six). On August 12, 2010 there was a version for Mac OS X. The volume of entries makes more than 8,7 million.

Lingvo in translation from language of Esperanto means "language" about what there are articles in the ABBYY Lingvo dictionaries (LingvoUniversal and LingvoComputer).

The multilingual version covers 15 languages — Russian, Ukrainian, English, German, French, Spanish, Italian, Turkish, Latin, Chinese, Portuguese, Tatar, Kazakh, Swedish, Polish and Finnish. Also there is the European version — 130 dictionaries in 7 languages and the English-Russian-English electronic dictionary.

In ABBYY Lingvo there is no function of the full text translation, but the word-by-word translation of texts from a clipboard is possible. In some dictionaries on English, German and

French the majority of words are sounded by professional announcers — native speakers.

The training Lingvo Tutor module helping to remember new words is a part of the program.

Besides the existing 150 professional dictionaries, result of lexicographic work of staff of the ABBYY company and authoritative paper and electronic dictionaries there is an extensive base of free user dictionaries for the program. Dictionaries are checked and are previously in the general access on the site of association of lexicographers of Lingvo.

3. The chapter on "General chemistry". Basic concepts and laws of chemistry. Chemical bond. The structure of the atom. The types of chemical reactions. Solutions solubility. Electrolysis

Chemical phenomena: some substances are converted into other, different from the original composition and properties, and the composition of the nuclei of atoms does not change.

Physical phenomena: changing the physical state of matter (evaporation, melting, electric conductivity, heat and light, malleability, and others.) Or the formation of new substances with a change in the composition of the nuclei of atoms.

Atomic - molecular theory.

1. All substances consist of molecules. Molecule - the smallest particle of a substance having its chemical properties.

2. The molecules consist of atoms. Atom - the smallest particle of a chemical element that retains all of its chemical properties. Various elements correspond to different atoms.

3. Molecules and atoms are in constant motion; among them there are forces of attraction and repulsion.

Chemical element - a kind of atoms, characterized by certain charges of the nuclei and the structure of the electron shells. Currently 110 known elements: 89 of them are found in nature (in the world), the rest obtained by artificial means. Atoms exist in a free state in compounds with atoms of the same or other elements to form a molecule. Ability atoms react with other atoms to form chemical compounds defined by its structure. Atoms consist of a positively charged nucleus and negatively charged electrons moving around it, forming electrically neutral system that obeys the laws specific to microsystems.

The atomic nucleus - the central part of an atom, composed of Z protons and N neutrons, in which the great bulk of the atoms.

Nuclear charge - positive, is equal in magnitude to the number of protons in the nucleus or electrons in the neutral atom and coincides with the ordinal number of the element in the periodic system. The sum of the protons and neutrons of the atomic nucleus is called the mass number $A = Z + N$.

Isotopes - chemical element with the same charge of the nuclei, but different mass numbers due to different numbers of neutrons in the nucleus.

Chemical formula - a conditional entry of substances using chemical symbols (proposed in 1814 by J. Berzelius) and index (index - a figure standing at the bottom right of the symbol. Denotes the number of atoms in the molecule). Chemical formula shows atoms which elements and in what proportion are interconnected in a molecule.

Allotropy - the phenomenon of formation of chemical elements more simple substances, which differ in structure and properties. Simple sub- stances molecules consist of atoms of the same element.

Complicated substance - a molecule made up of atoms of different chemical elements.

International atomic mass unit is equal to 1/12 of the mass of the isotope ^{12}C - the main isotope of natural carbon.

1 a.m.u. $= 1/12 \cdot m(^{12}C) = 1{,}66057 \cdot 10^{-24}$ g.

The relative atomic mass (A_r) - a dimensionless quantity equal to the ratio of average atomic mass element (counting the percentage of isotopes in nature) to 1/12 of the mass of the atom ^{12}C.

The average absolute atomic mass (m) is equal to the relative atomic mass multiplied by a.m.u.

A_r (Mg) = 24,312;

m (Mg) = 24,312 • 1,66057 • 10^{-24} = 4,037 • 10^{-23} g.

The relative molecular mass (M_r) - a dimensionless quantity that indicates how many times the mass of the molecule of the substance is greater than 1/12 of the mass of an atom of carbon ^{12}C.

Mg = Mg / (1/12 ma (^{12}C))

m - mass of a molecule of the substance;

ma (^{12}C) - the mass of the carbon atom ^{12}C.

Relative molecular mass of a substance is the sum of the relative atomic masses of all elements based indexes.

Examples.

M_r (B_2O_3) = 2 • A_r (B) + 3 • Ar (O) = 2 • 3 • 11 + 16 = 70.

M_r (KAl $(SO_4)_2$) = 1 • A_r (K) + 1 • A_r (Al) + 1 • 2 • Ar (S) + 2 • 4 • A_r (O) = • 39 = 1 + 1 + 1 • 27 • 32 • 2 + 2 • 4 • 16 = 258.

The absolute mass of the molecule is equal to the relative molecular mass multiplied by amu The number of atoms and molecules in the conventional samples of substances is very large, so the characteristic quantity of substance use a special unit - mol.

The amount of substance mol. Means a certain number of structural elements (molecules, atoms, ions). Denoted by n, measured in moles. Mol - amount of substance containing as many particles as there are atoms in 12 grams of carbon.

Number of Avogadro di Kvarenya (N_A). Number of particles in 1 mole of any substance is the same and equal to 6,02 • 10^{23}. (Avogadro constant has dimension - mol^{-1}).

Example.

How many molecules contained 6.4 g of sulfur?

The molecular weight of the sulfur is 32 g / mol. Determine the number of grams / mole of 6.4 g of sulfur:

n (s) = m (s) / M (s) = 6,4g / 32 g / mole = 0.2 mole

We define the number of structural units (molecules) using the Avogadro constant N_A

N (s) = n (s) • N_A = 0,2 • 6,02 • 10^{23} = 1,2 • 10^{23}

Molar mass shows a mass of 1 mole of a substance (denoted M).

M = m / n

The molar mass of a substance is the ratio of the mass of the substance to the appropriate amount of material.

The molar mass of the substance is numerically equal to its relative molecular mass, but the first value is of dimension g / mol, and the second - the dimensionless.

$M = N_A \bullet m$ (1 molecule) $= N_A \bullet Mg \bullet 1$ a.m.u. $= (N_A \bullet 1$ a.m.u.$) \bullet Mg$.

This means that if the mass of a certain molecule is, for example, 80 a.m.u. (SO_3), then the mass of one mole of molecules is equal to '80 Avogadro constant is the constant of proportionality, ensuring the transition from the molecular to the molar ratios. All statements regarding the molecules remain valid for moles (for replacement, if necessary, on the z a.m.u.) For example, reaction equation: $2Na + Cl_2 \rightarrow 2NaCl$, means that the two atoms of sodium reacts with one molecule of chlorine or that the same two moles of sodium will react with one mole of chlorine.

The law of conservation of mass

(Mikhail Lomonosov 1748 g .; Lavoisier, 1789)

The weight of all the substances that have entered into chemical reaction is the mass of the reaction products.

Atomic-molecular theory explains this law as follows: as a result of chemical reactions, the atoms do not disappear or appear, and their rearrangement occurs (ie chemical prevraschenie- this process of breaking some bonds between the atoms and the formation of other, resulting from the initial molecules substances derived molecule product of the reaction). Since the number of atoms before and after the reaction remains unchanged, then their total weight and should not vary. Under the weight is the value that characterizes the amount of matter.

In the early 20th century, the wording of the law of conservation of mass was revised due to the advent of the theory of relativity (Einstein, 1905), according to which the mass of a body depends on its velocity and, therefore, characterizes not only the quantity of matter, but also its movement. The resulting body of energy D_E is associated with an increase in the ratio of its mass D_m. $D_E = D_m \bullet c^2$, where c - speed of light. This value is not used in the chemical reactions, as 1 kJ of energy corresponds to the change in mass ~ 10-11 g and Dm can not be practically measured. In nuclear reactions where in D_E ~ 106 times greater than the chemical reactions, D_m should be considered.

Based on the law of conservation of mass, we can make the equation of chemical reactions and for them to make payments. It is the basis of quantitative chemical analysis.

Compilation of chemical equations

Involves three steps:

1. Write the formulas of substances unreacted (left) and reaction products (right), connecting them within the meaning of signs "+" and "→ ": $HgO \rightarrow Hg + O_2$.

2. Selection of the coefficients for each material so that the number of atoms of each element in the left and right side of the equation was the same: $2HgO \rightarrow 2Hg + O_2$.

3. Check the number of atoms of each element on the left and right sides of the equation.

Calculations based on chemical equations

Calculations based on chemical equations (stoichiometric calculations) based on the law of conservation of mass. In real chemical processes due to incomplete reactions and weight loss products is generally less Calculated theoretically. The reaction yield (h) is the ratio of the actual weight of the product (m_p) to the theoretically possible (m_t), expressed as a decimal or percentage.

$h = (m_p / m_t) \cdot 100\%$.

If the conditions of the problem out of the reaction products is not specified, it is taken into account for 100% (quantitative yield).

EXAMPLE 1

How many grams of copper is formed in the reduction 8g of hydrogen if the reaction yield was 82% of theoretical?

Solution

$CuO + H_2 \rightarrow Cu + H_2O$.

1. Calculate the theoretical yield of copper to the reaction equation: 80 g (1 mol) CuO in the reduction can form a 64 g (1 mol) Cu; 8 g of CuO in the reduction can form X g Cu.

2. Determine how many grams of copper is formed by 82% of the output of the product:

6.4 g - 100% yield (theoretical)

X g - 82%

X = (8 • 82) / 100 = 5.25 g.

EXAMPLE 2

Determine the reaction yield of tungsten by aluminothermy if 33.14 g of concentrate ore containing WO_3 and non-reducing admixtures (mass fraction of impurities 0.3) was obtained 12.72 g of the metal?

Solution

a) Determine the mass (g) WO_3 in 33.14 g of concentrate ore

w (WO_3) = 1,0 - 0,3 = 0,7

m (WO_3) = w (WO_3) • m = 0,7 • 33,14 = 23,2 g.

b) Determine the theoretical yield of tungsten by reduction of 23.2 g of WO_3 powder aluminum.

$WO_3 + 2Al \rightarrow Al_2O_3 + W$

When recovering 232 g (1 g-mole) WO_3 produced 187 g (1 g-mole) W, and 23.2 g of WO_3 - X z W

X = (23,2 • 187) / 232 = 18.7 g W

c) Calculate the practical output of tungsten

18.7 g of W - 100%

12,72 g W - Y%

Y = (12,72 • 100) / 68 = 18.7%

EXAMPLE 3.

How many grams of barium sulfate precipitate formed by the fusion of solutions containing 20.8 g of barium chloride and 8.0 g of sodium sulfate?

Solution.

$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

Calculation of the amount of the reaction product are on the starting material, take into deficit.

1. First determine which of the two starting materials is insufficient.

We denote the number of g Na_2SO_4 - X.

208 g (1 mol) $BaCl_2$ reacted with 132 g (1 mol) Na_2SO_4; 20.8 g - with X g

X = (20,8 • 132) / 208 = 13.2 g Na_2SO_4 .

We have found that the reaction of 20.8 g of $BaCl_2$ costs 13.2g Na_2SO_4, and given 18.0 g Thus, sodium sulphate is taken reacted in excess and subsequent calculations should be based on $BaCl_2$, taken in shortage.

2. Determine the number of grams of precipitate $BaSO_4$. 208 g (1 mol) $BaCl_2$ form 233 g (1 mol) $BaSO_4$; 20.8 g - Y g

Y = (233 • 20,8) / 208 = 23.3 g

Law of definite proportions

First formulated Zh.Prust (1808).

All individual chemicals have permanent qualitative and quantitative composition and the specific chemical structure, regardless of the preparation method.

From the law of constant composition implies that the formation of a compound elements combine with each other in certain weight ratios.

Example.

CuS - copper sulphide. m (Cu): m (S) = A_r (Cu): A_r (S) = 64: 32 = 2: 1.

In order to obtain copper sulphide (CuS) must be mixed powders of copper and sulfur in weight ratios of 2: 1.

If the combined amounts of the starting materials do not correspond to their proportion in the chemical formula of the compound, one of them will be in excess.

For example, if we take 3 g copper, and 1 g of sulfur, after reaction of 1 g of copper will remain which is not entered in a chemical reaction. Non-molecular structure of the substance does not have a strictly constant composition. Its composition depends on the preparation conditions.

Mass fraction of elements w (E) shows the percentage of the mass of a given element of the total mass of matter, where n - number of atoms; A_r (E) - the relative atomic mass of the element; M_r - relative molecular mass of the substance.

$w(E) = (n \cdot A_r(E)) / M_r$

Knowing the quantitative elemental composition of the compound can set it simple molecular formula:

1. Indicate the compound formula $A_xB_yC_z$

2. Calculate the ratio of X: Y: Z through the mass fractions of the elements:

$w(A) = (x \cdot A_r(A)) / M_r(A_xB_yC_z)$

$w(B) = (y \cdot A_r(B)) / M_r(A_xB_yC_z)$

$w(C) = (z \cdot A_r(C)) / M_r(A_xB_yC_z)$

$X = (w(A) \cdot M_r) / A_r(A)$

$Y = (w(B) \cdot M_r) / A_r(B)$

$Z = (w(C) \cdot M_r) / A_r(C)$

$x : y : z = (w(A) / A_r(A)) : (w(B) / A_r(B)) : (w(C) / A_r(C))$

3. The figures are divided by the smallest integers to obtain X, Y, Z.

4. Write down the formula of the compound.

Law of multiple proportions

(D.Dalton, 1803)

If two chemical elements give several compounds, the weight fractions of the same element in these compounds is attributable to one and the same proportion by weight of the second element, relate to each other as small integers.

N_2O N_2O_3 NO_2 (N_2O_4) N_2O_5

The number of oxygen atoms in the molecules of these compounds is attributable to two nitrogen atoms are between a 1: 3: 4: 5.

Act volumetric relationship (Gay-Lussac, 1808)

"The volume of the gases react chemically and volume of gases produced by the reaction, are to each other as small integers."

Corollary. Stoichiometric coefficients in the equations for the chemical reactions of molecules of gaseous substances show in what volume ratio of reactant or a gaseous substance.

Examples.

a) $2CO + O_2 \rightarrow 2CO_2$

In the oxidation of two volumes of carbon monoxide (II) with one volume of oxygen is formed of 2 volumes of carbon dioxide, i.e.

the volume of the original reaction mixture volume is reduced by one.

b) In the synthesis of ammonia from the elements:

$N_2 + 3H_2 \rightarrow 2NH_3$

One volume of nitrogen reacts with three volumes of hydrogen; formed with two volumes of ammonia - initial volume of the gaseous reaction mixture is reduced to 2 times.

Law Avogadro (1811)

At equal volumes of gases at identical conditions (temperature, pressure, etc.) contained the same number of molecules.

Law is valid only for gaseous substances.

Corollary.

1. The same number of molecules of various gases under the same conditions takes identical volumes.

2. Under normal conditions (0 ° C = 273 ° K, 1 atm = 101.3 kPa) 1 mole of any gas occupies a volume of 22.4 liters.

EXAMPLE 1.

What volume of hydrogen at STP highlighted by dissolving 4.8 g of magnesium in excess of hydrochloric acid?

Solution.

$Mg + 2HCl \rightarrow MgCl_2 + H_2$.

When dissolving 24 g (1 mol) magnesium stood HCl 22.4 L (1 mol) of hydrogen; by dissolving 4.8 g of magnesium - X L of hydrogen.

X = (4,8 • 22,4) / 24 = 4.48 liters of hydrogen

Example 2.

3.17 g of chlorine occupy a volume of 1 l (STP). Calculate based on these data the molecular weight of chlorine.

Solution.

Find the mass of 22.4 liters of chlorine

1 l - 3.17 g of chlorine

L-- X 22.4 g of chlorine

X = 3,17 • 22,4 = 71 g.

Consequently, the molecular weight of chlorine - 71.

The combined gas law - the union of three independent private gas laws: Gay-Lussac, Charles, Boyle, an equation that can be written as:

$P_1V_1 / T_1 = P_2V_2 / T_2$

Conversely, from the combined gas law

when P = const ($P_1 = P_2$) can be obtained

$V_1 / T_1 = V_2 / T_2$

(Gay-Lussac's law);

at T = const ($T_1 = T_2$):

$P_1V_1 = P_2V_2$

(Boyle's law);

at V = const

$P_1 / T_1 = P_2 / T_2$

(Charles' law).

Clapeyron-Mendeleev equation

If we write the combined gas law for any mass of any gas, then we obtain the equation Clapeyron-Mendeleev:

$pV = (m / M) RT$

where m - mass of gas; M - molecular weight; p - pressure; V - volume; T - absolute temperature (° K); R - universal gas constant (8.314 J / (mol • K) or 0.082 l atm / (mol • K)).

For a given mass of a specific gas ratio m/M is constant, so the equation of Clapeyron-Mendeleev get combined gas law.

Example.

What volume takes at a temperature of 17 °C and a pressure of 250 kPa carbon monoxide (II) weight 84 g?

Solution.

Number of moles CO is:

n (CO) = m (CO) / M (CO) = 84/28 = 3 mol.

The volume of CO at STP of

3 • 22,4 l = 67,2 L.

Izobedinennogo gas law Boyle and Gay-Lussac:

$(P \cdot V) / T = (P_0 \cdot V_0) / T_0$

It should

$V (CO) = (P_0 \bullet T \bullet V_0) / (P \bullet T_0) = (101{,}3 \bullet (273 + 17) \bullet 67{,}2) / (250 \bullet 273) = 28.93$ liters.

Relative density of gases shows how many times 1 mole of one gas is heavier (or lighter) 1 mole of another gas.

$D_A (B) = r (B) / r (A) = M (B) / M (A)$.

The average molecular weight of the mixture of gases is equal to the total weight of the mixture, divided by the total number of moles:

$M = (m_1 + ... + m_n) / (n_1 + ... + n_n) = (M_1 \bullet V_1 + ... Mn \bullet Vn) / (n1 + ... + nn)$.

Example1.

The density of a gaseous substance hydrogen is 17. What is the density of air (M_{air}= 29).

Solution.

$M_g = 2D_{H2} = 34$

$D_{air} = M_g / M_{air} = 34/29 = 1.17$.

Example 2.

Determine the density of air a mixture of nitrogen, argon and carbon dioxide, if the mass fractions of the components were 15, 50 and 35%, respectively.

Solution.

$D_{mixture}$ (air) = $M_{mixture} / M_{air}. = M_{mixture} / 29$.

Msmesi = (15 + 28 • 50 • 40 • 35 + 44) / 100 = (420 + 2000 + 1540) / 100 = 39.6.

$D_{mixture}$ (air) = $M_{mixture} / 29 = 39.6 / 29 = 1.37$.

Chemical bond - this is the interaction between two atoms, carried out by the exchange of electrons. In the formation of chemical bonds atoms tend to acquire stable vosmielektronnuyu (or two-electron) outer shell, the corresponding structure of the atom nearest inert gas. The following types of chemical bonds: covalent (polar and nonpolar, exchange and donor-acceptor), ionic, hydrogen and metal.

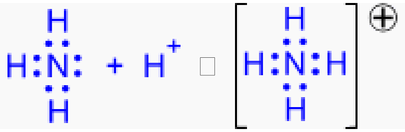
Covalent bonds

Carried out due to the electron pair belonging to both atoms. Distinguish exchange and donor-acceptor mechanism of the formation of a covalent bond.

1) exchange mechanism. Each atom gives one unpaired electron in the total electron pair:

$H^{\bullet} + {}^{\bullet}H$ □H : H

2) the donor-acceptor mechanism. One atom (donor) provides an electron pair and the other atom (acceptor) provides for this pair of free orbital;



Two atoms can socialize neckolko electron pairs. In this case we speak of multiple bonds:

(or N□N) – triple bond

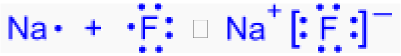
If the electron density is located symmetrically between atoms is called a nonpolar covalent bond.

If the electron density is shifted towards one of the atoms, it is called a polar covalent bond.

The polarity of the connection is greater, the greater the difference in electronegativities of the atoms.

Electronegativity - the ability of an atom to attract electron density from the other atoms. The most electronegative element - fluorine, the most electropositive - France.

Jonah - it's charged particles, in which the atoms are transformed as a result of the recoil electrons or accession.

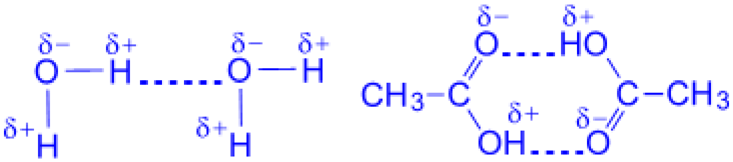


(sodium fluoride is composed of sodium ions Na^{+} and fluoride ions F^{-})

If the difference in electronegativities of the atoms is large, the electron pair, communicates, moves to one of the atoms, and both atoms become ions.

Chemical bonding between the ions, carried out at the expense of the electrostatic attraction is called an ionic bond.

Hydrogen bond. Hydrogen bond - LRA link between the positively charged hydrogen atom of one molecule and the negatively charged atom of another molecule. The hydrogen bond is partly electrostatic and partly donor-acceptor character.



The hydrogen bond is depicted points

The presence of hydrogen bonds explains the high boiling point of water, alcohols, carboxylic acids.

Metallic bonds

The valence electrons of metals rather weakly bound to their nuclei and can easily break away from them. Therefore, the metal contains a number of positive ions located at specific positions of the crystal lattice, and a large number of electrons move freely throughout the entire crystal. The electrons in the metal are in communication between all the metal atoms.

Structure of the Atom

In the late XIX - early XX century physicists have proved that the atom is a complex particles composed of a simple (elementary) particles. Were found:

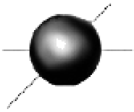
- cathode rays (English physicist James. James. Thomson, 1897), the particles of which are called electrons e- (carry a single negative charge);
- natural radioactive elements (French scientists - radiochemists Becquerel and M. Sklodowska-Curie, a physicist Pierre Curie, 1896) and the existence of α-particles (helium nuclei);

- presence in the center of the atom positively charged nucleus (English physicist and radiochemist Rutherford, 1911);
- artificial transmutation of one element into another, such as nitrogen into oxygen (Rutherford, 1919). From the nucleus of an atom of one element (nitrogen - in Rutherford) in collisions with α-particles to provide the nucleus of an atom of another element (oxygen) and new particles carrying a single positive charge and called proton (p +, the nucleus 1H).
- presence in the nucleus of the atom electrically neutral particles - neutrons n^0 (English physicist James. Chadwick, 1932).

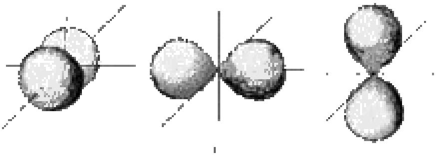
As a result of studies, it was found that the atom of each element (besides 1H) contains protons, neutrons, electrons, and protons and neutrons in the nucleus concentrated atoms and electrons - on its periphery (in the electron shell).

The number of protons in the nucleus is equal to the number of electrons in the shell of the atom and responsible ordinal number of this element in the periodic table.

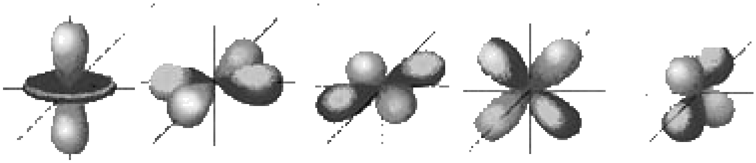
Electron shell of the atom is a complex system. It is divided into subshells with different energies (energy levels); levels in turn subdivided into sublayers and sublayers include atomic orbitals, which may vary in size and shape (denoted by the letters s, p, d, f et al.).



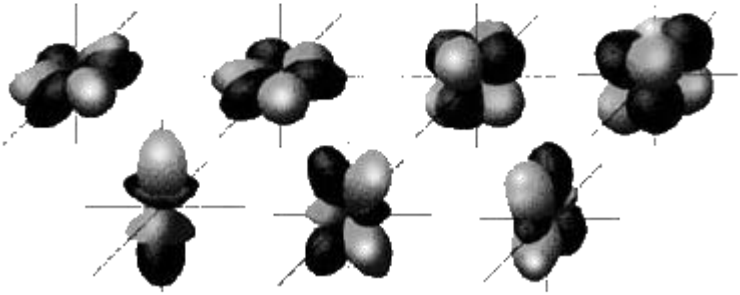
s-orbital of the s-orbital Shape - spherical.



Form p-orbitals (the number on the p-sublevel is 3) - dumbbell. p-orbitals



The form of d-orbitals (which number on the corresponding d-sublevel is 5) - is more complicated: d-orbitals.



More complex forms of f-orbitals, which number on the f-sublevels is 7.f-orbitals.

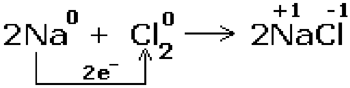
Types of chemical reactions

Chemical reactions on the number of starting materials and reaction products can be divided into groups:

Type of chemical reaction	Definition	Example
Connection	reactions between simple substances, or between multiple complex, where in the complex is formed one or more complex substance.	$CaO + H_2O = Ca(OH)_2$ $PbO + SiO_2 = PbSiO_3$ $2Na + Cl_2 = 2NaCl$
Decomposition	reaction in which a substance is formed	$Cu(OH)_2 = CuO + H_2O$

	from one or a few simple complex substances.	$CaCO_3 = CaO + CO_2$ $NH_4Cl = NH_3 + HCl$
Substitution	reactions between complex and simple substances, in which atoms of a simple substance replaces one of the atoms of a complex	$CuSO_4 + Fe = FeSO_4 + Cu$ $2KBr + Cl_2 = 2KCl + Br_2$
Exchange	reactions between the two composite materials, where they share their components	$AgNO_3 + KBr = AgBr\downarrow$ $NaOH + HCl = NaCl + H_2O$

Redox reactions, reactions which involve changes in the degree of oxidation:



$$2\overset{0}{Na} + \overset{0}{Cl_2} \longrightarrow 2\overset{+1}{Na}\overset{-1}{Cl}$$

In this reaction the oxidation state changed from chlorine and sodium hence it is the oxidation - reduction. Sodium Chlorine gives electrons, it is a reducing agent; chloro accepts electrons is oxidant. The process of recoil electrons is called oxidation, the process of accession - recovery.

Solution. SOLUBILITY

Solutions - homogeneous multicomponent system consisting of solvent, dissolved substances and products of their interaction.

The state of aggregation solutions may be liquid (sea water), gaseous (air), or solid (many metal alloys).

The particle sizes in a true solution - than 10-9 m (about the size of the molecules).

Unsaturated, saturated or supersaturated solutions

If the molecular or ionic particles distributed in the slurry are present in it in such an amount that under these conditions there is no further dissolution of the substance, called a saturated solution. (For example, if we put 50 g of NaCl in 100 g of H_2O, then dissolved at 200 ^{0}C only 36 g of salt).

Called saturated solution which is in dynamic equilibrium with excess solute.

Placing 100 grams of water at 200 ^{0}C less than 36 g NaCl, we obtain an unsaturated solution.

Upon heating the mixture with salt water up to 1000 ^{0}C occur dissolving 39.8 g NaCl in 100 g water. If now remove the insoluble salt from the solution and the solution is gently cooled to 200 ^{0}C, an excess amount of salt is not always precipitate. In this case we are dealing with a supersaturated solution. Supersaturated solution is very unstable. Stirring, Shaking, adding grains of salt can cause crystallization of excess salt and the transition to a saturated stable state.

Unsaturated solution - a solution containing less material than saturated.

Supersaturated solution - a solution containing a substance more than saturated.

Dissolution as a physico-chemical processes

The solutions formed by the interaction of the solvent and solute. The process of interaction of the solvent and solute called solvation (if the solvent is water - hydration).

Dissolution occurs with the formation of various shape and strength products - hydrate. In this case the forces involved both physical and chemical nature. The dissolution process due to such interactions is accompanied by various components of the thermal phenomena.

Energy characteristics of dissolution is the heat of formation of the solution, regarded as the algebraic sum of the thermal effects of endothermic and exothermic process steps. The most significant among these are:

- Absorbs heat processes - the destruction of the crystal lattice, breaks chemical bonds in molecules;
- Heat-generating processes - the formation of the products of interaction of dissolved solute (hydrates), and others.

If the fracture energy of the crystal lattice energy of hydration less solute, the dissolution comes with heat release (observed warming). Thus, dissolving NaOH - exothermic reaction: the destruction of the crystal lattice is wasted 884 kJ / mol, and the formation of hydrated Na^+ ions and OH^- allocated, respectively, 422 and 510 kJ/mol.

If the energy of crystal lattice energy of hydration greater than, the dissolution occurs with absorption of heat (in the preparation of an aqueous solution of NH_4NO_3 observed decrease in temperature).

Solubility

Maximum solubility of many materials in water (or other solvents) is a constant value corresponding to the concentration of a saturated solution at a given temperature. It is a qualitative characteristic solubility and references contained in grams per 100 grams of solvent (under certain conditions).

Solubility depends on the nature of the solute and solvent, temperature and pressure.

The nature of the solute. Crystalline substances are divided into:

P - highly soluble (more than 1.0 g per 100 g water);

M - slightly soluble (0.1 g - 1.0 g per 100 g water);

N - insoluble (less than 0.1 g per 100 g water).

The nature of the solvent. In the formation of the solution between the particles of each component are replaced by bonds between the particles of the different components. To new connection could be formed, the components of the solution should have the same type of communication, i.e. be of the same nature. Therefore, the ionic substances soluble in polar solvents, and poorly in the non-polar molecular substance and - vice versa.

Effect of temperature. If the solute is exothermic, the temperature increases, its solubility decreases (for example, $Ca(OH)_2$ in water) and vice versa. For most salts characteristic increase in solubility when heated.

Virtually all the gases are dissolved exothermically. The solubility of gases in liquids decreases with increasing temperature and with decreasing increases.

Effect of pressure. With increasing pressure the solubility of gases in liquids increases and decreases with decreasing.

In chemistry and manufacturing, electrolysis is a method of using a direct electric current (DC) to drive an otherwise non-spontaneous chemical reaction. Electrolysis is commercially highly important as a stage in the separation of elements from naturally occurring sources such as ores using an electrolytic cell. The voltage that is needed for electrolysis to occur is called the decomposition potential.

The key process of electrolysis is the interchange of atoms and ions by the removal or addition of electrons from the external circuit. The desired products of electrolysis are often in a different physical state from the electrolyte and can be removed by some physical processes. For example, in the electrolysis of brine to produce hydrogen and chlorine, the products are gaseous. These gaseous products bubble from the electrolyte and are collected:

$$2NaCl + 2H_2O \rightarrow 2NaOH + H_2 + Cl_2$$

A liquid containing mobile ions (electrolyte) is produced by:

- Solvation or reaction of an ionic compound with a solvent (such as water) to produce mobile ions.
- An ionic compound is melted (*fused*) by heating.

An electrical potential is applied across a pair of electrodes immersed in the electrolyte.

Each electrode attracts ions that are of the opposite charge. Positively charged ions (cations) move towards the electron-providing (negative) cathode. Negatively charged ions (anions) move towards the electron-extracting (positive) anode.

In this process electrons are either absorbed or released. Neutral atoms gain or lose electrons and become charged ions that then pass into the electrolyte. The formation of uncharged atoms from ions is called discharging. When an ion gains or loses enough electrons to become uncharged (neutral) atoms, the newly formed atoms separate from the electrolyte. Positive metal ions like Cu^{++} deposit onto the cathode in a layer.The terms forthis are electroplating electrowinning and electrorefining. When an ion gains or loses electrons without becoming neutral, its electronic charge is altered in the process. In chemistry the loss of electrons is called oxidation while electron gain is called reduction.

First law of electrolysis

In 1832, Michael Faraday reported that the quantity of elements separated by passing an electric current through a molten or dissolved salt is proportional to the quantity of electric charge passed through the circuit. This became the basis of the first law of electrolysis:

$$m = k \cdot q$$

Second law of electrolysis

Faraday discovered that when the same amount of electricity is passed through different electrolytes/elements connected in series, the mass of substance liberated/deposited at the electrodes is directly proportional to their equivalent weights.

4. The chapter on "inorganic chemistry." Mendeleev periodic law. Major classes of inorganic compounds. Water, its properties and methods of purification. Electrolytic dissosatsiya, ph, hydrolysis.

Periodic law - the law that explains the patterns of change in the properties of the elements. It was opened as a result of tremendous research Mendeleev. Mendeleev came to discover the law by comparing the properties and relative atomic masses of elements of various natural groups. At that time it was known 6 such groups - alkali metals, alkaline earth metals, halogens, an oxygen group, a nitrogen group carbon. In its work on the draft classification of the elements Mendeleev used the card elements, which were discharged their basic characteristics, these cards at his disposal in order of increasing atomic weights of the elements. Thanks to the deep analysis, comparison and generalization of data in 1869, Mendeleev formulated the periodic law: "Properties of chemical elements, as well as the shape and properties of the compounds are in periodic dependence on their atomic weight."

On the basis of the periodic law of Mendeleev corrected the characteristics of some of the known elements (eg, atomic weight and valence Be), and also predicted new elements that were not yet known at the time (Mendeleev called them eka-aluminum, eka-boron, ekasilitsiem. Later on, these elements have been discovered and are called gallium, scandium, germanium).

A consequence of the periodic law and its graphic representation has become a periodic system of chemical elements. Periodic system consists of 7 periods and 8 groups. Each element in the periodic system takes in accordance with the serial number a certain place in a certain period and its particular group.

Period - a horizontal row of elements, starting and ending with an alkali metal halogen and inert elements. Distinguish small and large periods. Small periods consist of one row of elements (I, II, III periods). Large periods contain two (IV, V) and three rows of elements (VI, VII periods).

Groups - a vertical column of elements having at least one common valence. Groups are divided into primary and secondary subgroups. Home subgroup - subgroup starting element of short-period (e.g., C, Si, Ge, Sn, Pb (IV); F, Cl, Br, I, At (VII)), the sub-groups - the subgroup starting element of long period (e.g., Cu, Ag, Au (I); Cr, Mo, W (VI)). Symbols of the elements included in the main and sub-groups in the table are shifted relative to each other, it emphasizes their differences.

In small periods with increasing atomic number:

- Weakens the metallic properties
- Amplified nonmetallic properties
- Valence in combination with oxygen increases from 1 to 7.

In the main group with increasing atomic number:

- Reinforcing metal properties
- Weakens nonmetallic properties
- Higher valence equal to the group number.

In the early 20th century, developed the theory of atomic structure, on the basis of the periodic law which currently reads:

The properties of the chemical elements, and they form simple and complex substances are in periodic dependence on the charge of the nucleus of an atom.

Between the position of the element in the periodic system and its electronic structure there is a connection.

Serial number of elements in the periodic system is equal to the charge of the nucleus of an atom (hence the serial number indicates the number of protons in the nucleus and the number of electrons in the atom).

Each period begins element, in which the atoms begin to be built new electronic layer, and the layer number is the number of periods (and thus period number indicates the number of atoms in the layers of electronic elements of this period).

Elements whose atoms have similar structurally electron shells fall into one subgroup of the periodic system. All elements of the main group electrons fill the outer electron layer, and the number of electrons in this layer is equal to the group number. In elements of groups I and II electrons fill the s-sublevel, so they are called s-elements. In elements III - VIII groups are filled p-sublevel, so these elements belong to the family of p-elements. In elements of the sub-groups are filled with electrons d-sublevel of the penultimate layer, while the lanthanides and actinides f- - sublevel penultimate layer.

The properties of elements are determined by their structure. Elements having the last layer of 1 - 2 electrons are metallic, 2 - 5 E - Transitional, 4 - 8 electrons - nonmetal.

In the period with increasing nuclear charge atoms metallic properties decrease and non-metallic reinforced. This is due to the increase in the number of electrons in the last layer.

In the subgroup with a major increase in the charge of the nucleus of atoms metallic properties are enhanced, and nonmetallic decrease. This is due to the increasing number of electronic layers, and hence to decrease the attractive forces of the electrons of the last layer to the core.

Periodic repetition of properties of elements is explained by periodic repetition of the number of electrons in the outer energy level and repeating the electronic structure of atoms.

Reactive elements determined by the structure of the external electron layer. Activity due to the lack of halogens 1 electron to complete the outer layer. We inert elements external electron layer is completed, so they are chemically inactive. Do alkali metal atoms 1 electron on the last layer is a kind of odd.

Classification of inorganic substances

Simple substances. The molecules consist of atoms of one species (atoms of the same element). In chemical reactions can not be decomposed to form other compounds.

Complex substance (or chemical compounds). Molecules consist of atoms of different species (atoms of different chemical elements). In chemical reactions decomposed to form a plurality of other substances.

Inorganics

simple	metals Non-metals
difficult	oxides grounds acids salts

Sharp boundary between metals and non-metals is not, because there are simple substances exhibiting dual properties.

Allotropy - the ability of some chemical elements to form a few simple substances, which differ in structure and properties.

C - diamond, graphite, carbyne.
O - oxygen, ozone.
S - rhombic, monoclinic, plastic.
P - white, red, black.

Allotropy phenomenon caused by two reasons:

1) a different number of atoms in the molecule, such as oxygen O_2 and ozone O_3

2) formation of various crystal forms, for example, graphite and diamond.

Oxides are chemical compounds with one or more oxygen atoms combined with another element (e.g. Li_2O).

Introduction

Some oxides can react directly with water to form an acidic, basic, or amphoteric solution. An amphoteric solution is a substance that can chemically react as either acid or base. However, it is also possible for an oxide to be neither acidic nor basic. There are different properties which help distinguish between the three types of oxides. The term anhydride ("without water") refers to compounds that assimilate H_2O to form either an acid or a base upon the addition of water.

Oxides are binary compounds of oxygen with another element, e.g., CO_2, SO_2, CaO, CO, ZnO, BaO_2, H_2O, etc. These are termed as oxides because here, oxygen is in combination with only one element. Based on their acid-base characteristics oxides are classified as acidic or basic. An oxide that combines with water to give an acid is termed as an acidic oxide. The oxide that gives a base in water is known as a basic oxide.

Acidic Oxides

Acidic oxides are the oxides of non-metals (groups 14-17). These acid anhydrides or acidic oxides form acids with water:

- Sulfurous Acid

$$SO_2+H_2O \rightarrow H_2SO_3$$

- Carbonic Acid

$$CO_2+H_2O \rightarrow H_2CO_3$$

- Sulfuric Acid

$$SO_3+H_2O \rightarrow H_2SO_4$$

Acidic oxides are, therefore, known as acid anhydrides, e.g., sulfur dioxide is sulfurous anhydride; sulfur trioxide is sulfuric anhydride. When these oxides combine with bases, they produce salts, e.g.,

$$SO_2+2NaOH \rightarrow H_2SO_3+H_2O$$

Basic Oxides

Generally Group 1 and Group 2 elements form bases called base anhydrides or basic oxides e.g.,

$$K_2O(c)+H_2O\rightarrow 2KOH(aq).$$

Basic oxides are the oxides of metals. If soluble in water they react with water to produce hydroxides (alkalies) e.g.,

$$CaO+H_2O\rightarrow Ca(OH)_2;$$

$$MgO+H_2O\rightarrow Mg(OH)_2;$$

$$Na_2O+H_2O\rightarrow 2NaOH.$$

These metallic oxides are therefore, known as basic anhydrides. They react with acids to produce salts, e.g.,

$$MgO+2HCl\rightarrow MgCl_2+H_2O$$

$$Na_2O+H_2SO_4\rightarrow Na_2SO_4+H_2O$$

Amphoteric oxides

An amphoteric solution is a substance that can chemically react as either acid or base. For example, when HSO_4^- reacts with water it can make hydroxide or hydronium ions.

$$HSO_4^- +H_2O\rightarrow SO_4^{2-} +H_3O^+$$

$$HSO_4^- +H_2O\rightarrow H_2SO_4 +OH^-$$

Amphoteric oxides are metallic oxides, which show both basic as well as acidic properties. When they react with an acid, they produce salt and water, showing basic properties. While reacting with alkalies they form salt and water showing acidic properties, e.g.,

$$ZnO + 2HCl \longrightarrow \underset{\text{zinc chloride}}{ZnCl_2} + H_2O \text{ (basic nature)}$$

$$ZnO + 2NaOH \longrightarrow \underset{\text{sodium zincate}}{Na_2ZnO_2} + H_2O \text{ (acidic nature)}$$

$$Al_2O_3 + 3H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2O \text{ (basic nature)}$$

$$Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O \text{ (acidic nature)}$$

Amphoteric oxides have both acidic and basic properties. A common example of an amphoteric oxide is aluminum oxide. In general, amphoteric oxides form with metalloids. (see chart below for more detail). Example with acidic properties:

$$Al_2O_3+H_2O\rightarrow 2Al(OH)^{2+}+2H^+$$

Example with basic properties:

$$Al_2O_3+H_2O\rightarrow 2Al^{3+}+3OH^-$$

Neutral Oxides

These are the oxides, which show neither basic nor acidic properties, that is, they do not form salts when reacted with acids or bases, e.g., carbon monoxide (CO); nitrous oxide (N_2O); nitric oxide (NO), etc., are neutral oxides.

Peroxides and Dioxides

Oxides: Group 1 metals react rapidly with oxygen to produce several different ionic oxides, usually in the form of M_2O. With the oxygen exhibiting an oxidation number of -2.

$$4Li+O_2\rightarrow 2Li_2O$$

Peroxides:

Often Lithium and Sodium reacts with excess oxygen to produce the peroxide, M_2O_2. with the oxidation number of the oxygen equal to -1.

$$H_2+O_2\rightarrow H_2O_2$$

Superoxides: Often Potassium, Rubidium, and Cesium react with excess oxygen to produce the superoxide, MO_2. with the oxidation number of the oxygen equal to -1/2.

$$Cs+O_2\rightarrow CsO_2$$

A peroxide is a metallic oxide which gives hydrogen peroxide by the action of dilute acids. They contain more oxygen than the corresponding basic oxide, e.g., sodium, calcium and barium peroxides.

$$BaO_2 + H_2SO_4 \longrightarrow BaSO_4 + H_2O_2$$

$$Na_2O_2 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O_2$$

Dioxides like PbO_2 and MnO_2 also contain higher percentage of oxygen like peroxides and have similar molecular formulae. These oxides, however, do not give hydrogen peroxide by action with dilute acids. Dioxides on reaction with concentrated HCl yield Cl_2 and on reacting with concentrated H_2SO_4 yield O_2.

$$Pb\,O_2 + 4HCl \longrightarrow PbCl_2 + Cl_2 + 2H_2O$$

$$2PbO_2 + 2H_2SO_4 \longrightarrow 2PbSO_4 + 2H_2O + O_2$$

Compound oxides

Compound oxides are metallic oxides that behave as if they are made up of two oxides, one that has a lower oxidation and one with a higher oxidation of the same metal, e.g.,

Red lead: $Pb_3O_4 = PbO_2 + 2PbO$

Ferro-ferric oxide: $Fe_3O_4 = Fe_2O_3 + FeO$

On treatment with an acid, compound oxides give a mixture of salts.

$$Fe_3O_4 + 8HCl \longrightarrow 2FeCl_3 + FeCl_2 + 4H_2O$$

$$\text{Ferro - ferric oxide} \longrightarrow \text{ferric chloride} + \text{ferrous chloride}$$

By direct heating of an element with oxygen

Many metals and non-metals burn rapidly when heated in oxygen or air, producing their oxides, e.g.,

$$2Mg + O_2 \xrightarrow{\text{Heat}} 2MgO$$

$$2Ca + O_2 \xrightarrow{\text{Heat}} 2CaO$$

$$S + O_2 \xrightarrow{\text{Heat}} SO_2$$

$$P_4 + 5O_2 \xrightarrow{\text{Heat}} 2P_2O_5$$

By reaction of oxygen with compounds at higher temperatures

At higher temperatures, oxygen also reacts with many compounds forming oxides, e.g.,

- Sulphides are usually oxidized when heated with oxygen.

$$2PbS + 3O_2 \xrightarrow{\Delta} 2PbO + 2SO_2$$

$$2ZnS + 3O_2 \xrightarrow{\Delta} 2ZnO + 2SO_2$$

- When heated with oxygen, compounds containing carbon and hydrogen are oxidized.

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

- By thermal decomposition of certain compounds like hydroxides, carbonates, and nitrates:

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

$$2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2 + O_2$$

$$Cu(OH)_2 \xrightarrow{\Delta} CuO + H_2O$$

By oxidation of some metals with nitric acid

$$2Cu + 8HNO_3 \xrightarrow{Heat} 2CuO + 8NO_2 + 4H_2O + O_2$$

$$Sn + 4HNO_3 \xrightarrow{Heat} SnO_2 + 4NO_2 + 2H_2O$$

By oxidation of some non-metals with nitric acid

$$C + 4HNO_3 \longrightarrow CO_2 + 4NO_2 + 2H_2O$$

Trends in Acid-Base Behavior

The oxides of elements in a period become progressively more acidic as one goes from left to right in a period of the periodic table. For example, in third period, the behavior of oxides changes as follows:

$$\underbrace{Na_2O,\ MgO}_{\text{Basic}} \qquad \underbrace{Al_2O_3,\ SiO_2}_{\text{Amphoteric}} \qquad \underbrace{P_4O_{10},\ SO_3,\ Cl_2O_7}_{\text{Acidic}}$$

If we take a closer look at a specific period, we may better understand the acid-base properties of oxides. It may also help to examine thephysical properties of oxides, but it is not necessary. Metal oxides on the left side of the periodic table produce basic solutions in water (e.g. Na_2O and MgO). Non-metal oxides on the right side of the periodic table produce acidic solutions (e.g. Cl_2O, SO_2, P_4O_{10}). There is a trend within acid-base behavior: basic oxides are present on the left side of the period and acidic oxides are found on the right side. However, this trend yields the question of where and when does the shift occur? The figure below shows how, as we move from left to right, the oxides are more acidic and as we move from top to bottom, the oxides are more basic.

Aluminum oxide shows acid and basic properties of an oxide, it is amphoteric. Thus Al_2O_3 entails the marking point at which a change over from a basic oxide to acidic oxide occurs. It is important to remember that the trend only applies for oxides in their highest oxidation states. The individual element must be in its highest possible oxidation state because the trend does not follow if all oxidation states are included.

Problems

1. Can an oxide be neither acidic nor basic?
2. $Rb + O_2$ (excess) →?
3. $Na + O_2 \rightarrow ?$
4. BaO_2 is which of the following: hydroxide, peroxide, or superoxide?
5. What is an amphoteric solution?
6. Why is it difficult to obtain oxygen directly from water?

Quests for fixing

1. The oxide reacts with the acid to form a salt - is
   1) SO_3 2) P_2O_5 CuO 3) SO_2 4) CO_2
2. The basic and acidic oxides are, respectively:
   1) calcium oxide and alumina
   2) sodium oxide and chromium oxide (VI)
   3) magnesium oxide and beryllium oxide
   4) nitric oxide (II) and carbon monoxide (IV)
3. Reacted with hydrochloric acid
   1) the nitric oxide (IV) 2) copper oxide (II)
   3) oxide iron (II) 4) magnesium oxide
4. Reacts with acids and alkalis:
   1) zinc oxide 2) strontium oxide
   3) barium oxide 4) sulfur oxide (VI)
5. Acid oxides are all substances in the series:

1) MnO, FeO, CuO 2) Mn_2O_7, CrO_3, SO_3
3) NO_2, N_2O, NO 4) Al_2O_3, MgO, CO.

Base - complex substance whose molecules consist of metal atoms and hydroxy groups capable substituted for metal $Me(OH)_n$, n- number of hydroxy groups. By modern nomenclature are usually called hydroxides of elements indicating the degree of oxidation: NaOH - sodium hydroxide, KOH - potassium hydroxide, $Cu(OH)_2$ - copper hydroxide (II).

Metal hydroxides are usually divided into two groups: soluble in water (formed with alkali and alkaline earth metals) and insoluble in water. Soluble base (alkali) izmnenyayut coloring indikaiorap litmus blue, insoluble bases do not change oerasku indicator. For example, water-soluble strong bases (alkali) - LiOH - lithium hydroxide, water-insoluble weak base, for example, $Fe (OH)_2$- hydroxide iron (II) . Also, classified by the base acidity odnokislotnye, e.g., NaOH, diacid For example, $Ca(OH)_2$, trehkislotnye, e.g., $Fe(OH)_3$. By degree of electrolytic dissociation (→) are divided into a strong base (NaOH, KOH), weak (NH_4OH, $Cu(OH)_2$).

All base (metal hydroxides) - solids. S-metal hydroxides colorless hydroxides many d-painted metal.

A common method for obtaining a base exchange reaction, by which can be prepared as soluble and insoluble base.

$$CuSO_4 + 2KOH = Cu (OH)_2 \downarrow + K_2SO_4$$

$$K_2CO_3 + Ca (OH)_2 = CaCO_3 \downarrow + 2KOH$$

Alkali in the art typically produced by electrolysis of aqueous solutions of chlorides: $2NaCl + 2H_2O = 2NaOH + H_2 + Cl_2$

Alkalis may also be prepared by reacting the alkali and alkaline earth metals or their oxides with water: $2Li + 2H_2O = 2LiOH + H_2\uparrow$

$$CaO + H_2O = Ca(OH)_{2.}$$

General chemical property of soluble and insoluble hydroxides is their ability to interact with water - reacting neutralization.

$$NaOH + HNO_3 = NaNO_3 + H_2O$$

$$Mg (OH)_2 + 2HCl = MgCl_2 + 2H_2O$$

Alkali oxides react with the acid.

$2KOH + CO_2 = K_2CO_3 + H_2O$.

Alkalis can interact with some nonmetals (halogens white phosphorus, silicon):

$$2NaOH + Cl_2 = NaCl + NaOCl + H_2O \text{ (cold)}$$

$$6KOH + 3Cl_2 = KclO_3 + KCl + 3H_2O \text{ (with heating).}$$

$$3KOH + 4P + 3H_2O = PH_3 + 3KH_2PO_2$$

$$2NaOH + Si + H_2O = Na_2SiO_3 + 2H_2\uparrow$$

Unlike the alkali-insoluble base is thermally dehydrated, for example:

$$Cu(OH)_2 \xrightarrow{t} CuO + H_2O.$$

Hydroxides of certain metals decompose at ordinary temperature, i.e. are unstable, for example:

$$2CuOH = Cu_2O + H_2O.$$

Hydroxides, where d- metals have low oxidation, can be oxidized by atmospheric oxygen, for example:

$$Mn(OH)_2 + O_2 + 2H_2O = 2Mn(OH)_4.$$

D- metals hydroxides react complexation:

$$Cu(OH)_2 + 4NH_3 \rightarrow Na_2[Cu(NH_3)_4].$$

Alkali unlike insoluble bases interact with amphoteric oxides and hydroxides: $2NaOH + Al_2O_3 + 3H_2O = 2K[Al(OH)_4]$

$$2KOH + Zn(OH)_2 = K_2[Zn(OH)_4].$$

Alkali enter into exchange reactions with salts, if the result of the chemical reaction produces a weak base or insoluble salt.

$$Ba(OH)_2 + H_2SO_4 = 2H_2O + BaSO_4\downarrow$$

$$2NaOH + CuSO_4 = Cu(OH)_2\downarrow + Na_2SO_4$$

$$NaOH + NH_4Cl = NaCl + NH_3 + H_2O.$$

Alkali react with metals forming amphoteric oxides and hydroxides: $Zn + 2NaOH + 2H_2O = Na_2[Zn(OH)_4] + H_2$.

For alkalis characteristic qualitative reactions, ie, reaction by which recognize substance. For this reaction with alkali indicators (from the Latin word "pointers). If a solution of alkali add 1-2 drops of indicator solution, then it will change its color. The color change is given in the table below:

Indicator	Color of the indicator in a neutral environment	Colouring indicator in an alkaline medium.
Litmus	purple	blue

Methyl orange (Methyl orange)	orange	yellow
Phenolphtalein	Colourless	raspberry

Quests for fixing

1. Dilute nitric acid is reacted:
1) aluminum phosphate 2) magnesium hydroxide
3) a sulfur oxide (VI) 4) sodium chloride

2. With potassium hydroxide and sulfuric acid is reacted:
1) nitrate, copper (II) 2) Sodium carbonate
3) Zinc oxide 4) Potassium sulphate

3.Gidroksid lithium can not be obtained by reacting:
1) Li and H_2O 2) LiCl and KOH
3) Li_2O and H_2O 4) Li_2SO_4 and $Ba(OH)_2$

4. Sodium hydroxide solution reacts with each material set:
1) Al_2O, CO, $CuCl_2$, HCl 2) Al_2O_3, HNO_3, SiO_2, $CuCl_2$
3) KNO_3, ZnO, H_2SO_4, CO_2 4) CaO, HNO_3, SO_2, ZnO

An acid (from the Latin acidus/acēre meaning sour) is a chemical substance whose aqueous solutions are characterized by a sour taste, the ability to turn blue litmus red, and the ability to react with bases and certain metals (like calcium) to form salts. Aqueous solutions of acids have a pH of less than 7. A lower pH means a higher acidity, and thus a higher concentration of positive hydrogen ions in thesolution. Chemicals or substances having the property of an acid are said to be acidic.

There are three common definitions for acids: the Arrhenius definition, the Brønsted-Lowry definition, and the Lewis definition. The Arrhenius definition defines acids as substances which increase the concentration of hydrogen ions (H^+), or more accurately, hydronium ions (H_3O^+), when dissolved in water. The Brønsted-Lowry definition is an expansion: an acid is a substance which can act as a proton donor. By this definition, any compound which can easily be deprotonated can be considered an acid. Examples include alcohols and amines which contain O-H or N-H fragments. A Lewis acid is a substance that can accept a pair of electrons to form a covalent bond. Examples of Lewis acids include all metal cations, and electron-deficient molecules such as boron trifluoride and aluminium trichloride.

Common examples of acids include hydrochloric acid (a solution of hydrogen chloride which is found in gastric acid in the stomach and activates digestive enzymes), acetic acid (vinegar is a dilute solution of this liquid), sulfuric acid (used in car batteries), and tartaric acid (a solid used in baking). As these examples show, acids can be solutions or pure substances, and can be derived from solids,liquids, or gases. Strong acids and some concentrated weak acids are corrosive, but there are exceptions such as carboranes and boric acid.

In the classical naming system, acids are named according to their anions. That ionic suffix is dropped and replaced with a new suffix (and sometimes prefix), according to the table below. For example, HCl has chloride as its anion, so the -ide suffix makes it take the form hydrochloric acid. In the IUPAC naming system, "aqueous" is simply added to the name of the ionic compound. Thus, for hydrogen chloride, the IUPAC name would be aqueous hydrogen chloride. The prefix "hydro-" is added only if the acid is made up of just hydrogen and one other element.

Classical naming system:

Anion prefix	**Anion suffix**	**Acid prefix**	**Acid suffix**	**Example**
per	ate	per	ic acid	perchloric acid ($HClO_4$)
	ate		ic acid	chloric acid ($HClO_3$)
	ite		ous acid	chlorous acid ($HClO_2$)

hypo	ite	hypo	ous acid	hypochlorous acid (HClO)
	ide	hydro	ic acid	hydrochloric acid (HCl)

Getting acids		
oxygen-containing acid	acid oxide +	$SO_3+H_2O=H_2SO_4$ $P_2O_5+3H_2O=2H_3PO_4$
	Nonmetal + strong oxidant	$P+5HNO_3+2H_2O=3H_3PO_4+5NO$
	The salt + less volatile acid	$NaNO_3+H_2SO_4=HNO_3+NaHSO_4$
Non-oxygen - containing acid	Hydrogen + nonmetal	$H_2+Cl_2=2HCl$
	The salt + less volatile acid	$NaCl+H_2SO_4=2HCl\uparrow+NaHSO_4$

Chemical properties acids can be divided into two groups: common to all acids reactions associated with the presence of the H+ ion solution (sometimes hydroxonium ion H_3O^+) and specific, i.e. specific system acids.

Hydrogen ions may, on the one hand, enter into redox reactions to recovering hydrogen and on the other hand, react with the negatively charged compound neutral particles or particles having a lone pair of electrons (the acid-base interaction).

The first type of transformations acids include the reaction of acids with a metal facing in the row voltages to hydrogen, for example:

$$Zn + H_2SO_4 = ZnSO_4 + H_2$$

For acid-base type are reacted with basic oxides and bases, for example: $2HCl + CaO = CaCl_2 + H_2O$

$H_2SO_4 + Ca(OH)_2 = CaSO_4 + 2H_2O$.

Specific properties of acids are linked, primarily, with the redox reaction. Anoxic acid in aqueous solution can only be oxidized by:

$$2KMnO_4 + 16HCl = 5Cl_2 + 2KCl + 2MnCl_2 + 8H_2O$$

$$H_2S + Br_2 = S + 2HBr.$$

Oxyacids can be oxidized, just as the central atom which is in an intermediate oxidation state, such as in sulfurous acid:

$$H_2SO_3 + Cl_2 + H_2O = H_2SO_4 + 2HCl.$$

Many oxyacids in which the central atom has a maximum oxidation state (S^{6+}, N^{5+}, Cr^{6+}), exhibit the property of strong oxidants (H_2SO_4, is a strong oxidant only at high concentrations):

$$Cu + 2H_2SO_4 = CuSO_4 + SO_2 + 2H_2O$$

$$3P + 5HNO_3 + 2H_2O = 3H_3PO_4 + 5NO.$$

Acids can be reacted with salts, if formed slightly soluble, volatile or malodissotsiiruyuschee substance:

$$H_2SO_4 + BaCl_2 = BaSO_4\downarrow + 2HCl$$

$$2HCl + Na_2CO_3 = 2NaCl + H_2O + CO_2.$$

Weak acids are readily decomposed: $H_2SiO_3 = H_2O + SiO_2$.

The acids can be recognized by the indicators.

Indicator	Color of the indicator in a neutral environment	Colouring indicator in acidic medium
Litmus	purple	Red
Methyl orange (Methyl orange)	orange	Red and pink
Phenolphtalein	Colourless	Colourless

Quests for fixing

1. The nitric acid may be obtained by the schemes:

1) KNO_3 (s) + H_2SO_4 (s) = 3) $NaNO_3$ (c) + HCl =

2) $NO_2 + H_2O + O_2$ = 4) KNO_3 (c) + H_2SO_4 (conc) =

2. Sulfuric acid is reacted in solution with each material set:

1) $Cu(OH)_2$, SiO_2, $BaCl_2$, MgO 2) Fe, Zn, Ag, Mg

3) Cu, $BaCl_2$, MgO, Ba $(OH)_2$ 4) Na_2CO_3, Zno, Zn, Mgo

3. Ammonia can not drain through:

1) the soda lime 2) of concentrated sulfuric acid
3) solid potassium hydroxide 4) quicklime

In chemistry, salts are ionic compounds that result from the neutralization reaction of an acid and a base. They are composed of related numbers of cations (positively charged ions) and anions (negative ions) so that the product is electrically neutral (without a net charge). These component ions can be inorganic, such as chloride (Cl^-), or organic, such as acetate ($C_2H_3O_2^-$); and can be monatomic, such as fluoride (F^-), or polyatomic, such as sulfate (SO_4^{2-}).

There are several varieties of salts. Salts that hydrolyze to produce hydroxide ions when dissolved in water are *basic salts*, whilst those that hydrolyze to produce hydronium ions in water are *acidic salts*. *Neutral salts* are those that are neither acid nor basic salts. Zwitterions contain an anionic centre and a cationic centre in the same molecule, but are not considered to be salts. Examples include amino acids, many metabolites, peptides, and proteins.

Usually, non-dissolved salts at standard temperature and pressure are solid, but there are exceptions (see Molten salt sand ionic liquids).

Molten salts and solutions containing dissolved salts (e.g., sodium chloride in water) are called electrolytes, as they are able to conduct electricity. As observed in the cytoplasm of cells, in blood, urine, plant saps and mineral waters, mixtures of many different ions in solution usually do not form defined salts after evaporation of the water. Therefore, their salt content is given for the respective ions.

Salts are associated with all classes of inorganic compounds and can be obtained from almost any class.

The methods of preparation of salts medium. Average salts formed by the reaction:

1) base with an acid (neutralization reaction):
$Ba(OH)_2 + 2HCl = BaCl_2 + 2H_2O$.
2) of the acid with basic oxides: $H_2SO_4 + MgO = MgSO_4 + H_2O$.
3) salts with an acid:

$MgCO_3 + 2HNO_3 = Mg(NO_3)_2 + H_2O + CO_2\uparrow$.

4) Two different salts: $AgNO_3 + KCl = AgCl + KNO_3$.

5) salts with acidic oxides (acidic oxide should be less volatile than that formed during the reaction):

$CaSO_3 + SiO_2 = CaSiO_3 + SO_2\uparrow$.

6) Base with acid oxides: $NaOH + P_2O_5 = 2Na_3PO_4 + 3H_2O$.

7) Reasons salts: $3NaOH + FeCl_3 = 3NaCl + Fe(OH)_3\downarrow$.

8) Basic oxides with acid: $CaO + SiO_2 = CaSiO_3$.

9) of metals with nonmetals: $2K + Cl_2 = 2KCl$.

10) of metals with acids: $Mg + 2HCl = MgCl_2 + H_2\uparrow$.

11) of the metal salts: $CuSO_4 + Zn = ZnSO_4 + Cu\downarrow$.

12) The amphoteric metals with melts of alkali:

$Zn + 2NaOH \overset{t}{=} Na_2ZnO_2 + H_2\uparrow$.

13) Non-metals with alkalis. Halogens (except fluorine) and sulfur react with alkali to form two salts - anoxic and oxyacids:

$3S + 6NaOH = 2Na_2S + Na_2SO_3 + 3H_2O$.

$Cl_2 + 2KOH = KCl + KClO + H_2O$.

14) Non-metals and salts: $Cl_2 + 2KI = KCl + I_2$.

15) When heating some salts oxygenate acid salts are formed with less oxygen content, or did not contain it:

$2KNO_3 \overset{t}{=} 2KNO_2 + O_2\uparrow$.

$2KClO_3 \overset{t,\ MnO_2}{=} 2KCl + O_2\uparrow$.

Chemical properties of salts.

Many salts are stable when heated. However, ammonium salts, as well as some low-level metal salts, weak acids and acids, in which elements exhibit a higher or lower oxidation state, are decomposed under heating:

$CaCO_3 \overset{t}{=} CaO + SO_2$.

$NH_4Cl = NH_3 + HCl$.

Chemical reactions of salts exhibit features both cations and anions within them. The metal ions in solution may react with other

anions to form insoluble compounds or in the redox reaction, both due to the cation and anion by: $2FeCl_2 + Cl_2 = 2FeCl_3$;
$2KNO_3 + C = 2KNO_2 + CO_2\uparrow$.

Acid and salt medium can be regarded as a product of incomplete conversion of acids and bases. According to the international nomenclature hydrogen atom, a part of the acid salt, denoted by the prefix hydro- and the OH group prefix hydroxy: $NaHS^-$ sodium hydrosulfide, $Mg (OH) Cl^-$ hydroxychloride magnesium.

Acid addition salts may be prepared either partial neutralization of acids or an excess of acid over medium salts, alkalis, acids or salts thereof: $NaOH + H_2SO_4 = NaHSO_4 + H_2O$;
$CaCO_3 + CO_2 + H_2O = Ca (HCO_3)_2$.

Upon heating, many acidic salts decompose:

$$2NaHCO_3 \overset{t}{=} Na_2CO_3 + CO_2 + H_2O.$$

Basic salts are often obtained by careful addition of small amounts of alkali to secondary solutions of metal salts having low solubility of a base, or by the action of salts of weak acids salts medium:
$AlCl_3 + 2NaOH = Al(OH)_2Cl + 2NaCl$.

Chemical properties of acidic salts in contrast to the properties of the medium due to the presence of salts, not only the metal cations, and hydrogen cations. Therefore, they exhibit not only properties salts and acids.
Hydrogen cations determine the interaction of acid salts:

1) For alkali:

$NaHCO_3 + NaOH = Na_2SO_4 + H_2O$.

2) by salts:

$2NaHSO_4 + MgCO_3 = MgSO_4 + Na_2SO_4 + H_2O + CO_2\uparrow$.

3) metals:

A) located in the electrochemical series of stresses to hydrogen, but the rules in relation to the metal forming the salt:
$2NaHSO_4 + Fe = Na_2SO_4 + FeSO_4 + H_2\uparrow$.

B) arranged in the electrochemical series voltage to hydrogen, but to the left with respect to the metal forming the salt. In this case, enters the reaction as a metal cation or hydrogen cation:

$Fe(HSO_4)_2 + 2Mg = 2MgSO_4 + Fe + H_2\uparrow$.

Formation of acid and normal salts of great importance in explaining the process of hydrolysis.

Quests for fixing

1. To remove impurities from $CuSO_4$ solution of iron sulfate (II) should be added: 1) NaOH 2) H_2S 3) Zn 4) $BaCl_2$.

2. The basic and acidic oxides are formed during the thermal decomposition of the salt:

1) $NaNO_3$ 2) $KClO_3$ 3) NH_4Cl 4) $MgCO_3$

3. acidic salts include:

1) $H_2Cr_2O_7$ 2) K_2CrO_4 3) CsH_2PO_4 4) Sn(OH)Cl

4. Since chlorine is reacted in aqueous solution:

1) Sodium hydrogen 2) Potassium iodide

3) sulfate, lithium 4) Lead (II) nitrate

5. Sodium bicarbonate does not interact with

1) acetic acid 2) with hydrochloric acid

3) NaOH 4) oxide, copper (II)

The structure consists of two water molecules hydrogen atom and one oxygen atom, the polar atoms linked by a covalent bond, bond angle is $104,5^o$. They say that the water molecule is a dipole.

$H\cdot + \cdot O \cdot + \cdot H \rightarrow H \cdot\cdot O \cdot\cdot H$.

Water - colorless volatile liquid, in a thick layer - blue, odorless, density - 1 g / cm^3 (at 40C), mp. = 0^0C, boiling point. = 100^0C. Water is a good solvent.

Chemical properties:

When passing through the electric current acidified water solution is decomposed into simpler substances: oxygen and hydrogen: $2H_2O= 2H_2 + O_2$.

Water reacts with the alkali and alkaline earth metals, under normal conditions, with one water molecule is replaced by a hydrogen atom to the metal atom and alkali and hydrogen are formed. The reaction proceeds with the liberation of large amounts of heat: $2Na + 2H_2O = 2NaOH + H_2$.

In the interaction of basic oxides with water, it forms lye. For example, by reacting calcium oxide (calcium oxide) with water forms calcium hydroxide (slaked lime): $CaO + H_2O = Ca(OH)_2$.

Acidic oxides dissolve in water to form acids, e.g., sulfur oxide (IV), when dissolved in water forms sulfurous acid: $SO_2 + H_2O = H_2SO_3$.

Pollutants in natural waters are toxic wastes, which for many years were buried in the mines and wells, and continue to be buried now, underground storage of oil and products of its processing, pesticides used in agriculture. The main and constant contaminant in natural waters are the waste water that flow out of the cities, with factories, mines, rural farms. They are formed in different ways, but in general, in all of them the same way - into the nearest river or lake or sea.

Organic pollutants from wastewater can cause a chain reaction that destroys the normal water content of oxygen to be toxic to organisms living in water and contribute to the development of less desirable species and the capture of a dominant position. Nitrogen and phosphorus contained in the wastewater cause rapid growth of microscopic aquatic plants, which leads to the phenomenon of "flowering" of water and gradual waterlogging pond. Water pollution control - a set of methods of sewage treatment to such an extent that their dumping into natural waters did not cause any problems. Waste water to be cleaned before being discharged into natural water sources. First they pass through the system poles and nets, and then fall into the sand trap, then into the sump - primary treatment - removal of various sizes of insoluble impurities. Secondary treatment - removal of dissolved impurities - a biological treatment, using the micro-organisms and bacteria that break down organic matter. Tertiary wastewater treatment is carried out to remove it from the nitrogen and phosphorus compounds. Phosphorus compounds are removed by precipitation of salts of iron, aluminum and lime. Nitrogen compounds are removed by means of special strains of microorganisms. The last step in wastewater treatment is chlorination.

Purification of natural waters (for domestic use).

In 1872 it was found that the filtration of water through the sand bed is a good way to clean it and make it relatively safe to drink. Sand filters are also effective for removal of water pathogens (cholera, typhoid, dysentery). At the beginning of the 20th century, the practice was introduced chemical "decontamination" of water by chlorine or its compounds. When using natural water purification aeration (to remove odor), activated charcoal (for decolouration water and improve its taste), aluminum and iron alum (to remove suspended particles in the water), filtered through a sand filter (for removal of the water bacteria and viruses other microorganisms), chlorination (for a complete disinfection of water). alternative to chlorination is the ozonation of water, but in the ozonation does not remain free of traces of ozone and the consumer can not be sure of the complete destruction of bacteria and viruses in the water.

Questions:

1. Make the reactions with water the following substances: lithium, calcium, barium oxide. What are the substances produced by the reaction.

2. When the water decomposition electric current generated hydrogen and oxygen. Can we say that the composition of water consists of two simple substances? Give a reasoned response.

3. In response to the entered water 28 g of calcium oxide. Calculate the mass of the resulting material.

Dissociation of water

Pure water, albeit poorly (in comparison with electrolyte solutions), but it may conduct electrical current. This is due to the ability of the water molecule decay (dissociate) into two ions which are the conductors of electric current in pure water (below the dissociation implied by electrolytic dissociation - decay into ions): $H_2O \leftrightarrow H^+ + OH^-$.

Approximately 556 million of water molecules are not dissociated dissociates only one molecule, but it is 60 billion molecules dissociated in 1mm3. Dissociation is reversible, i.e. the H^+ ions and OH^- can form a molecule of water again. It results in a dynamic equilibrium with an amount equal to the number of broken molecules formed from the H^+ and OH^- ions. In other words, the speed of both processes are equal. In our case, the equation of chemical reaction can be written as follows:

$\upsilon_1 = \kappa_1 \bullet [H_2O]$ (for the dissociation of water);

$\upsilon_2 = \kappa_2 \bullet [H^+] \bullet [HO^-]$ (reverse process).

where υ - the reaction rate; κ - reaction rate constant (depending on the nature of the reactants and temperature); $[H_2O]$, $[H^+]$ and $[HO^-]$ - concentration (mol/l).

In equilibrium $\upsilon_1 = \upsilon_2$, therefore:

$\kappa_1 \bullet [H_2O] = \kappa_2 \bullet [H^+] \bullet [HO^-]$

Draw some simple math and obtain

$\kappa_1 / \kappa_2 = [H^+] \bullet [HO^-] / [H_2O]$;

$\kappa_1 / \kappa_2 = K$.

K - equilibrium constant, and in this case the dissociation constant, which depends on the temperature and nature of the materials and does not depend on the concentrations (as κ_1 and κ_2). K_{water} $1{,}8 \bullet 10^{-16}$ at 25 °C (reference value).

Due to the very small number of dissociated molecules concentration $[H_2O]$ may be taken as the total concentration of water, and the total concentration of water in dilute solutions as a constant value:

$[H_2O] = 1000$ (g /l) / 18 (g/mol) = 55.6 mol / l.

Replacing κ_1 / κ_2 on K and using the value of $[H_2O]$, we determine what is the product of the concentrations of $[H^+]$ and $[HO^-]$, which is called - ionic product of water:

$K = [H^+] \bullet [HO^-] / 55{,}6$ mol / l

$1{,}8 \bullet 10^{-16} \bullet 55{,}6$ mol / l $= [H^+] \bullet [HO^-]$

$10^{-14} = [H^+] \bullet [HO^-]$.

Since, at a predetermined temperature value used in calculating the ionic product of water (K, $[H_2O]$) constant, the value of the ion product of water $[H\ ] \bullet [HO^-]$ same time. Since the dissociation of water molecules formed the same number of ions $[H^+]$ and $[HO^-]$, which is obtained for pure water concentration $[H^+]$

and $[HO^-]$ will be equal to 10^{-7} mol / l. From the constancy of the ion product of water it follows that if the number of H^+ ions becomes larger, the number of ions gets smaller HO^-. For example, if the clean water to add the strong acid is HCl, it is a strong electrolyte entire prodissotsiiruet to H^+ and Cl^-, as a result of the concentration of H^+ ions will increase dramatically and this will increase the speed of the process opposite dissociation since it depends on the concentrations of H^+ ions and OH^-.

$\upsilon_2 = \kappa_2 \bullet [H^+] \bullet [HO^-]$

During accelerate the process of the opposite dissociation, ion concentration HO- reduced to a value corresponding to the new equilibrium, in which they will be so small that the rate of dissociation of water and reverse the process will again be equal. If the concentration of the resulting solution is HCl 0,1mol / liter, the equilibrium concentration [HO-] is equal to:

$[HO^-] = 10^{-14} / 0,1 = 10^{-13}$ mol / l

By adding the strong base is NaOH shift downwards concentration H^+.

pH of water

For convenience, the concentration of $[H^+]$ and $[HO^-]$ is expressed as the pH and hydroxyl index pOH. pH and pOH - is negative decimal logarithm of the concentration $[H^+]$ and $[HO^-]$ (not correct to use the concentration and activity), respectively:

$pH = -lg [H^+]$

$pOH = -lg [OH^-]$

Logarithm of equation $[H^+] \bullet [HO^-] = 10^{-14}$ obtain

$lg [H^+] + lg [OH^-] = -14.$

$-lg [H^+] - lg [OH^-] = 14.$

$pH + pOH = 14.$

The resulting sum and pH pOH, as well as the product that is logarithmic, is constant and is equal to 14 because if pH = 3 then pOH = 11 (pH pOH and may be negative, and if the pH = -1 then pOH = 15).

Depending on the pH of the solution is divided into neutral, acidic and alkaline. At pH = 7 neutral solution at pH <7 - acid, at pH> 7 - alkaline.

The pH of the solution is highly dependent on the course of many chemical reactions, both at the level of processes taking place in the laboratory and in the workplace, and at the level of the reactions in living organisms, so chemists and biologists with the pH value has to deal with very often. All the inhabitants of natural waters and soils adapted to a specific pH, and in case of changes may be lost. Most living organisms can exist only in environments close to neutral. This is partly due to the fact that under the action of H^+ ions and OH^- many proteins containing acidic or basic groups, change their shape and charge. A strongly acidic and strongly alkaline environments breaks a peptide bond that connects the individual amino acid residues long protein chains. Because of this ultrabasic (strongly alkaline) alkali solution causes skin burns and destroy wool and silk, consisting of the protein. All living organisms have to maintain a certain liquids in the intracellular pH value. The magnitude of the pH value of the soil solution depends on the yield of different crops. On acid soils with pH = 5-5,5 not develop barley, but well developed potatoes.

Questions:

1. Calculate the pH of 0.01 N. acetic acid solution, wherein the acid dissociation degree is 0.042.

2. Determine the pH of the solution to 1 liter of which contains 0.1 g of NaOH. Dissociation is reason to believe the full.

3. How many times the hydrogen ion concentration in the blood (pH = 7.36) than in the cerebrospinal fluid (pH = 7.53)?

4. What is the concentration of the solution of acetic acid, the pH of which is equal to 5.2?

5. The degree of dissociation of weak monobasic acid in 0.2N. the solution is 0.03. Calculate the value of $[H^+]$, $[OH^-]$ and Ron for this solution.

6. Calculate the pH of the solution obtained by mixing 25 ml 0.5 M HCl solution, 10 ml of 0.5M NaOH solution and 15 ml of water. Ion activity coefficients assumed to be 1.

7. Calculate the pH of a 0.2 M solution of formic acid to 1 liter is added to 3.4g HCOONa if α(HCOONa)=93%.

8. How the pH value of a solution of acetic acid characterized in that its mass fraction of 0.6% (p = solution density of 1 g/ml)? How much water must be added to this solution, 1 liter, the pH value was equal to 3?

9. Calculate the pH of the solution of nitric acid with a concentration ω = 0,5%. The density of the solution and the degree of dissociation of HNO_3 assumed to be equal to unity.

10. How to change the pH of the water when it is heated from 25 to 60C? At $T = 60^{o}C$ K_w=$9{,}61 \cdot 10^{-14}$.

Hydrolysis. Hydrolysis - the exchange reaction between the solute (eg, salt) with water. Hydrolysis occurs in cases where the ions are capable of forming salts with the H^+ and OH^- ions, water little- dissociated electrolytes.

Salts formed with a strong base and a weak acid, e.g., CH_3COONa, Na_2CO_3, Na_2S, KCN hydrolysed by anion:

$CH_3COONa + CH_3COOH + NaOH\ HOH$ (pH> 7).

Hydrolysis of salts of polybasic acids takes place in steps. Stage 1:

$$CO_3^{2-} + HOH \leftrightarrow HCO_3^{-} + OH^{-}$$

or molecular form:

$$Na_2CO_3 + HOH \leftrightarrow NaHCO_3 + NaOH.$$

Stage 2:

$$HCO_3^{-} + HOH \leftrightarrow H_2CO_3 + OH^{-}$$

or molecular form:

$NaHCO_3 + HOH \leftrightarrow H_2CO_3 + NaOH.$

The hydrolysis products in the first stage the second stage of suppressing the hydrolysis in a second step the hydrolysis proceeds slightly.

Constant and the degree of hydrolysis

Constant K_r, and a degree of hydrolysis of g for solutions II-valent electrolytes linked equation identical in form with the equation Ostwald:

$$K_{\text{т}} = \frac{\alpha_{\text{т}}^{2} c}{1 - \alpha_{\text{т}}}.$$

Hydrolysis constant K_r can be calculated based on the values of the ion product of water and the dissociation constant K_W K_d resulting from the hydrolysis of a weak acid or weak base:

$$K_r = \frac{K_w}{K_d}.$$

1. Hydrolysis increase as Na_2SO_3 salt added to the solution substances: a) H_2O b) Na_2CO_3 a) NaOH d) H_2SO_4 g) Na_2S e) Na_2SO_4

2. Write the reaction of $NiCl_2 + Na_2CO_3 + H_2O$.
3. Write the reaction of $Fe_2(SO_4)_3 + Na_2CO_3 + H_2O$.
4. Write the reaction $KCr(SO_4)_2 + K_2S + 6H_2O$.
5. Write the hydrolysis reaction $BiCl_3$.
6. Write the hydrolysis reaction $Al_2(SO_4)_3$.
7. Write the hydrolysis reaction SO_2Cl_2.
8. Determine the pH of a 0.01 M solution of Na_2HPO_4 K at 298, if the dissociation constant of phosphoric acid at the same temperature are, respectively:

$K_1 = 7{,}11 \times 10^{-3}$; $K_2 = 6{,}34 \times 10^{-8}$; $K_3 = 4{,}4 \times 10^{-13}$.

9. At 298 K pH 0.049 M solution of KCN is 11. To determine the dissociation constant of hydrocyanic acid at the same temperature.
10. Calculate constant hydrolysis degree of hydrolysis of 0.18 M NH_4NO_3 solution 0.18 M if the pH of the ammonium nitrate solution is 5.

5. The main sections of "organic chemistry". Theoretical foundations of organic chemistry. The theory of the structure of organic compounds. The structure of carbon atoms. The theory of hybridization. Electronic effects in organic molecules. ososbenno and slassifikatsiya organic soedmneny. Hydrocarbons. Alkanes, Alkenes, Alkadienes, Alkynes, Aromatic uglevodrody benzene series. Isomers. Nomenclature. Functional derivatives of hydrocarbons. Halogenated derivatives, amines, nitro compounds, sulphonated derivatives, alcohols, phenols, aldehydes, ketones, carboxylic acids, proteins, carbohydrates.

Organic chemistry - studies the connections that are based on the carbon atoms are connected to each other, and many elements of the periodic system of simple and multiple bonds capable of forming linear and branched chains, loops, etc. polycycles.

1.1. Historical Background

For the first time the concept of of organic matter and organic chemistry introduced on the Swedish scientist Berzelius. In his textbook of chemistry Berzelius (1827) expressed the belief that "... in the wild elements obey different laws than in a lifeless" and that organic matter can not be formed under the influence of conventional physical and chemical forces, but require for their special education "vitality. "Organic chemistry and it is determined as the chemistry of plant and animal substances. The subsequent development of organic chemistry proved the fallacy of these views.

1928 Vëller showed that the inorganic substance-ammonium cyanide when heated turns into a waste product of animal body-urea.

1845 Kolbe synthesized organic substance acetic acid in as the starting material substances he used charcoal, sulfur, chlorine and water. Over a relatively short period, were synthesized, and other organic acids which previously were limited from plants.

1854 Berthelo was able to synthesize substances belonging to the class of alcohols.

Development of organic chemistry demanded resolution of the question of whether the molecule disorderly heap of atoms held together by attractive forces, or whether they are particles with a certain structure, which can be established by examining the properties of matter. In organic chemistry, by the time the accumulated facts and generalizations that could serve the basis for establishing the structure of molecules.

Played a decisive role discovery valence elements. Her opening directly leads to the idea that the molecules have a certain structure. how to determine the structure of the molecule. This issue could not be resolved without a truly scientific theory of organic chemistry, which was created in 1861 A.M.Butlerov. He wrote: "Based on the idea that each chemical atom, which is part of the body involved in the formation of the latter and is valid here a certain amount of inherent chemical force, I call the chemical structure of the distribution activities of the forces that caused the chemical atoms, indirectly affecting each other, are connected to the chemical species. "

Main provisions of the theory of the structure of Butlerov.

1. In the molecule of the compound there is a certain order of the atoms, which carries the name of the structure.

2. Chemical properties are determined by the composition and structure of its molecules.

3. Various structure with the same composition and molecular weight of the substance causes the phenomenon of isomerism. Isomers - a substance having the same composition but different structure and different properties respectively.

4. Since the change in chemical reactions, not all but only some of the molecules is studied compound products of chemical reactions, can set its structure

5. Reactivity of atoms in a molecule. vary depending on the atoms with which they are associated in the molecule. This is due to the mutual influence of atoms on each other.

The structure of carbon atoms

Obviously, all the reactions that take organic molecules associated with the structure of the carbon atom of the molecule and the specific restructuring its outer valence orbitals in the process of transformation.

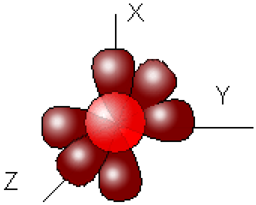
In the ground state carbon atom has two electrons in the s-orbital of the second sub-layer (2s-orbitals), and 2 electrons on two (out of 3) p-orbitals of the two sublevels (2px- and 2py-orbitals):

2s	$2p_x$	$2p_y$	$2p_z$
↑↓	↑	↑	

As a result, energy from outside the carbon atom in an excited state, when one of the 2s-electron moves to a higher energy of the 2p orbital of:

2s	$2p_x$	$2p_y$	$2p_z$
↑	↑	↑	↑

Thus, the external orbitals on carbon has 4 electrons capable of forming bonds. According to the theory, the form of the s- and p-orbitals describe the probability of finding the electron relative to the nucleus of the atom. Unhybridised s- and p-orbitals are spherical and uniform "dumbbell" and placed in the space according to the following scheme:



The phenomenon of hybridization

Consider the formation of a chemical bond in a molecule of methane CH_4 (Fig. 1).

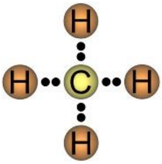


Fig. 1. The formation of a chemical bond in a molecule of methane CH_4

A link between atoms of hydrogen and carbon - polar covalent.

E formula carbons: $1s^2$ $2s^2$ p^2. On the outer energy level of the atom has 2 pairs of electrons (Fig. 2).

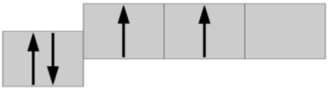


Figure 2. Graphic formula external electronic energy levels of atoms of carbon

For the formation of the carbon atom of the methane molecule in an excited state: C * $1s^2$ $2s^1$ $2p^1$ $2p^1$ $2p^1$ (Fig. 3).

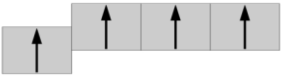


Fig. 3. Graphical formula external electronic energy level of carbon atoms in the excited state

Since the hydrogen atoms attached involved electron 1 s-p-3 and the outer electron energy level of the carbon atom (Fig. 4), it follows that chemical bonds must be unequal length and strength. However, experience shows that the molecules containing central atoms with different valence orbitals, all links are equal. This explains the phenomenon of hybridization.

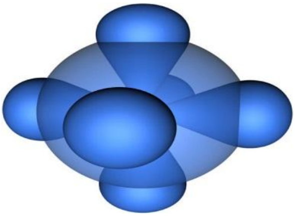


Fig. 4. Model orbitals external energy level of an atom of carbon

Hybridization of atomic orbitals - changing the shape and energy of the orbitals of the atom in the formation of a covalent bond to achieve better overlap of orbitals.

Different orbital energies are not very different form the corresponding number of hybrid orbitals. Hybrid orbitals number equal to the number of atomic orbitals involved in the hybridization. Hybrid orbitals same shape of the electron cloud and for energy. In comparison with the atomic orbitals are more elongated in the direction of the formation of chemical bonds and, therefore, cause the best overlap of the electron clouds.

Fig. 5 shows a hybrid orbitals by combining s- and p-orbitals. Hybrid orbitals more extended on one side of the core than on the other.

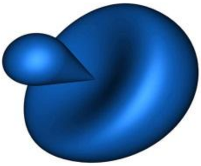


Fig. 5. The form of hybrid orbitals due to a combination of one of the s- and p-one atomic orbitals

In the formation of methane molecule 1 s-electron and electron p-3 carbon atoms form four identical hybrid orbitals.

This type is called hybridization sp^3-hybridization. In addition to the energy levels of s and p, the hybridization process may also be part of d- and f-levels. Fig. 6 shows the possible forms of hybrid orbitals formed by hybridization s-, p-, and d-atomic orbitals. The shape of the orbitals depends on the magnetic quantum number characterizing the orbital.

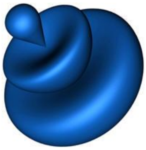


Fig. 6. Possible forms of hybrid orbitals by a combination of s-, p-, and d-atomic orbitals

In hybridization can involve not only the s- and p-orbitals and s-, p- and d orbitals, but, for example, s- and d-orbitals without p-orbitals or only p- and d-orbitals. The theory of hybridization with f-orbitals yet hardly developed.

It should be noted that the concept of hybridization is theoretical. The concept was introduced scientist Linus Pauling in the 20-ies of XX century.

Model hybridization MO based on the theory of symmetry, with which of the original canonical MO. MO building, which are localized on the links molecule. Such localization of Defense called hybrid molecular orbitals. In the case of a water molecule is s-MO and MO describing the lone pairs.

Nature of hybridization of atomic orbitals of each atom depends on the number of nearest neighboring atoms (coordination number) and the presence or absence of his lone electron pairs. At the coordination number of three and above have to build hybrid orbitals with the inclusion of d-type. Other cases are shown in Table hybridization.

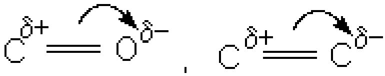
Structural effects in organic molecules and intermediates (inductive / mesomeric effect) - Chemical behavior of organic molecules and intermediates is determined by the structural environment of the reaction center. Structural effects of substituents on the chemical reaction based on the volume and nature of their deputies electronic interaction with the reaction center. Recent divided into inductive effect, coupling effect and the effect of hyperconjugation.

Polarity of chemical bonds in organic molecules. Inductive effect.

If the chemical bond is formed between two different atoms, the electrons bind them shifted toward more electronegative atom. As a result, the centers of gravity of the positive and negative charges are displaced and the connection becomes polar. This phenomenon is depicted by means of partial charges for example, -$H^{\square +}$; $Cl^{\square -} – C^{\square +}$.

Displacement of electrons can also be represented by the arrows on the link, $C^{\square +}$ □ $Cl^{\square -}$.

Electronic offset is also carried out in the double and triple bonds, but in this case there is a large polarization, since the electrons of these bonds are more mobile (polarizability). To denote the displacement of electrons in multiple bonds used a curved arrow.



The electronic polarization due to displacement of the displacement causes the links to the neighboring, but this effect is attenuated along the length of the chain. The experimentally observed effect transmission electron displacement and polarization on the other, neighboring communication is called inductive effect and is denoted by I. If the deputy pulls electrons in its side, its effect is called negative inductive effect and is denoted -I. If the Vice pushes away the electrons in the neighboring bonds or atoms, this effect is called positive inductive effect and is denoted by + I.

Polarity is important in chemical reactions. If the attacking cations particles protrude, they have an affinity for the negative charge (electrophilicity) and preferably attacking places in the molecule with a higher electron density. As a consequence, the substituents with + I effect accelerate such reactions, and with -I effect of slowing down. If the attacking agent is negatively charged particle or particle having a lone pair of electrons, these particles have an affinity for the positive charge (nucleophilicity) and preferably attack places with low electron density. Therefore substituents with + I effect of such slow reaction, and with -I effect -

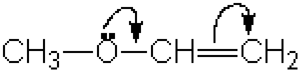
accelerate them. Inductive effect decays rapidly along the length of the chain.

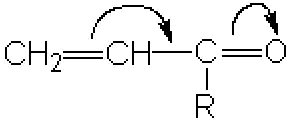
The polarity of the molecules - the result of the vector addition of the dipole moments of chemical bonds within the molecule. The polarity of the environment due to the polarity of the solvent molecules is an important factor in the rate of chemical reactions.

Coupling effect (mesomeric effect)

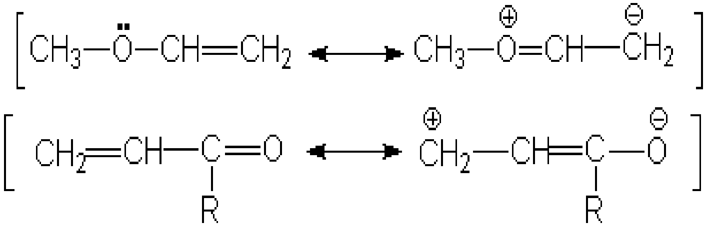
Coupling effect is manifested in cases where the deputy has p - bonds filled, vacant or poluvakantnye p orbitals and are at the carbon atom in the state sp^2- or sp- hybridization.

With such a combination structure deputy and the rest of the molecule occurs overlapping p orbitals and p orbitals p deputy with multiple bonds rest of the molecule. As a result, the deputy is related to the rest of the molecule in addition to the usual s -bonds further by a small p-electron cloud. This effect is called the effect of conjugation and is represented by the curved arrow:





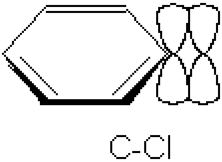
or by resonance structures:



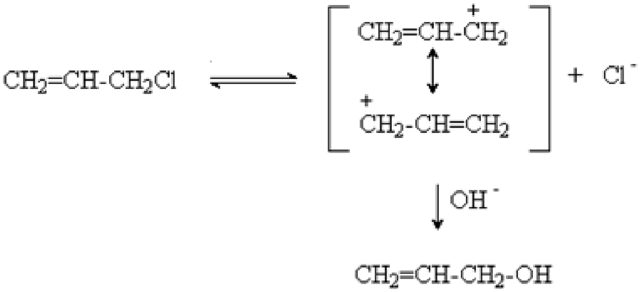
If the Vice-by pairing loses electrons, then this effect is called positive mezomernymeffektom denoted + M.

If the Vice-by pairing pulls the electrons themselves, then this effect is called negative mesomeric effect and is denoted by-M.

Coupling effect is an important factor in chemical reactions. For example, if a chlorine atom located at the aromatic nucleus, it is further linked to the aromatic nucleus by overlapping its p orbital with the p-electrons of the aromatic ring.



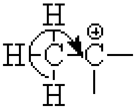
Due to this additional binding C-Cl bond is strengthened and its hard to break. This makes chlorine sedentary. For example, it is very difficult to hydrolyse compared with chlorobenzene chloroalkane. On the contrary, allyl chloride reacts much faster chloroalkane, which is associated with stabilization resulting in a rate-determining step carbocation.



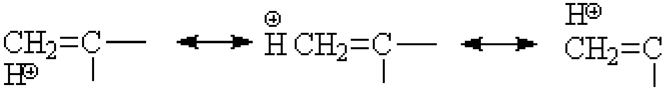
It can be seen that the stabilization of the allyl carbocation due to conjugation vacant p-orbital of the carbon atom with the p orbitals of the double bond.

Hyperconjugation.

Under hyperconjugation understand the effect of p -s conjugation, which is in the interaction of electrons s bond with a blank or partially filled p-orbital. Most of all, this effect is manifested in the case of CH bonds in the reaction center adjacent to the carbon atom. In case this effect carbocation depicted as follows:



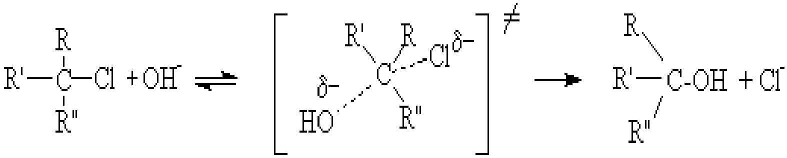
or



This interaction leads to a considerable delocalization of the positive charge, making it a more stable carbocation. If carbocation - the reaction product, the effect hyperconjugation accelerates the reaction, if the reagent - the reaction slows down.

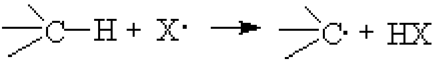
Steric (volume) effects.

Steric effects associated with the influence of the volume of the substituents on the success of chemical reactions. In this regard, 1-3 distinguished effect, leading to inhibition of the reaction. This effect occurs when bulky substituents hinder the attacker's agent approach to this center. For example, the bimolecular reaction volume hydrolysis alkyl substituents block approach hydroxyl anions to the central carbon atom.

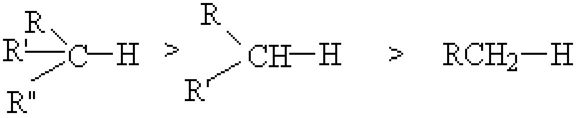


Steric acceleration associated with the removal of the stress between the valence angles, which occurs due to the repulsion of the bulky substituents in the molecule.

Generally steric acceleration occur when implementing hydrogen separation reactions.



According to the modern interpretation of a number of reactivity of the C-H bonds in alkanes Radical substitution associated with lower degree of removal of steric strain in this series.



Hydrocarbons

Hydrocarbons - the simplest organic compounds consisting of carbon and hydrogen. Depending on the nature and ratios of carbon bonds between carbon atoms and hydrogen are divided into limit (saturated) and unsaturated (unsaturated) having one or more multiple bonds. Depending on the structure of the carbon chain hydrocarbons are compounds with an open (not closed) carbon chain and closed, i.e. cyclic compounds. Among cyclic hydrocarbons special group of aromatic hydrocarbons, has a number of specific properties.

Alkanes (paraffin)

By saturated hydrocarbons - alkanes (paraffins) are open-chain compound, wherein carbon atoms are interconnected by simple (single) bonds, and the remaining free valences are saturated with their atoms of hydrogen. Under normal circumstances, few reactive alkanes, where their name came "waxes" - from the Latin. parrum affinis - inactive.

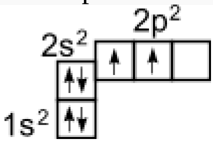
The members of the homologous series of saturated hydrocarbons of the general formula $C_nH_{2n + 2}$. The simplest representative of saturated hydrocarbons is methane, which is the structural formula.

H
I
H–C–H

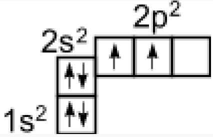
I
H

The structure of the methane molecule

The above structural formula of methane does not reflect the spatial structure of the molecule. For its consideration of the structure necessary to recall the shape of the electron cloud and the electronic structure of carbon atoms. Electronic structure of carbon atoms depicted as follows: $1s^2$ $2s^2$ $2p^2$ or schematic:



As can be seen, the outer shell has two unpaired electron of carbon should be therefore divalent. However, in most cases, the carbon in organic compounds is tetravalent. This is due to the fact that the formation of a covalent bond the carbon atom in an excited state in which the electron pair on 2s – uncoupling orbital and one electron occupies the vacant p-orbital. schematically:



As a result, there is not two but four unpaired electrons. Since these four different electron (2s - 2p - and electrons), they must be different and the carbon atom connection, however clearly show that bond in methane equivalent. Turns out to be "mixed" four orbitals excited carbon atoms (one and three 2s- 2p- orbitals) form four equivalent sp^3- hybrid orbitals. They have a dumbbell shape, one half of which is much greater than the other. Due to mutual repulsion sp^3- hybrid orbitals are directed in the space to the heights of the tetrahedron and the angles between them are 109 ° 28 '(the most advantageous location).

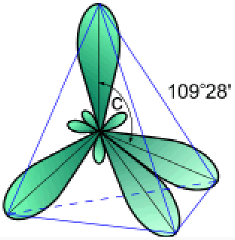


Figure 1. Model sp^3- hybrid state of the electron shell of an atom of carbon.

Hybridization sp^3- characteristic of carbon atoms in saturated hydrocarbons (alkanes) - in particular in methane.

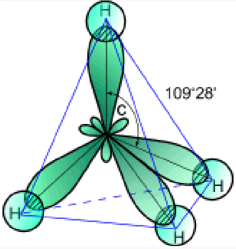


Figure 2. Scheme of the electronic structure of a molecule of methane

Figure 2 shows that each sp^3- hybrid orbitals overlap with at s-orbital of the hydrogen atoms forms with them four, so-called, s-connection. s- Communication - is a single covalent bond is formed with overlapping orbitals in a straight line joining the nuclei of atoms, with a maximum overlap on this line. The carbon atom in the molecule of methane is located in the center of the tetrahedron, the hydrogen atoms - at its vertices, all the bond angles between the directions of the bonds are equal to each other and form an angle of 109°28 '. It should be noted that in the molecule ethane (CH_3-CH_3) one of seven s- bonds (C-C) formed by two overlapping sp^3- hybrid orbitals of carbon atoms.

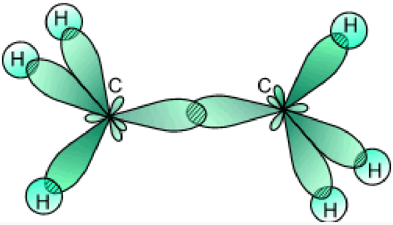
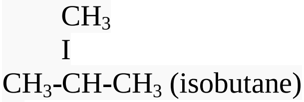


Fig. 3. Education ethane molecule overlap two hybrid electron clouds of carbon atoms.

Isomerism

The first three members of the homologous series of alkanes - methane, ethane, propane - do not have isomers. The fourth member - Butane C_4H_{10} characterized in that it has two isomers: normal butane, straight-chain and branched-chain isobutane.

CH_3-CH_2-CH_2-CH_3 (normal butane)



$$\begin{array}{l} \quad CH_3 \\ \quad\ | \\ CH_3\text{-}CH\text{-}CH_3 \end{array}$$ (isobutane)

Type of isomerism in which substances differ from each other order of the atoms in the molecule, called structural isomers or isomer of the carbon skeleton.

Number isomers increases with the number per molecule of hydrocarbon carbon atoms. Thus, their pentane 3 in hexane - 5 in heptane - 9 of octane - 18, nonane - 35 and dean $C_{10}H_{22}$ - 75 already.

Receiving

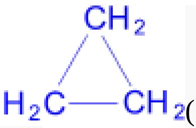
1) Saturated hydrocarbons from C_1 to C_{11} is isolated by fractional distillation of crude oil, natural gas or mixtures of hydrocarbons obtained by hydrogenation of coal. Coal hydrogenation reaction pressure hydrogenation monoxide or carbon dioxide in the presence of catalysts (iron, cobalt, nickel), at elevated temperature is important for an independent value saturates.

$$n\,C + (n+1)\,H_2 \xrightarrow{400^{\circ}C,p} C_nH_{2n+2}$$

$$n\,CO + (2n+1)\,H_2 \xrightarrow{200\square C,Ni} \square\; C_nH_{2n+2} + n\,H_2O$$

2) prepared by hydrogenation of unsaturated alkanes or cyclic hydrocarbons in the presence of catalysts (platinum, palladium, nickel).

$$R–CH=CH–R' + H_2 \xrightarrow{kat} \square\; R–CH_2–CH_2–R'$$


(cyclopropane)+$H_2 \overset{Pd}{\rightarrow} CH_3–CH_2–CH_3$ (propane)

3) Preparation of alkanes Wurtz reaction can be carried out, consisting in the action of sodium metal on monogalogenoproizvodnye hydrocarbons.

$2CH_3$-CH_2Br (ethyl bromide)+2Na → $CH_3–CH_2–CH_2–CH_3$ (butane) + 2NaBr

4) In laboratory practice saturates decarboxylation of carboxylic acids obtained by alloying them with alkali.

$R\text{-}COONa+NaOH=Na_2CO_3+R\text{-}H$

5) Methane can also be prepared by hydrolysis of aluminum carbide: $Al_4C_3 + 12H_2O \rightarrow 3CH_4 + 4Al(OH)_3$.

Physical properties

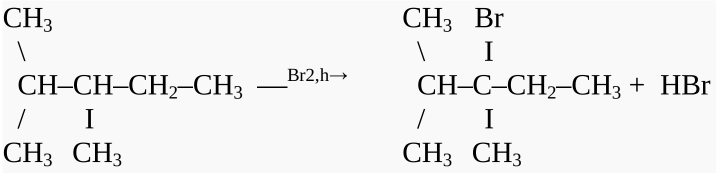
Under normal conditions, the first four members of the homologous series of alkanes - gases, C_5-C_{17} - liquid and from C_{18} - solids. Melting points and boiling alkanes density increases with increasing molecular weight. All alkanes lighter than water, it is not soluble, but soluble in nonpolar solvents (e.g., benzene) are themselves good solvents.

Chemical properties

Saturated hydrocarbons under normal conditions do not interact with either strong acids or with bases, or even with an active reagent such as potassium permanganate. For them, the characteristic of the substitution reaction of hydrogen atoms and splitting. These reactions due to the strength of bonds C-C and C-H or flow under heat, or light, or by using catalysts.

Consider some examples of this type of reaction.

1) Halogenation.



$$\begin{matrix}CH_3 & & & \\ \backslash & & & \\ CH & {-}CH & {-}CH_2 & {-}CH_3 \\ / & I & & \\ CH_3 & CH_3 & & \end{matrix} \xrightarrow{Br2,h} \begin{matrix}CH_3 & Br & & \\ \backslash & I & & \\ CH & {-}C & {-}CH_2 & {-}CH_3 \\ / & I & & \\ CH_3 & CH_3 & & \end{matrix} + HBr$$

2) Nitration.

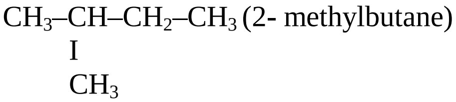
$$RH + HNO_3 \rightarrow RNO_2 + H_2O$$

3) with formation of saturated and unsaturated hydrocarbons with shorter chains.

$CH_3–CH_2–CH_2–CH_3$(butane) $\xrightarrow{400C}$ $CH_3–CH_3$(Ethane) + $CH_2=CH_2$(ethylene)

4) The isomerization. Under the influence of catalysts by heating the hydrocarbons undergo isomerization of normal structure - a carbon skeleton rearrangement to form alkanes branched structure.

$CH_3–CH_2–CH_2–CH_2–CH_3$ (pentane) $\xrightarrow{t,AlCl_3}$



$$\underset{\underset{CH_3}{I}}{CH_3{-}CH}{-}CH_2{-}CH_3 \text{ (2- methylbutane)}$$

5) Oxidation. Under normal conditions, alkanes are resistant to the action of oxygen and oxidizing agents. When ignited in air alkanes burn, turning into carbon dioxide and water, releasing large amounts of heat.

$$CH_4 + 2O_2 \xrightarrow{flame} CO_2 + 2H_2O$$

$$C_5H_{12} + 8O_2 \xrightarrow{flame} 5CO_2 + 6H_2O$$

Alkanes - a valuable high-energy fuel. Combustion alkanes gives heat, light, and drives the many machines.

Application - The first in a series of alkanes - methane - is the main component of natural and associated gas and is widely used as an industrial and domestic gas. Processed in the industry acetylene, carbon black, fluoro and chlorine derivatives.

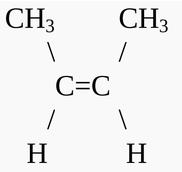
The lower members of the homologous series are used to obtain the corresponding unsaturated compounds dehydrogenation reaction. A mixture of propane and butane is used as a household fuel. The average member of the homologous series are used as solvents and motor fuels. Higher alkanes are used for the production of higher fatty acids, synthetic fats, lubricants.

Alkenes - Alkenes or olefins, or ethylenically unsaturated hydrocarbons called hydrocarbon molecule containing one double bond and having the general formula C_nH_{2n}.

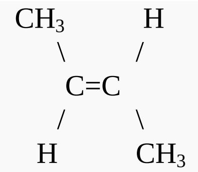
Isomerism - In addition to the isomerism associated with the structure of the carbon chain, is observed in a series of positional isomers of olefins double bond. Furthermore, there is a physical olefins (geometric) or cis-trans-isomerism.

Cis-trans isomerism among alkenes

"Along with the isomer related to the structure of the carbon skeleton and the position of the double bond, among alkenes occurs geometric or cis-trans-isomerism. Its existence is due to the lack of free rotation of the atoms bonded by a double bond.



Cis- isomerism



Trans isomerism

The methyl groups in these examples may be located on one side of the double bond (such cis-isomer is called isomer) and on the opposite side (this is called isomer trans isomer). Names mentioned isomers derived from the Latin cis - on this side and trans- through on the other side. Conversion of one isomer into the other is not possible without breaking the double bond. "

Receiving

1) The main industrial source of the first four terms of the series of alkenes (ethylene, propylene, butylene and pentylenes) are gases cracking and pyrolysis oil, gas and coking coal (ethylene, propylene). Cracking of the pyrolysis gases and petroleum products contain from 15 to 30% olefins. Thus, cracking butane at 600 °C leads to a mixture of hydrogen, methane, ethane and olefins - ethylene, propylene, butene-2 with a ratio of olefins ≈ 3,5: 5: 1.5, respectively.

2) All the more significant amounts of dehydrogenation of alkanes alkenes produced at elevated temperature with a catalyst.

$$CH_3–CH_2–CH_2–CH_3 \xrightarrow{300C, Cr_2O_3} \begin{cases} \rightarrow CH_2=CH–CH_2–CH_3 \text{(butene-1)} + H_2 \\ \rightarrow CH_3–CH=CH–CH_3 \text{(butene-2)} + H_2 \end{cases}$$

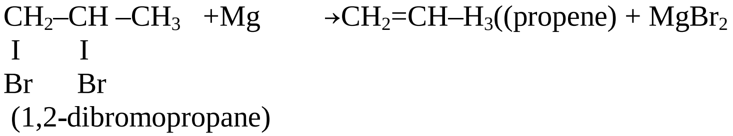
3) In practice, the most common laboratory method for producing an alkene dehydration (elimination of water) of alcohols with heating under dehydrating agent (concentrated sulfuric acid or phosphoric acid) or alcohol vapor is passed over the catalyst (alumina).

$CH_3–CH_2–OH$ (ethanol) $\xrightarrow{t, Al2O3}$ $CH_2=CH_2 + H_2O$

4) Procedure for the dehydration of secondary and tertiary alcohols A.M. Zaitsev determined rule: the formation of a hydrogen atom splits off water from the least hydrogenated adjacent carbon atoms, i.e. with the smallest number of hydrogen atoms.

CH_3 –	CH–C I I OH H	$H–CH_3$(butanol -2) → $CH_3–CH=CH–CH_3$(butene -2) + H_2O

5) dehalogenation reaction (cleavage of the two halogen atoms from adjacent carbon atoms) by heating with active metal dihalides also leads to alkenes.



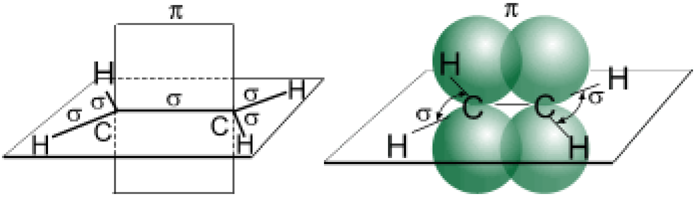
$$\underset{\substack{\text{I}\\ Br}}{CH_2}\text{–}\underset{\substack{\text{I}\\ Br}}{CH}\text{ –}CH_3\ \ +Mg \rightarrow CH_2{=}CH\text{–}H_3(\text{(propene)} + MgBr_2$$

(1,2-dibromopropane)

Physical properties similar to ethylene hydrocarbon alkanes. Under normal conditions, the hydrocarbons C_2-C_4 - gases, C_5-C_{17} - liquid highest representatives - solids. Their melting points and boiling points and density increase with increasing molecular weight. All olefins are lighter than water, poorly soluble therein but soluble in organic solvents.

Chemical properties

Carbon atoms in the molecule are ethylene sp^2- hybridization condition, i.e. one involved in the hybridization of s- and p orbitals of the two.



Schematic representation of the molecular structure of ethylene

As a result, each carbon atom has three sp^2 hybrid orbitals whose axes are in one plane at an angle of 120º to each other, and one non-hybrid orbital of the p-dumbbell, the axis of which is at right angles to the plane of the axes of the three sp^2 orbitals. One of the three hybrid orbitals of carbon atoms such orbital overlap with another carbon atom, forming s- contact. Each remaining hybrid orbitals of carbon atoms s- orbital overlap with the hydrogen atoms, resulting in the same plane in four bonds s- C-H. Two non-hybrid orbitals p- carbon atoms overlap and form a p- connection, the maximum density which is perpendicular to the plane of the s- ties. Consequently, the double bond of alkenes is a combination of s- and p- ties.

Communication p- less durable than s- bond as p- orbitals are overlapped with parallel axes is considerably smaller than during the formation of the same p- and s- orbitals of the s- orbitals of the connection (the overlap of orbitals is carried out along the axis). In this regard, p- linkage easily torn and becomes two new s- connection by joining at the double bond of two atoms or groups of the reactants. In other words, for the most typical alkenes are addition reaction. In addition reactions double bond acts as an electron donor, so characteristic of alkenes Electrophilic addition.

1) Halogenation. Alkenes under normal conditions halogens attached, resulting digalogenoproizvodnym alkanes containing halogen atoms on adjacent carbon atoms.

$H_2C=CH_2 + Br_2 \rightarrow BrCH_2–CH_2Br$ (1,2-dibromoethane).

The above reaction - desaturation alkene bromine water quality is a reaction to the double bond.

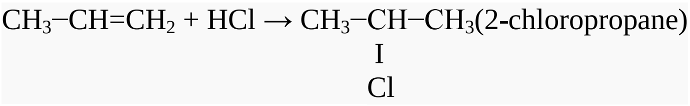
2) hydrogenation. Alkenes easily attached hydrogen in the presence of catalysts (Pt, Pd, Ni), forming saturates.

$CH_3–CH=CH_2 + H_2 \xrightarrow{N} CH_3–CH_2–CH_3$ (propane).

3) Gidrogalogenirovanie. Ethylene and its homologs attached halides, leading to halogenated hydrocarbons.

$H_2C=CH_2 + HBr \rightarrow CH_3–CH_2Br$ (ethyl bromide).

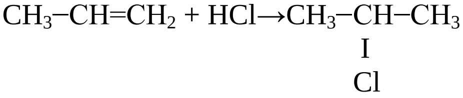
Accession halides to alkenes propylene and another takes place in accordance with Rule V.V.Markovnikova (hydrogen attached to most hydrogenated carbon atom at the double bond).



$$CH_3-CH=CH_2 + HCl \rightarrow CH_3-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_3 \text{(2-chloropropane)}$$

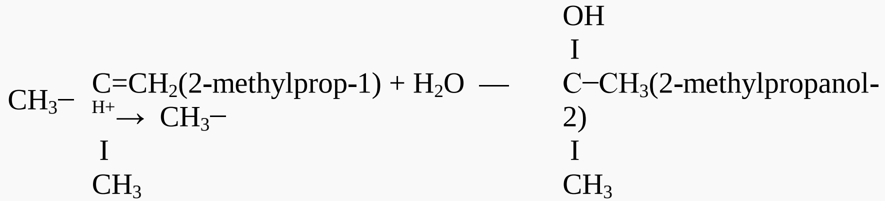
For a more complete study of the material on the accession of hydrogen halides to alkenes (reaction gidrogalogenirovaniya) you want to see the animated film "electrophilic addition to alkenes" (available only on CD-ROM). Please note that the text that accompanies this film in its entirety moved to this subsection and the following is.

The addition reaction of hydrogen chloride to the alkenes are nonsymmetric for Markovnikov rule, namely: a hydrogen atom attached to most hydrogenated carbon atom at the double bond, i.e. a carbon atom with the largest number of hydrogen atoms.



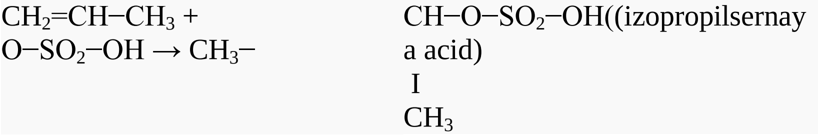
$$CH_3-CH=CH_2 + HCl \rightarrow CH_3-\underset{\underset{Cl}{|}}{CH}-CH_3$$

4) Hydration. In the presence of mineral acids, water olefins attached to form alcohols.



$$CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2\text{(2-methylprop-1)} + H_2O \xrightarrow{H^+} CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3\text{(2-methylpropanol-2)}$$

6) Sulfation (O- sulfonation). Reacting alkenes with sulfuric acid leads to acidic sulfuric acid esters.



$$CH_2=CH-CH_3 + O-SO_2-OH \rightarrow CH_3-\underset{\underset{CH_3}{|}}{CH}-O-SO_2-OH\text{((izopropilsernaya acid)}$$

As can be seen, the direction of hydration reactions and sulfonation as defined by the rule Markovnikov.

6) Oxidation. Alkenes are easily oxidized. Depending on the reaction conditions produces a variety of products.

a) The combustion air olefins yield carbon dioxide and water.

$$H_2C=CH_2 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

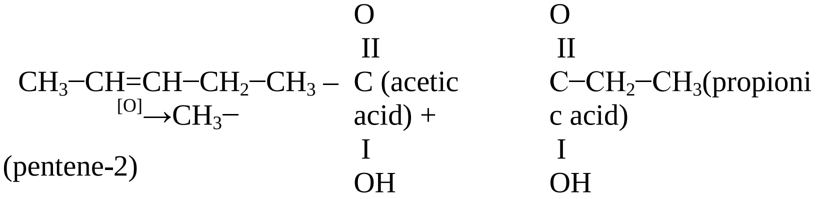
b) The oxidation of alkenes with a dilute solution of potassium permanganate formed dihydric alcohols - glycols (reaction E.E.Vagnera). The reaction takes place in the cold.

$$3H_2C=CH_2 + 2KMnO_4 + 4H_2O \rightarrow 3CH_2-CH_2 + 2MnO_2 + 2KOH$$

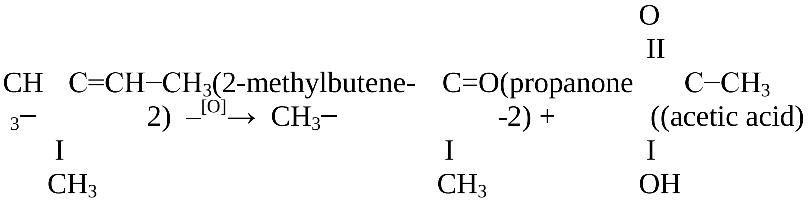
$$\underset{OH}{\underset{|}{}}\quad\underset{OH}{\underset{|}{}}$$

The reaction is observed discolouration potassium permanganate solution. Reaction Wagner serves quality breakdown on the double bond.

c) In the oxidation of alkenes hard boiling solution of potassium permanganate in acidic medium the complete rupture of the double bond and the formation of acids or ketones.



$$\underset{\text{(pentene-2)}}{CH_3-CH=CH-CH_2-CH_3} \xrightarrow{[O]} CH_3-\underset{OH}{\underset{|}{\overset{O}{\overset{\|}{C}}}}\text{ (acetic acid) + }\underset{OH}{\underset{|}{\overset{O}{\overset{\|}{C}}}}-CH_2-CH_3\text{(propionic acid)}$$



$$CH_3-\underset{CH_3}{\underset{|}{C}}=CH-CH_3\text{(2-methylbutene-2)} \xrightarrow{[O]} CH_3-\underset{CH_3}{\underset{|}{C}}=O\text{(propanone-2) + }\underset{OH}{\underset{|}{\overset{O}{\overset{\|}{C}}}}-CH_3\text{((acetic acid)}$$

For products formed (acids and ketones) may conclude that the structure and composition radicals attached ethylenic group in the starting compound. Prior to the development of spectral methods for the identification of organic compounds, this reaction has been widely used to determine the structure of unknown alkene.

7) Polymerization. "One of the most important in practical terms reactions of unsaturated compounds (or olefins) is the polymerization. Polymerization reaction is called the formation of a high molecular compound (polymer), by joining together molecules of the initial low molecular weight compound (monomer). When the polymerizable double bonds in the starting unsaturated compound, "expandable", and formed by the free valences of these molecules are connected with each other.

Polymerization of olefins is caused by heat, pressure, radiation, free radicals or catalysts. In simplified form, an example of such a reaction to ethylene can be represented as follows:

$$nCH_2{=}CH_2 \rightarrow –(–CH_2{-}CH_2)–_n$$

Diene hydrocarbons (alkadienes)

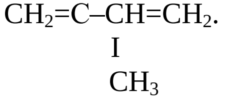
Diene hydrocarbons or alkadienes - is unsaturated hydrocarbons containing two double carbon - carbon bonds. Alkadienes general formula C_nH_{2n-2}.

Depending on the relative position of the double bonds dienes are classified into three types:

1) hydrocarbons cumulated double bond, i.e. adjacent to the same carbon atom. For example, allene or propadiene $CH_2 = C = CH_2$;

2) hydrocarbons with isolated double bonds, ie, separated by two or more single bonds. For example, pentadiene -1,4 $CH_2 = CH\text{-}CH_2\text{-}CH = CH_2$;

3) hydrocarbons with conjugated double bonds, ie, separated by one single bond. For example, 1,3 -butadiene or divinyl: $CH_2 = CH\text{-}CH = CH_2$, 2-methylbutadiene-1,3, isoprene, or



$$CH_2{=}\underset{\substack{|\\ CH_3}}{C}–CH{=}CH_2.$$

Receiving

Hydrocarbons with conjugated double bonds is obtained:

1) dehydrogenation of alkanes contained in natural gas and refinery gases by passing them over a heated catalyst

$$CH_3–CH_2–CH_2–CH_3 \xrightarrow{600C;Cr2O3,Al2O3} CH_2{=}CH–CH{=}CH_2 + 2H_2$$

$$CH_3–\underset{\substack{|\\ CH_3}}{CH}–CH_2–CH_3 \xrightarrow{600C;Cr2O3,Al2O3} CH_2{=}\underset{\substack{|\\ CH_3}}{C}–CH{=}CH_2 + 2H_2$$

2) dehydrogenation and dehydration of ethanol by passing the alcohol vapor over a heated catalyst (method Acad. S.V. Lebedev)

$$2CH_3CH_2OH \xrightarrow{450C;ZnO,Al2O3} CH_2{=}CH{-}CH{=}CH_2 + 2H_2O + H_2$$

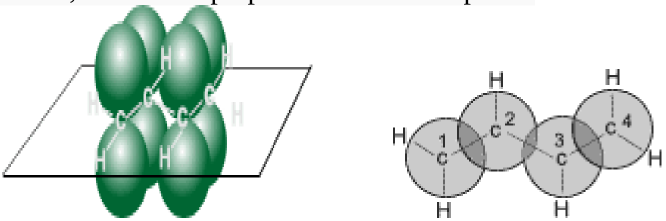
Physical properties

1,3 butadiene - easily liquefied gas with an unpleasant odor, t ° mp. = -108,9 °C, t ° boiling. = -4,5 °C; insoluble in ether, benzene, does not dissolve in water.

2- methylbutadiene -1.3 - volatile liquid, t°mp. = -146°C, t ° boiling. = 34,1 °C; soluble in most hydrocarbon solvents, ether, alcohol does not dissolve in water.

Chemical properties

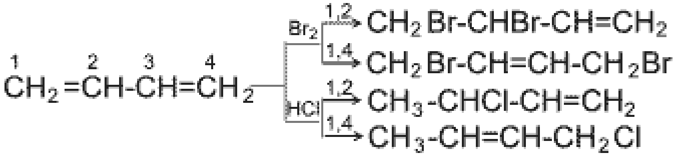
The carbon atoms in the molecule of 1,3-butadiene are sp^2 - hybrid state, which means that the position of these atoms in the same plane and the presence of each one of them p- orbitals occupied by electrons, and one is perpendicular to said plane.



Schematic representation of the molecular structure didivinila (a) and top view of the model (b).

The overlap between the electron clouds C_1-C_2 and C_3-C_4 greater than that between C_2-C_3.

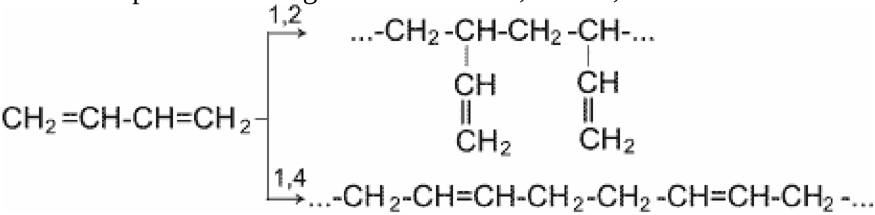
Consider the halogenation reaction and gidrogalogenirovaniya conjugated diene.



As can be seen, the bromination reaction and lead to the hydrochlorination products of 1,2- and 1,4-joining, the amount of the latter depends, inter alia, on the nature of the reagent and reaction conditions.

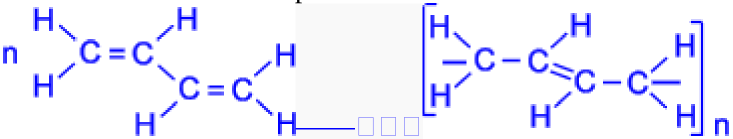
An important feature of the conjugated diene hydrocarbons is, furthermore, their ability to enter into the polymerization reaction. Polymerization of olefins as that carried out under the influence of catalysts or initiators.

It can take place according to the schemes 1,2 and 1,4 connection.



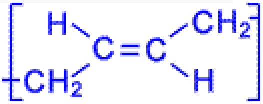
Polymerization of the diene compounds

In simplified form, a polymerization reaction 1,3-butadiene 1,4 connection scheme can be represented as follows:

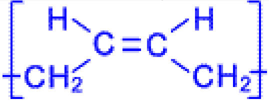


In polymerization involving two double bonds of diene. During the reaction, they are broken, the pair of electrons forming s-communication uncoupling, after which each unpaired electron is involved in the formation of new connections: the electrons of the second and third carbon atoms as a result of generalizations give a double bond, and the electrons in the outer chains of carbon atoms with electrons in the generalization corresponding atoms other monomer molecules bind monomers in the polymer chain.

Cell cell polybutadiene is as follows:



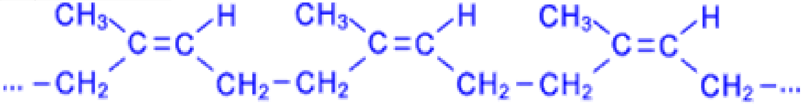
As can be seen, the resulting polymer has a trans-configuration of the polymer components of the cell. However, the most valuable in practical terms, the products obtained by stereospecific (in other words, the spatial ordering) polymerization of diene hydrocarbons under the scheme of joining to form 1,4-cis configuration of the polymer chain. For example, cis- polybutadiene



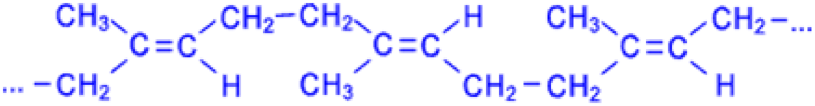
Natural and synthetic rubbers

Natural rubber is obtained from the milky juice (latex) rubber tree Hevea, which grows in the rainforests of Brazil.

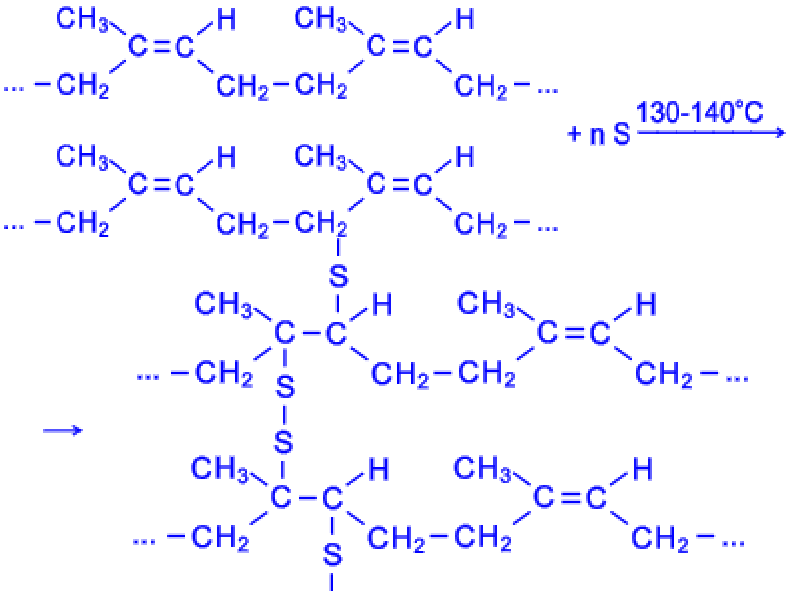
When heated without air rubber decomposes to form diene hydrocarbon - 2- methylbutadiene-1,3 or isoprene. Rubber - a stereoregular polymer in which isoprene molecules are connected with each other by joining with scheme 1,4-cis configuration of the polymer chain:



The molecular weight of natural rubber ranges from 7.104 to 2,5.106. Trans-isoprene polymer also occurs naturally in the form of gutta-percha.



Natural rubber has a unique combination of properties: high fluidity, resistance to abrasion, adhesion, water and gas tightness. To impart the necessary rubber physicomechanical properties: strength, elasticity, resistance to solvents and aggressive chemical environments - rubber vulcanized by heating to 130-140°C with sulfur. In its simplest form the process of vulcanization of rubber may be represented as follows:



Exercises:

1. Write the structural formulas of the isomers of S_5N_8 diene hydrocarbons. Call them.
2. Ethanol → Butadiene -1,3 → butadiene rubber.
3. Given substance: $CH_2 = CH\text{-}CH_2\text{-}CH_2\text{-}CH_3$. Write the formula of its two isomers name.
4. Which of these compounds is reacted butene - 1: Cl_2, HBr, H_2O, HNO_3, butene - 1, pentane? Record the possible reaction equations, call the resulting substance.
5. Write down the equation:

a) hydrogenation of propene; b) combustion of pentane; a) hydration of propene;
g) adding HCl to hexene - 1. Name the resulting substance.

Alkynes. Acetylenic hydrocarbons.

Alkynes - is hydrocarbons, which are present in the molecules of carbon atoms spent in connection with the adjacent carbon atom three valence, ie forming a triple bond.

Alkynes general formula - C_nH_{2n-2}.

Carbon atoms with a triple bond in a state sp-hybridization.

Names are constructed similarly alkenes, with the replacement of the end -en on -in.

The ancestor of the genus - acetylene CH≡CH.

Isomers of alkynes.

Despite the existence of multiple communication alkynyl, they are characterized by not all types of isomerism, alkenes used. Since acetylenic hydrocarbons for not using cis-trans-isomerism is due to the presence in their structure of the triple bond.

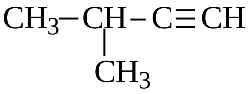
Begins with structural isomers butyne. But they differ only in the position isomers S_4N_6 triple bond.

$$\underset{\text{butyne-1}}{CH_3 - CH_2 - C{\equiv}CH} \qquad \underset{\text{butyne-2}}{CH_3 - C \equiv C - CH_3}$$

Isomerism carbon skeleton similar isomerism alkanes and alkenes.

In structural isomers alkynes are not used consoles sim and single-ended, because at the triple bond can not be two deputy.

$$\underset{\text{pentyne-1}}{CH_3 - CH_2 - CH_2 - C{\equiv}CH} \rightarrow$$



$$CH_3-\underset{\underset{CH_3}{|}}{CH}-C\equiv CH$$

2-methyl butyne-1

Positional isomers multiple bond

$$\underset{\text{butyne-1}}{CH_3 - CH_2 - C{\equiv}CH} \rightarrow \underset{\text{butyne-2}}{CH_3 - C \equiv C - CH_3}$$

Nomenclature

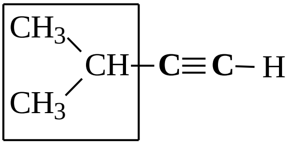
1. The trivial nomenclature. Trivial name is called only the first representative of alkynes - acetylene.

2. A rational nomenclature - the basis is acetylene, as the first representative of the homologous series. Main homologues - derivatives of acetylene.

For example:

$$\boxed{CH_3}-\mathbf{C}\equiv\mathbf{C}-\boxed{CH_3}$$

dimetilatsetilen



izopropilatsetilen

IUPAC nomenclature:

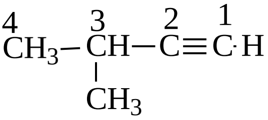
1) for the main circuit take the longest chain comprising a triple bond.

2) the numbering of the chain beginning with that end where near the triple bond

3) the names of alkynes are built from names similar alkanes with replacement at the end -an -in, the figures show the position of the double bond

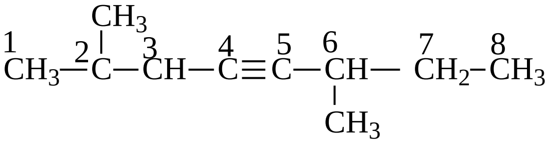
4) The number and position of the substituents shown prefixes and numbers similar to alkanes and alkenes.

For example:



$$\overset{4}{CH_3}-\underset{\underset{\displaystyle CH_3}{|}}{\overset{3}{CH}}-\overset{2}{C}\equiv\overset{1}{C}\cdot H$$

3-methyl-butyne-1

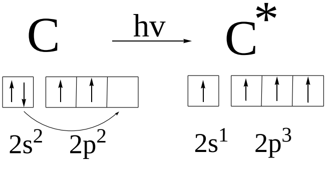


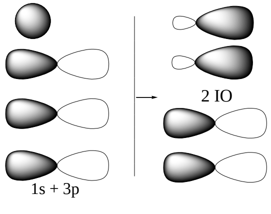
$$\overset{1}{CH_3}-\overset{\overset{\displaystyle CH_3}{|}}{\overset{2}{C}}-\overset{3}{CH}-\overset{4}{C}\equiv\overset{5}{C}-\underset{\underset{\displaystyle CH_3}{|}}{\overset{6}{CH}}-\overset{7}{CH_2}-\overset{8}{CH_3}$$

6-methyl-octyn-4

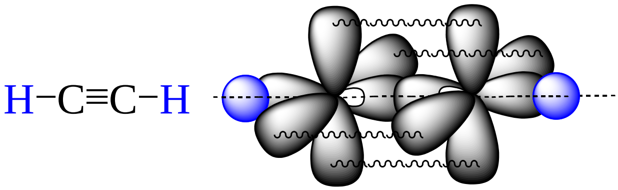
The structure of the alkyne.

Consider the example of the structure of alkyne acetylene. In the case of alkynes are involved in hybridization 1s- and 1p-cloud.





Two p-clouds remain unhybridized they overlap in two mutually perpendicular planes.



Physical properties

Acetylene - a colorless gas, slightly soluble in water. Forms explosive mixtures with oxygen.

Methods for preparing alkynes:

1. Carbide method. Industrial and laboratory method for producing acetylene. Effect on the calcium carbide with water.

$CaC_2 + H_2O \rightarrow HC\equiv CH + Ca(OH)_2$

2. Dehydration - pyrolysis of saturated hydrocarbons.

$$2CH_4 \xrightarrow{1400^0} HC\equiv CH + 3H_2$$

3. The validity of an alcoholic solution of alkali on vicinal and geminal digalogenproizvodnye saturated hydrocarbons.

If the halogen atoms are located at adjacent carbon atoms - such halogenated hydrocarbons are called vicinal.

$$R - CHCl - CH_2\,Cl + 2KOH \rightarrow R - C \equiv CH + 2KCl + 2H_2O$$

4. Alkylation of acetylene. By this method, derivatives of acetylene.

The first method is carried out using sodium amide, sodium acetylide formation occurs and its subsequent reaction with halogen derivatives of alkanes.

$$HC{\equiv}CH + NaNH_2 \longrightarrow HC{\equiv}CNa + NH_3$$

$$HC{\equiv}CNa + C_2H_5Br \longrightarrow HC{\equiv}C\text{-}C_2H_5 + NaBr$$

In the second case, a Grignard reagent to obtain an intermediate product (Iotsicha reagent), which is then reacted with alkyl halides also.

$$\mathbf{HC{\equiv}CH + C_2H_5\text{-}MgI \longrightarrow HC{\equiv}CMgI + CH_4}$$

$$\mathbf{HC{\equiv}CMgI + CH_3\text{-}I \longrightarrow HC{\equiv}C\text{-}CH_3 + MgI_2}$$

The chemical properties of alkynes

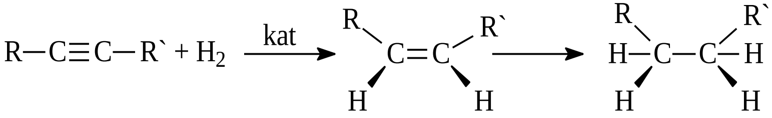
The chemical properties of alkynes due to their structure. They are most active in reactions with nucleophiles. S-orbitals Ratio is 50%, and more than the proportion of s-orbitals, the electrons close to the nucleus and, consequently, the more difficult the electrons involved in the electrophilic addition reaction. On the other hand, acetylene carbon nucleus more readily available due to its linear structure.

The same features are explained acetylene groups and mobility of hydrogen atoms, the so-called C-H acidity of acetylene. cause of acid properties of acetylene is the strong polarization C-H bond.

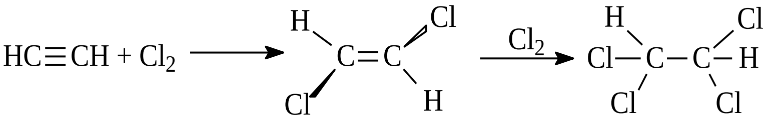
Addition reaction:

Electrophilic addition Ad_E

1. Hydrogenation of the acetylenic hydrocarbon occurs in the presence of hydrogenation catalysts: platinum, palladium (at 250C), nickel (with heating).



2. Halogenation proceeds similarly hydrogenated, i.e. attachment is to the double bond.



trans-1,2-dichloroethylene alkene 1,1,2,2-tetrachloroethane

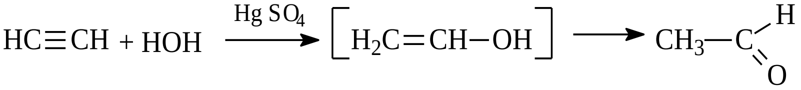
3. Gidrogalogenirovanie, ie attaching halide occurs in the presence of a catalyst which is copper chloride and mercury. The reaction proceeds according to Markovnikov's rule, similar to alkenes.

$$HC\equiv CH + HCl \xrightarrow{kat} H_2C{=}CHCl \xrightarrow{HCl} CH_3\text{-}CHCl_2$$

vinyl chloride 1.1 –dihloretan

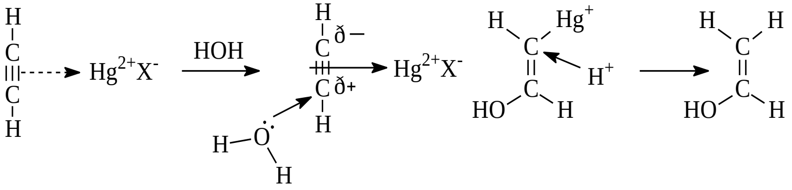
Nucleophilic addition Ad_N

4. Hydration - addition reaction of water. Proceeds in the presence of a catalyst (mercury salt) in an acidic medium. This reaction is also called - Kucherov reaction. Acetylene reaction in such adjoining water forms an unstable vinyl alcohol, which is then converted into acetaldehyde.



5. Other alkynes turn to ketones. Hydration is used in the industrial synthesis of acetaldehyde from acetylene.

Possible reaction mechanism Kucherov:



6. C-H acidity - the substitution reaction. The reaction takes place to form acetylides.

$$HC\equiv CH + Ag(NH_3)_2OH \longrightarrow Ag{-}C\equiv C{-}Ag$$

Exercises:

1. Write the structural formulas of the isomeric composition C_7H_{12} acetylene hydrocarbons, the main chain consisting of five carbon atoms, and name them.
2. When passing the mixture of propane and acetylene through a flask with bromine water bottle weight increased by 1.3, with the complete combustion of the same amount of hydrocarbon feed mixture identified 14 l (STP), carbon monoxide (IV). Determine the weight proportion of propane in the starting mixture.
3. As chemically isolate butyn-2 from its mixtures with 1-butyne?
4. An equimolar mixture of acetylene and formaldehyde is completely reacted with 69.6g of silver oxide (ammonia solution). Determine the mix (in% by weight).
5. Dihloralkan wherein chlorine atoms are located on adjacent carbon atoms, the alcohol solution treated with excess alkali. The mass of gas released was a 2,825-fold less than that of the original dihloralkana. Install the structure of the parent compound and the reaction product.

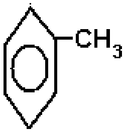
Aromatic hydrocarbons (arena)

Homologous series of benzene

Benzene series hydrocarbons have the general formula $C_nH_{2n-6.}$ First representatives of aromatic hydrocarbon derived from natural ingredients, has a peculiar odor. Now under the aromaticity understand the ability of some unsaturated compounds readily enter into substitution rather than joining, and resistance to oxidants, temperature.

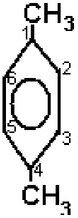
Nomenclature arena

First homologue benzola- methylbenzene, or toluene, C_7H_8:

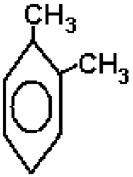


It has no positional isomers as all monosubstituted proizvodnye.Vtoroy homologue C_8H_{10}, can exist in four forms:

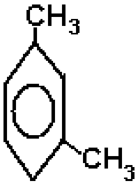
C_6H_5-C_2H_5 ethylbenzene and the three xylene or xylene, $C_6H_4(CH_3)_2$ (ortho-, meta-, para-xylene, or 1, 2-, 1, 3-, 1, 4-dimethylbenzene).



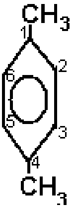
Ethylbenzene



o-xylene



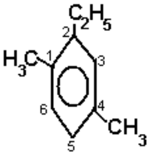
m-xylene



p-Xylene

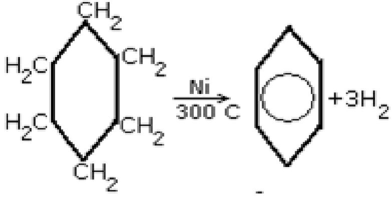
Radical (balance) benzene C_6H_5- is called phenyl (and often denoted by Ph); benzene homologues title radicals derived from the names of the hydrocarbons by adding a suffix to the top - yl (tolyl, xylyl, etc...) and are designated by letters (o-, m-, p-) position numbers or side chains. The general name for all aromatic radicals aryls similar name alkyl radicals of alkanes. Radical C_6H_5-CH_2- called benzyl.

Describing more complex derivatives of benzene, as in the case of an alicyclic compound selected from the possible orders in which the sum of digits of numbers of substituents is smallest. For example, dimethylbenzene structure

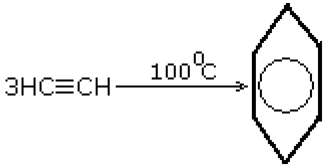


Methods for the preparation stage

1. The dehydrogenation of cyclohexane



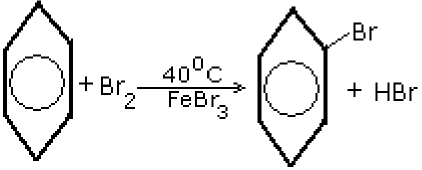
2.Trimerizatsiya acetylene



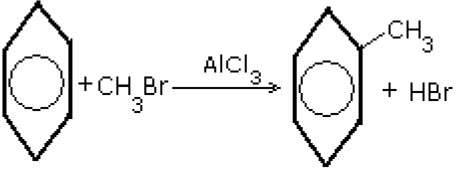
3.Vydelenie from petroleum, coal tar.

Chemical properties. I.Reaktsii replacement

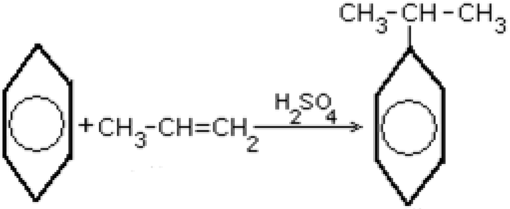
1. interaction with halogens



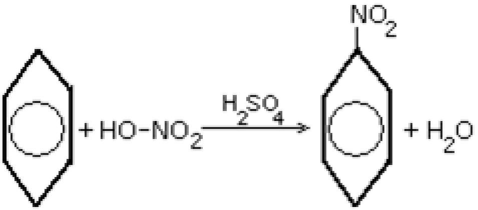
2. Interaction with halogenated alkanes



3. Interaction with unsaturated hydrocarbons

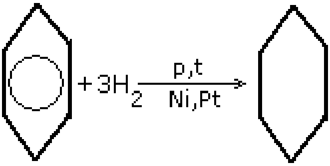


4. The nitration reaction

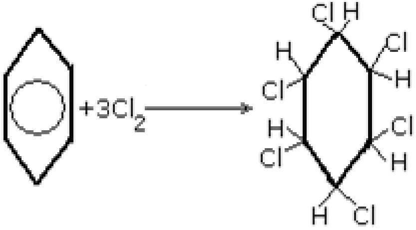


II. addition reaction

1. The addition of hydrogen



2. Accession of chlorine in the light



The use of aromatic hydrocarbons.

Aromatic hydrocarbons, particularly benzene, are widely used in the industry: as a gasoline additive in the manufacture of solvents, explosives, aniline dye, pharmaceuticals, pesticides, plastics.

Exercises

1. Write the reactions, with which you can carry out the following conversion:

$$C_2H_4 \longrightarrow C_2H_4Cl_2 \xrightarrow{KOH} X_1 \xrightarrow[t^o]{C}$$
$$\longrightarrow X_2 \xrightarrow[H^+]{} X_3 \xrightarrow[t^o]{KMnO_4,\ H_2SO_4} C_6H_5COOH$$

2. Write the reactions, with which you can carry out the following conversion:

$$CaC_2 \rightarrow X_1 \rightarrow \text{benzene} \xrightarrow{CH_3Cl, AlCl_3} X_2 \rightarrow \text{benzoic acid} \xrightarrow{NaOH} X_3$$
$$\longrightarrow \text{benzene}$$

3. Write the reactions, with which you can carry out the following conversion:

cyclopropane→1-bromopropane$\rightarrow X_1 \xrightarrow{Na} X_2 \xrightarrow{Pt}$ toluene $\xrightarrow{Cl_2} X_3$

4. With some reactions may razlichitt benzene and toluene?

Oxygenated organic compounds

Alcohols.

Homologous series of alcohols.

Alcohols referred hydrocarbon derivatives containing a group (or a group) -OH called hydroxyl group or hydroxyl.

According to the number of hydroxyl groups contained in the molecule, monohydric alcohols are divided into (one hydroxyl) dihydric (two hydroxyls) trihydric (three hydroxyls), and polyhydric.

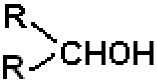
Like saturated hydrocarbons, monohydric alcohols to form naturally built a number of homologs: $C_nH_{2n+1}OH$.

As in other homologous series, each member of the series of alcohols differs from the previous and subsequent to the homology of the difference ($-CH_2-$)

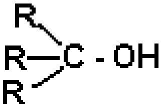
Depending on the carbon atom at which is hydroxyl, distinguish primary, secondary, and tertiary alcohols.

$R-CH_2OH$

primary alcohol



secondary alcohol

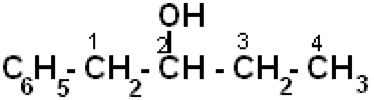


tertiary alcohol

The range of alcohols.

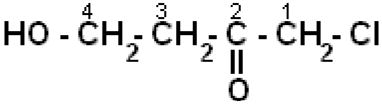
In accordance with the nomenclature of IUPAC name in the construction of a monohydric alcohol to the parent hydrocarbon name suffix ol. If you have a combination of older functions hydroxyl group identified by the prefix denotes hydroxy (in Russian language is often used prefix oxide). As the main chain is the longest is selected unbranched chain of carbon atoms, which includes the carbon atom bound to a hydroxyl group; if the compound is unsaturated, then this circuit is also included and the multiple bond should be noted that when determining the number of hydroxyl numbering function usually has an advantage over the halogen, alkyl, a double bond, and therefore the numbering begins with the end of the chain, which is located closer to the hydroxyl group :

H_3C-CH_2-OH

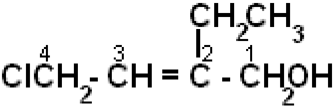


$C_6H_5-\overset{1}{C}H_2-\overset{OH}{\overset{|}{\overset{2}{C}}}H-\overset{3}{C}H_2-\overset{4}{C}H_3$

Ethanol 1-phenyl butanol-2



$HO-\overset{4}{C}H_2-\overset{3}{C}H_2-\underset{\underset{O}{\|}}{\overset{2}{C}}-\overset{1}{C}H_2-Cl$

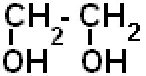


$Cl\overset{4}{C}H_2-\overset{3}{C}H=\overset{CH_2CH_3}{\overset{|2}{C}}-\overset{1}{C}H_2OH$

4-Hydroxy-2-one hlorbutanon 4-chloro-2-ethylbuten2-ol-1

Dihydric alcohol.

If the hydrocarbon replace two hydrogen atoms on different carbon atoms of different hydroxyl groups formed dihydric alcohols or glycols.

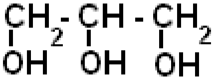


$\underset{OH}{\underset{|}{CH_2}}-\underset{OH}{\underset{|}{CH_2}}$

2-ethanediol or ethylene glycol

Trivalent alcohol.

Trihydric alcohols, glycerol is also known to contain three hydroxyl groups.



$\underset{OH}{\underset{|}{CH_2}}-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH_2}}$

1,2,3-propanetriol or glycerol

Preparation of alcohols

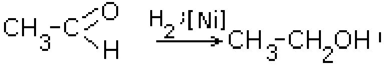
1.Gidroliz monogalogenproizvodnyh aqueous alkaline solutions

$$CH_3-CH_2-Br+H-OH \xrightleftharpoons{OH^-} CH_3-CH_2-OH+HBr$$

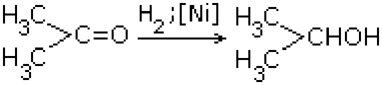
2. The effect of water on ethylene hydrocarbons

$$CH_2=CH_2+HOH \xrightarrow{H^+} CH_3-CH_2OH$$

3. Reduction of aldehydes and ketones



$$CH_3-C\genfrac{}{}{0pt}{}{\nearrow O}{\searrow H} \xrightarrow{H_2;[Ni]} CH_3-CH_2OH$$



4. Fermentation of vegetable raw materials containing starch

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH+2CO_2$$

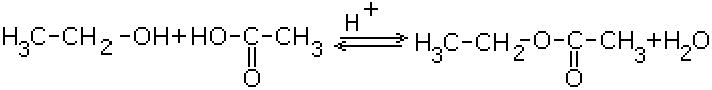
Chemical properties of the alcohols

I. The reactions that occur with the participation of the hydrogen atom of the hydroxyl group

1. Interaction with alkali metals

$$C_2H_5OH+2Na \longrightarrow C_2H_5ONa+H_2$$

2. The reaction with carboxylic acids



$$H_3C-CH_2-OH+HO-\underset{\underset{O}{\parallel}}{C}-CH_3 \overset{H^+}{\rightleftarrows} H_3C-CH_2-O-\underset{\underset{O}{\parallel}}{C}-CH_3+H_2O$$

II. The reactions that occur with participation of the hydroxyl group

1. Interaction with hydrogen halides

$$C_2H_5OH+HBr \longrightarrow C_2H_5Br+HOH$$

2. The removal of water

$$C_2H_5OH \longrightarrow CH_2=CH_2+H_20$$

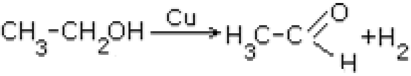
3. Intermolecular dehydration

$$C_2H_5OH+HOC_2H_5 \longrightarrow (C_2H_5)_2O+H_2O$$

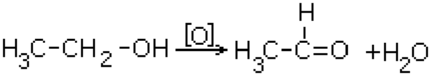
Formed diethyl ether

III. Oxidation reaction

1. Cleavage of hydrogen (dehydrogenation)



2. The oxidation of alcohols, strong oxidants [$KMnO_4$ + H_2SO_4]



$$H_3C-CH_2-OH \xrightarrow{[O]} H_3C-\overset{\overset{H}{|}}{C}=O \ +H_2O$$

The oxidation of secondary alcohols formed ketones

3. The combustion reaction of alcohols

$$C_2H_5OH+3O_2=2CO_2+3H_2O$$

The use of alcohols.

Methanol is used to producing formaldehyde-based plastics acrylic acid as a solvent for lacquers and paints. Ethyl alcohol is used as solvent, the disinfectant in the food industry. Ethylene glycol as antifreeze, brake fluid, is also used in the manufacture of plastics. polyester fibers and explosives.

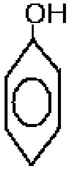
Glycerin is used in paper, printing. perfumery and pharmaceutical industries, production of nitroglycerine, alkyd and epoxy paints.

Exercises:

1. The molar mass and structure of the alcohol, if it is known that the interaction of the alcohol, 7.4g of sodium metal with 1.12 liters of gas released (STP), when the oxidation of copper (II) compound is formed, which gives reaction "silver mirror. "
2. What is the volume (in liters) of oxygen (STP) required for complete combustion of 31.25 ml of ethanol (density 0.8 g / ml) and the number of grams of precipitate obtained if the reaction products passing through the lime water?
3. Unknown constitution alcohol reacts with the substitution of 48% solution of hydrobromic acid to form the alkyl bromide having a density of Hydrogen 61.5. Define the structure of the alcohol, if you know that when it is formed aldehyde oxidation.
4. When a mixture of two intermolecular dehydration was allocated monoalcohols 10.8 g of water and 36g of a mixture formed of three organic compounds in equal molar quantities, which belong to the same class of organic compounds (yield: 100%). What is the structure of the starting alcohol?
5. A mixture of an aromatic hydrocarbon (benzene homolog) phenol and 14g of total mass of water was treated with bromine (phenol reacts only). At the same time fell 33.1g sediment. The structural formula of the aromatic hydrocarbon, it is known that it was in the starting mixture in an amount of 0.05 mol.

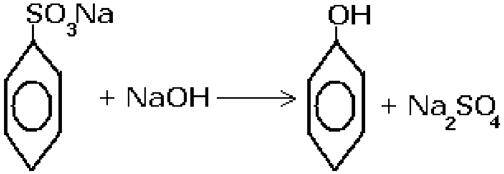
Phenol obtained, the chemical properties and application

Organic compounds containing a hydroxyl group bonded directly to a carbon atom of an aromatic nucleus, called phenols.



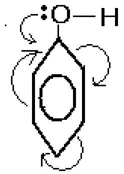
Getting phenols

Phenols contain significant quantities of coal tar. The phenol was also prepared by melting the sodium salt of benzenesulfonic acid with sodium hydroxide.

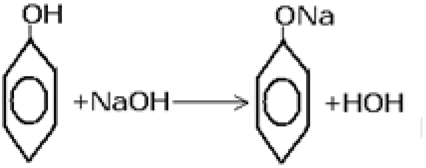


Chemical properties of the phenol.

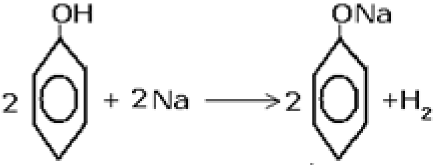
In phenol pronounced acidic properties. This is due to the fact that the free electron pair of oxygen is drawn in to the phenol nucleus.



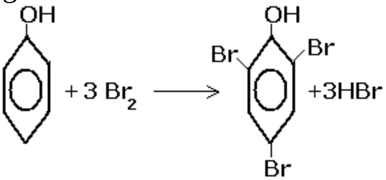
In the interaction of phenol with alkali salts are formed – phenolates



Phenol, due to the hydroxyl group will react with the alkali metals.



With halogen phenols reacted with by substitution of hydrogen on the benzene ring.



Use of phenols.

The phenol used in the manufacture of plastics, picric acid, dyes, agents for combating insects. All phenols obdadayut bactericidal action, so they are used as disinfectants in human and veterinary medicine.

Objectives:

1. When processing the mixture of 4.18 g of benzyl alcohol, cresol and phenol with excess potassium was allocated 448 ml (STP), of gas. Calculate the weight proportion of phenol in the starting mixture.

2. At 15 degrees, 100 grams of water is dissolved 8.20 g of phenol. What volume of hydrogen (STP) is highlighted in the processing of 50 grams of saturated phenol solution with excess sodium?

3. Under the action of an excess of sodium phenol solution in methanol was allocated in 1176 ml of gas (eg. In.). For the same amount of neutralization solution took 10 ml of an aqueous NaOH solution with a concentration of 20 mg / ml. What is the mass fraction of phenol in the initial solution?

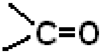
4. What weight potassium phenolate can be prepared from potassium hydroxide, 20g of phenol and 20g?

5. When bromination weight phenol obtained 28.2 g cake weighing 79.44g Calculate the weight fraction (in%) yield.

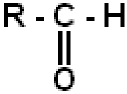
Aldehydes. Ketones

Homologous series of aldehydes, ketones.

Class oxo compounds include organic compounds containing the group:

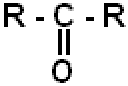


This is called a carboxyl group or carbonyl. There are two variants of the compounds:



$R-\overset{\displaystyle O}{\overset{\|}{C}}-H$

Aldehydes

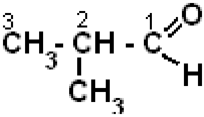


$R-\overset{\displaystyle O}{\overset{\|}{C}}-R$

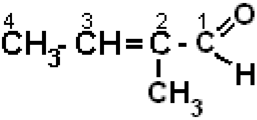
Ketones

Nomenclature of aldehydes, ketones

Trivial names of aldehydes are very common, they are bound by trivial names acids with the same carbon skeleton: formic aldehyde, acetaldehyde, and so on. D. IUPAC presence of an aldehyde group is denoted by the suffix - al:

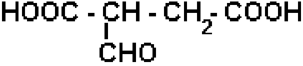


2-methylpropanal



2-methyl-2-butenal

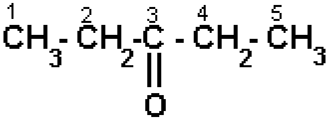
If the aldehyde group is not included in the main chain due to the presence of older groups, it is denoted by the prefix formyl-



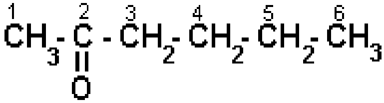
$HOO\overset{1}{C}-\underset{CHO}{\overset{2}{C}H}-\overset{3}{C}H_2-\overset{4}{C}OOH$

2-formilbutandiovaya acid

Names of simple ketones are typically composed of titles radicals attached to a carbonyl group, and the words ketone:

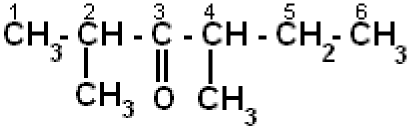


$$\overset{1}{C}H_3\text{-}\overset{2}{C}H_2\text{-}\overset{3}{\underset{\underset{O}{\|}}{C}}\text{-}\overset{4}{C}H_2\text{-}\overset{5}{C}H_3$$



$$\overset{1}{C}H_3\text{-}\overset{2}{\underset{\underset{O}{\|}}{C}}\text{-}\overset{3}{C}H_2\text{-}\overset{4}{C}H_2\text{-}\overset{5}{C}H_2\text{-}\overset{6}{C}H_3$$

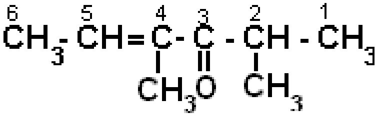
diethyl ketone (3-pentanone)
methyl butyl ketone (2-hexanone)



$$\overset{1}{C}H_3\text{-}\overset{2}{\underset{\underset{CH_3}{|}}{C}H}\text{-}\overset{3}{\underset{\underset{O}{\|}}{C}}\text{-}\overset{4}{\underset{\underset{CH_3}{|}}{C}H}\text{-}\overset{5}{C}H_2\text{-}\overset{6}{C}H_3$$

isopropyl sec-butyl ketone (2, 4-dimetilgeksanon-3)

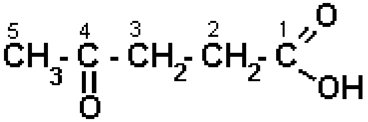
For the names of more complex ketones use the suffix -one (IUPAC):



$$\overset{6}{C}H_3\text{-}\overset{5}{C}H=\overset{4}{\underset{\underset{CH_3}{|}}{C}}\text{-}\overset{3}{\underset{\underset{O}{\|}}{C}}\text{-}\overset{2}{\underset{\underset{CH_3}{|}}{C}H}\text{-}\overset{1}{C}H_3$$

2, 4-dimethyl-4-one-3

If there are more senior group of the ketone group identified by the prefix oxo:



$$\overset{5}{C}H_3\text{-}\overset{4}{\underset{\underset{O}{\|}}{C}}\text{-}\overset{3}{C}H_2\text{-}\overset{2}{C}H_2\text{-}\overset{1}{C}OOH$$

4-oxopentanoic acid

Preparation of aldehydes

1.Degidrirovanie alcohols

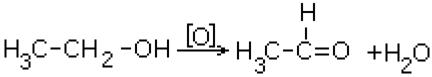
$$CH_3\text{-}CH_2OH \xrightarrow{Cu} H_3C\text{-}C\overset{O}{\underset{H}{\lessgtr}} + H_2$$

The ketones are prepared by oxidation of secondary alcohols.

$$CH_3\text{-}CH(OH)\text{-}CH_3 \xrightarrow{ZnO,\ 380°\ C} CH_3\text{-}CO\text{-}CH_3$$

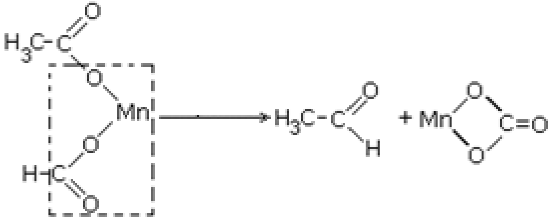
2-propanol, acetone (yield-90%)

2. The oxidation of alcohols

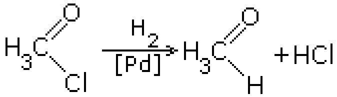


$$H_3C-CH_2-OH \xrightarrow{[O]} H_3C-\overset{H}{\overset{|}{C}}=O + H_2O$$

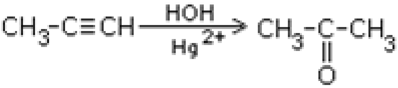
3. Preparation of salts of carboxylic acids



4. Reduction of acid chlorides



5. Hydration alkilatsetilenov.

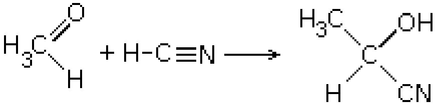


$$CH_3-C\equiv CH \xrightarrow[Hg^{2+}]{HOH} CH_3-\underset{\underset{O}{\|}}{C}-CH_3$$

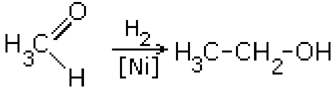
Chemical properties

I. Addition reactions

1. Accession of hydrocyanic acid

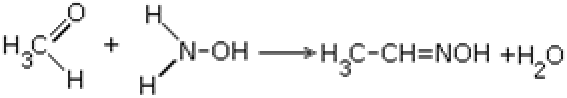


2. The addition of hydrogen



II. The substitution reaction of the carbonyl oxygen

1. Interaction with hydroxylamine



2. Interaction with phosphorus pentachloride

$CH_3CHO+PCl_5 \rightarrow CH_3CHCl_2+POCl_3$

Use of aldehydes and ketones

1. An aqueous solution of formalin-methanal-strong disinfectant is used to disinfect the premises and seed dressing.
2. Methanal used for phenol-formaldehyde resins.
3. Methanal used in the manufacture of pharmaceuticals and dyes.
4. ethanal used for the production of acetic acid.
5. Acetone - a good organic solvent.

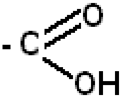
Exercises:

1. Write the reactions, with which you can using of carbon monoxide (2) to obtain formaldehyde.
2. Unlabelled without labels in four flasks following substances are: formaldehyde, an aqueous solution of ethylene, ethanol, cyclohexane. As chemically recognize which substance is in each of the flasks? Write down the corresponding reactions.
3. Which of the following substances is reacted benzaldehyde: oxygen, hydrogen, hydrogen cyanide, bromo, hydroxide diamminserebra, copper hydroxide, (2)? Write the equation of possible responses, specify the conditions for their implementation.
4. How many liters of formic aldehyde required to obtain 16 grams of a 20% methanol solution?

Carboxylic acid

Homologous series of carboxylic acids.

The class of carboxylic acids are compounds having carboxyl group



The names and formulas of some carboxylic acids.

Name acid	**Formula**
Formic	HCOOH
Acetic	CH_3COOH
Propionic	C_2H_5COOH
Oil	C_3H_7COOH
Isobutyric	$(CH_3)_2COOH$
Valeric	$CH_3\ (CH_2)_3COOH$
Nylon	$CH_3(CH_2)_4COOH$
Oxalic	HOOC - COOH
Malonic	$HOOC\ CH_2$ - COOH
Amber	$HOOC\ (CH_2)_2$ - COOH
Glutaric	$HOOC\ (CH_2)_3$ - COOH
Adipic	$HOOC\ (CH_2)_4$ - COOH

Nomenclature of carboxylic acids

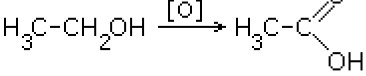
Compounds containing a carboxyl group are referred monobasic carboxylic acids and and containing two carboxyl groups refers to the diacid.

IUPAC nomenclature permitted to retain their trivial names. For more complicated cases, the name of the title acid proivodit hydrocarbons having the same number of carbon atoms in the acid molecule, with the addition of closure - oic acid, and keywords. Formic acid HCOOH called methane acid, acetic acid CH_3COOH - ethanoic acid.

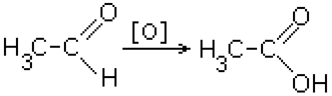
In most cases are trivial names which indicate generally the natural source from which the acid was isolated.

Preparation of carboxylic acids

1. The oxidation of alcohols



2. Oxidation of aldehydes



Chemical properties of carboxylic acids.

1. Interaction with metals

$$2CH_3COOH+Ca\rightarrow(CH_3COO)_2Ca+H_2.$$

2. Interaction with metal oxides

$$2CH_3COOH+CaO\rightarrow(CH_3COO)_2Ca+H_2O.$$

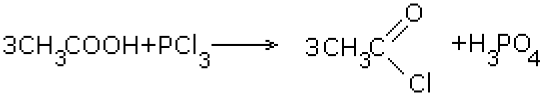
3. Neutralization

$$2CH_3COOH+Ca(OH)_2\rightarrow(CH_3COO)_2Ca+2H_2O.$$

4. Interaction with salts

$$2CH_3COOH+CaCO_3\rightarrow(CH_3COO)_2Ca+H_2O+CO_2.$$

5. Effect of halogenating agents



6. The esterification reaction

$$CH_3COOH+HOCH_2CH_3CH_3COOC_2H_5+H_2O.$$

7. Halogenation acids

$$CH_3COOH+Br_2\rightarrow CH_2BrCOOH.$$

The use of carboxylic acids

Formic acid is used as a reductant in formic medicine-alcohol (1.25% alcoholic solution) of formic acid.

Acetic acid is used for the synthesis of dyes, medicines, esters, in the manufacture of cellulose acetate fibers. In the household, as a flavoring and preservative.

Exercises:

1. In three test tubes without numbers are formic, acetic and hydrochloric acid. Describe how, based on differences in their physical and chemical properties, determine which test tube which is acid.

2. Give the structural formulas of compounds:

1. propanedioic acid

2. 2-hydroxypropanoic acid
3. propionyl
4. butoxide calcium
5. The propionic acid anhydride
6. formamide
7. propionic acid phenyl ester
8. n-chlorobenzoic acid

3. What properties differ from formic acid, other carboxylic acids? Give an equation for the reaction?

4. Determine the weight of the ester formed by reacting 150 g of a 60% solution of acetic acid and 150 ml of 96% strength ethanol solution (density 0.8 g/ml). It is known that the mass fraction of 0.09 ether evaporated during the distillation.

5. For the neutralization 2.08 g dibasic carboxylic acid took 40 ml of 1 M sodium hydroxide solution. Define the structure of the carboxylic acid.

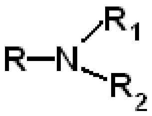
Amines

Homologous series of amines. Nomenclature.

Amines called hydrocarbon derivatives formed by substituting the hydrogen atoms in the latter group - NH_2, $-NHR_1$, - NR_1R_2:

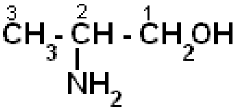
primary amine

secondary amine



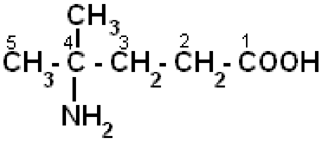
tertiary amine

Names of amines derived from the name of their constituent radicals with the accession of graduation - amine: methylamine CH_3-NH_2; dimethylamine $(CH_3)_2$ - NH, trimethylamine $(CH_3)_3$ - N. In more complex cases, the amino group is considered as a functional group and its name is an amino put before the name of the main chain (IUPAC):



$\overset{3}{C}H_3-\underset{NH_2}{\overset{2}{C}H}-\overset{1}{C}H_2OH$

2 -aminopropanol- 1



$\overset{5}{C}H_3-\underset{NH_2}{\overset{CH_3}{\overset{4}{C}}}-\overset{3}{C}H_2-\overset{2}{C}H_2-\overset{1}{C}OOH$

4 - amino - 4 - methylpentanoic acid

Receiving

1. The effect of ammonia on alkyl halides (reaction of Hoffmann) $H_3C\text{-}I+NH_3+NaOH \rightarrow CH_3NH_2+NaI+H_2O$.

2. Restoration of nitro compounds

$$H_3C\text{-}NO_2+3H_2 \rightarrow H_3CNH_2+2H_2O.$$

3. Heating amides with alkaline solutions of salts of hypobromous

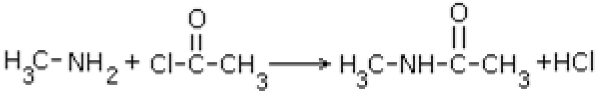
$$CH_3\text{-}CO\text{-}NH_2+2NaOH+NaOBr \rightarrow CH_3NH_2+Na_2CO_3+NaBr+H_2O.$$

Chemical properties of amines

1. Salt formation

$$H_3C\text{-}NH_2+HCl \rightarrow H_3C\text{-}NH_2 \cdot HCl$$

2. Acylation of amines (primary and secondary only)



$H_3C-NH_2+Cl-\overset{O}{\overset{\|}{C}}-CH_3 \longrightarrow H_3C-NH-\overset{O}{\overset{\|}{C}}-CH_3+HCl$

3. The action of nitrous acid on amines

$$H_3C\text{-}NH_2+O{=}NOH \rightarrow CH_3OH+N_2.$$

Exercises:

1. Write the structural formulas of the following substances: a) 2-amino-2,3,3-trimethylhexane, b) dimethylethylamine, c) 2-amino-2,3-dimethyl-4-etiloktan

2. Write chemical reaction equation obtaining amines starting from inorganic reagents: a) methylamine, b) diethylamine b) aniline.

3. Compare the basic properties of the following substances: methylamine, dimethylamine, ammonia, trimethylamine, aniline.

4. Write the reactions, with which you can carry out the following conversion:

а) $CH_4 \rightarrow CH_3Cl \rightarrow C_2H_6 \rightarrow C_2H_5NO_2 \rightarrow C_2H_5NH_2$;

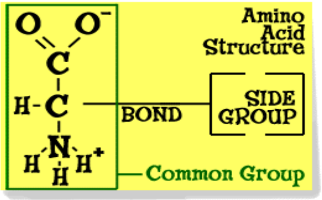
б) $CH_3COONa \rightarrow CH_4 \rightarrow C_2H_2 \rightarrow C_2H_4 \rightarrow C_2H_5Cl \rightarrow C_2H_5NH_2 \rightarrow C_2H_5\text{-}NH\text{-}CH_3.$

5. Get the weight 1-bromopropane, to obtain the required 45 g 1-aminopropane, if the proportion of the reaction yield is 65% of the theoretically possible.

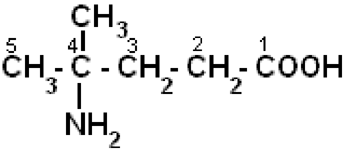
Amino acids

1. Homologous series of amino acids. Nomenclature.

Amino acids are compounds whose molecules contain both amine and carboxyl group.V depending on the position of the amino group to the carboxyl group distinguish α-, β-, γ-value amino acids. The most important are processes in α-amino acids, of which just consist proteins. More likely to use common names.



According to international nomenclature, the numbering starts with the carbon atom of the carboxyl group



$$\overset{5}{C}H_3-\overset{4}{C}(CH_3)(NH_2)-\overset{3}{C}H_2-\overset{2}{C}H_2-\overset{1}{C}OOH$$

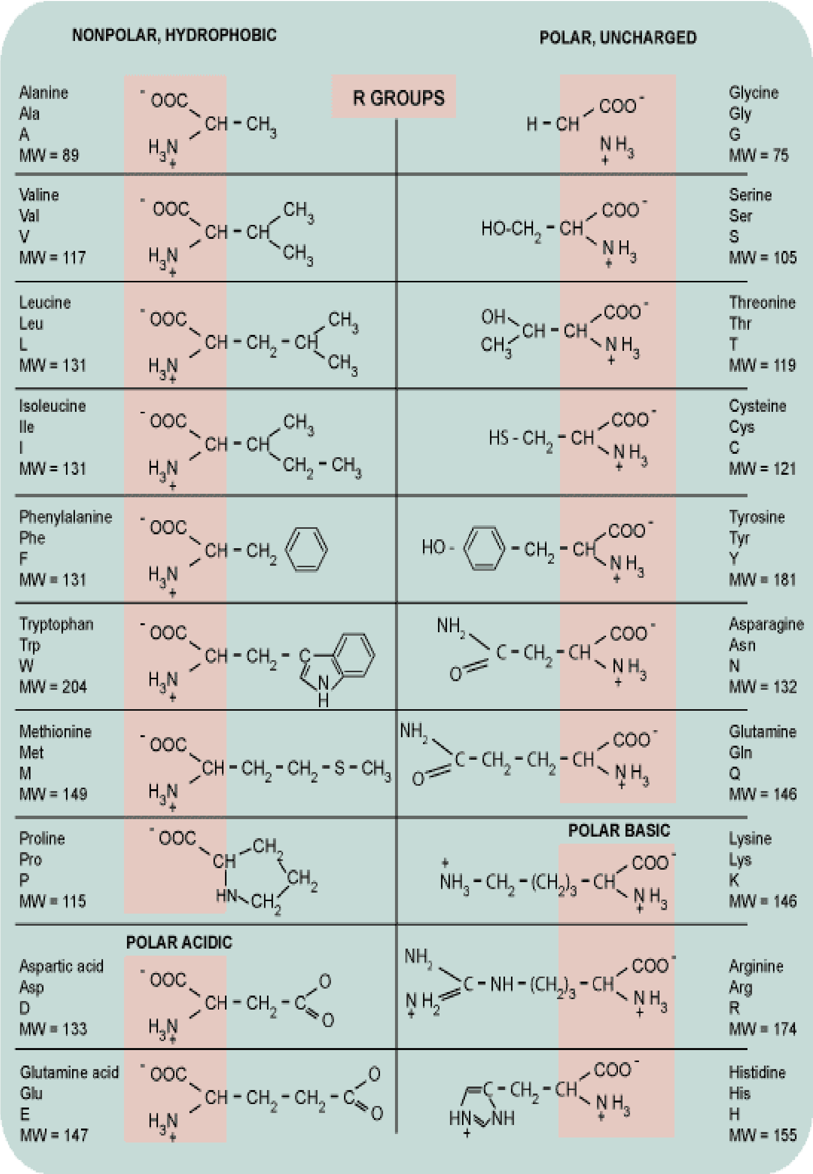
4-methyl-4-aminopentanoic acid.

Methods of synthesis and chemical properties of amines.

The action of ammonia

$ClCH_2COOH+2NH_3 \rightarrow NH_2CH_2COOH+NH_4Cl$.

glycine


NONPOLAR, HYDROPHOBIC
POLAR, UNCHARGED
R GROUPS
Alanine Ala A MW = 89
Glycine Gly G MW = 75
Valine Val V MW = 117
Serine Ser S MW = 105
Leucine Leu L MW = 131
Threonine Thr T MW = 119
Isoleucine Ile I MW = 131
Cysteine Cys C MW = 121
Phenylalanine Phe F MW = 131
Tyrosine Tyr Y MW = 181
Tryptophan Trp W MW = 204
Asparagine Asn N MW = 132
Methionine Met M MW = 149
Glutamine Gln Q MW = 146
Proline Pro P MW = 115
POLAR BASIC
Lysine Lys K MW = 146
POLAR ACIDIC
Aspartic acid Asp D MW = 133
Arginine Arg R MW = 174
Glutamine acid Glu E MW = 147
Histidine His H MW = 155

Amino acids are of the same chemical properties as the carboxylic acids and amines, due to carboxyl and amino groups.

The value of amino acids and their use.

Amino acids and their derivatives are used as medicines in medicine. Since glycine has a strengthening effect on the body and stimulates the brain. Lysine and methionine are used as feed additives in agricultural animals.

Exercises:

1. Write the structural formulas of the two rows of dipeptide-$C_5H_{10}N_2O_3$.

2. With some of these substances will not react aminoacetic acid: а) Na; б) HNO_3; в) CH_4; г) LiOH.

3. Of all inorganic substances can be obtained aminoacetic acid? Write the corresponding equations of reactions.

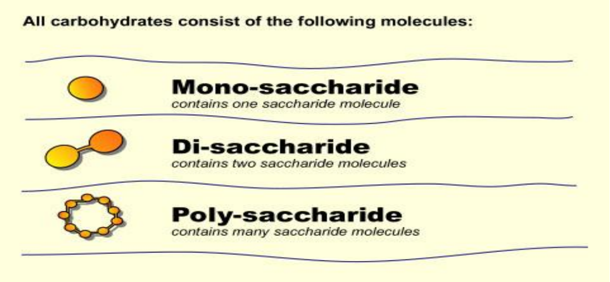
4. What do you call the tie between the amino acid residues in proteins?

5. The mass fraction of carbon, hydrogen, oxygen and nitrogen in an amino acid are respectively 32,00; 6.66; 42.67 and 18.67%. Amino acid called - ?.

Carbohydrates

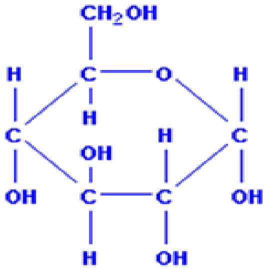
Classification of carbohydrates.

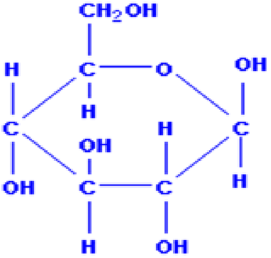
The name of carbohydrates obtained because the ratio of hydrogen and oxygen in their molecules known representatives of the first was 2: 1, whereby they were treated with the compounds with water.



Glucose

Consider the structure, properties and application of basic carbohydrates. Let's start with glucose.Glucose - monosaccharide, one of eight isomeric aldohexoses. The molar mass of 180 g/mol. Glucose in the form of D-form (dekstoza, grape sugar) is the most common carbohydrate. D-glucose (normally referred to simply as glucose) occurs in free form and in the form of oligosaccharides (cane sugar, lactose), polysaccharides (starch, glycogen, cellulose, dextran), glycosides, and other derivatives. In the form of the free D-glucose contained in fruits, flowers and other plant organs and in animal tissues (blood, brain and others.). D-glucose is the major source of energy in animals and microorganisms. Like other monosaccharides D-glucose forms several forms. Crystal D-glucose obtained in 2 forms: aD-glucose (Figure 1) and bD-glucose (Figure 2).





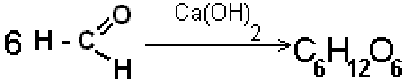
Being in nature

In a special form of glucose found in almost all organs of green plants. Especially a lot of it in grape juice, so glucose is sometimes called grape sugar. Honey consists essentially of a mixture of glucose and fructose.

In humans, glucose is contained in the muscles, blood (0.1 - 0.12%) and is the primary source of energy for cells and tissues. Increasing the concentration of glucose in the blood leads to an increase of pancreatic hormone - insulin-reducing carbohydrate content of the blood. The chemical energy of nutrients entering the body, enclosed in a covalent bond between the atoms. In the glucose amount of potential energy is 2800 kJ per 1 mol (i.e. 180 grams).

Preparation of glucose

1.Sintez glucose from formaldehyde in the presence of calcium hydroxide (reaction Butlerova)



2. Starch hydrolysis

$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow{H_2SO_4,\ t\,^{\circ}C} nC_6H_{12}O_6$$

Chemical properties glucose

Properties due to the presence in the molecule		**Specific Properties**
hydroxyl groups	**of the aldehyde group**	
1. Reacts with carboxylic acids to form esters (five hydroxyl groups of glucose will react with acids)	1. Reacts with silver oxide (I) in an ammonia solution (reaction "silver mirror"): $CH_2OH(CHOH)_4$-COH + $Ag_2O \rightarrow CH_2OH(CHOH)_4$-$COOH$ + 2Ag	Glucose is able to undergo fermentation: a) fermentation of the alcohol $C_6H_{12}O_6 \rightarrow 2CH_3$-$CH_2OH$ +2 CO_2
		b) lactic fermentation $C_6H_{12}O_6 \rightarrow 2CH_3$-CHOH-COOH
2. As the polyhydric alcohol reacts with copper hydroxide (II) c alkoxide form copper (II)	2. Oxidized copper hydroxide (II) (with loss of red sludge) 3. Under the action of reducing agents is converted in hexahydroxyalcohols	c) butyric acid fermentation $C_6H_{12}O_6 \rightarrow C_3H_7COOH + 2H_2 + 2CO_2$ butyric acid

Glucose is a valuable nutritious product. In the body, it undergoes a complicated biochemical processes resulting in the formation of carbon dioxide and water, at this energy is released according to the final equation: $C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2 + 2800kJ$.

This process takes place in steps, so energy is released slowly.

Glucose is also involved animal cell energy metabolism (glucose splitting). The overall equation looks like this:

$$C_6H_{12}O_6 + 38H_3PO_4 + 38\ ADP \longrightarrow 6CO_2 + 38\ ATP + 44H_2O.$$

Since glucose is easily absorbed by the body, it is used in medicine as a restorative remedy for symptoms of heart weakness, shock, she is a member of replacing the liquid blood and antishock liquids. Widely used in confectionery actually glucose (manufacture jellies, candies, cakes and the like. D.), In the textile industry as a reducing agent, as a starting material in the production of ascorbic acid and for synthesizing a number of sugar derivatives, etc.

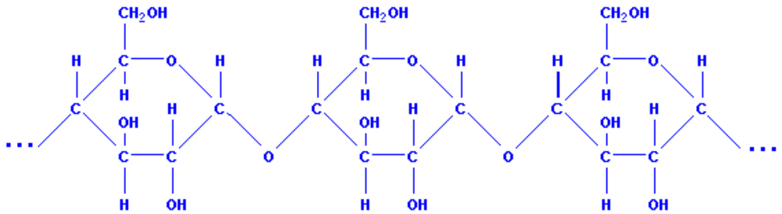
Of great importance are the processes of fermentation of glucose. Thus, for example, sauerkraut, cucumbers, milk lactic fermentation occurs glucose, as well as in silage. If silage is exposed to the mass of compacted enough, then under the influence of air is permeated butyric acid fermentation and food becomes unfit for use.

In practice, as alcohol fermentation using glucose, for example in the production of beer.

Starch

The structure of the starch.

Starch comprises two polysaccharides - amylose and amylopectin glucose residues formed. Experimentally proved that the chemical formula of starch $(C_6H_{10}O_5)_n$.



Found that starch does not only consist of linear molecules and branched molecules of the structure. This explains the granular structure of the starch. Accumulates in the form of grains, mainly in the cells of seeds, bulbs, tubers, and also in the leaves and stems. Starch - white powder, insoluble in cold water. In hot water, it swells and forms a paste.

Being in nature. Preparation of starch.

Accumulates in the form of grains, mainly in the cells of seeds, bulbs, tubers, and also in the leaves and stems. Starch - white powder, insoluble in cold water. In hot water, it swells and forms a paste.

Starch is usually obtained from potato. To this pulverized potatoes, washed with water and pumped into large vessels where settling occurs. The resulting starch was washed once with water, and dried in defending a current of warm air.

Use of starch.

Starch - the main part of the most important foods: flour (75 - 80%), potatoes (25%), sago and others. Energy value of about 16.8 kJ/g.

It is a valuable nutritious product. To facilitate the process of digestion, starch-containing products are subjected to high temperature, ie potatoes cook, bake bread. Under these conditions, partial hydrolysis of starch and dextrins are formed, which are soluble in water. Dextrins in the digestive tract are further hydrolyzed to glucose, which is absorbed by the body. Excess glucose is converted to glycogen (animal starch). Glycogen same composition as that of starch, - $(C_6H_{10}O_5)_n$, but it is more branched molecules. Especially many contain glycogen in the liver (10%). In the body glycogen reserve is a substance that is converted into glucose as it is consumed in cells.

In industry, the starch is converted by hydrolysis in molasses and glucose. For this purpose it is heated with dilute sulfuric acid which is then neutralized with an excess of chalk.

$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow{H_2SO_4,\ t\ ^\circ C} n\,C_6H_{12}O_6$$

The resulting precipitate of calcium sulfate is filtered off, the solution evaporated and secrete glucose. If the hydrolysis of starch not lead to the end, a mixture of dextrins to glucose - syrup, which is used in the confectionery industry. Obtained by means of starch dextrin used as an adhesive for paints thickened when printing on fabric.

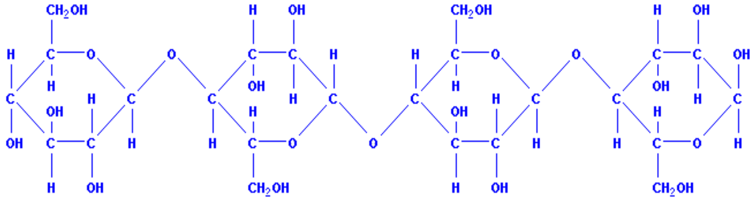
Starch is used for starching clothes. Under the hot iron a partial hydrolysis of starch and its transformation into dextrins. The latter form a dense film on the fabric, which adds shine fabric and protects it from zagryaneniya.

Starch and its derivatives are also used in the manufacture of paper, textiles, and other foundry industries and pharmaceutical industries.

Cellulose

The structure of cellulose.

Molecular formula cellulose (-$C_6H_{10}O_5$-)$_n$, as in the starch.



Cellulose is also a natural polymer. Macromolecule it consists of many molecules of glucose residues. Can voeniknut question: why starch and cellulose - a substance with the same molecular formula - have different properties?

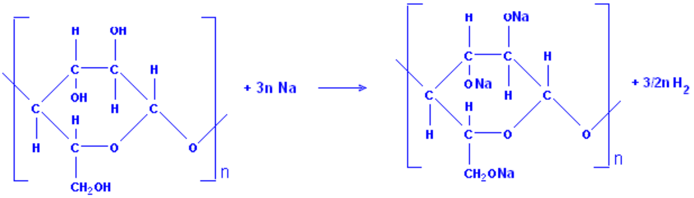
In considering synthetic polymers, we have found that their properties depend on the number of elementary units, and their structures. The same situation applies to the natural polymers. It turns out that the degree of polymerization in cellulose is much greater than that of the starch. Moreover, comparing the structure of these natural polymers, have found that the cellulose macromolecules, unlike starch molecules consist of residues (-glucose and have only a linear structure. Macromolecules pulp located in the same direction and form fibers (flax, cotton, hemp).

Each glucose residue of the molecule contains three hydroxyl groups. Cellulose - a fibrous substance. It does not melt and does not pass into the vapor state: when heated to approximately 350 °C decomposes cellulose - char. Cellulose is insoluble in either water or in most other organic and inorganic solvents.

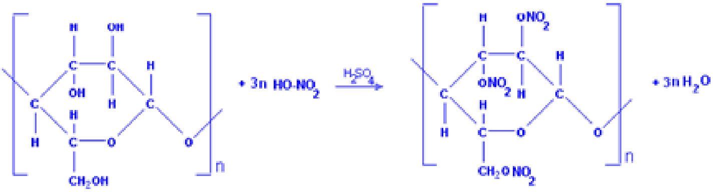
Reagent is a solvent pulp Schweitzer - hydroxide solution of copper (II) with ammonia, with which it cooperates simultaneously. Concentrated acids (sulfuric, phosphoric) and a concentrated solution of zinc chloride is also dissolved cellulose, but its partial decomposition occurs (hydrolysis), accompanied by a decrease in molecular weight.

Chemical properties of the pulp.

1. The action of sodium metal



2. The reaction of cellulose with nitric acid in the presence of concentrated sulfuric acid, depending on the conditions and trinitrotsellyuloza dinitrotsellyuloza formed is an ester:



3. One of the most characteristic properties of pulp - the ability to hydrolyze the presence of acids to form glucose. Similarly hydrolysis of starch proceeds stepwise cellulose. Total this process can be represented as follows:

$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow{H_2SO_4\ ,t\ ^\circ C} n\,C_6H_{12}O_6$$

Exercises for carbohydrates:

1. With the help of some reactions can be carried out following the conversion of sucrose →glucose → gluconic acid?

2. Glucose-derived compound $C_3H_6O_3$ reaction forms a compound with sodium composition $C_3H_4Na_2O_3$, calcium carbonate - $CaCO_3$ with ethanol in the presence of sulfuric acid - $C_5H_{10}O_3$. Call it a connection and write reaction equations.

3. Substance $C_6H_{12}O_5Cl_2$ composition upon hydrolysis in aqueous solution into a mixture of pyranose and B, wherein A includes fragments of the cellulose. Write the structural formulas of compounds A and B, as well as the equations of the corresponding reactions.

4. Organic matter contains 84.21% carbon and 15.79% hydrogen. Vapor density of matter in the air is 3.93. Determine the chemical formula of the substance.

5. When burning 0.156 g of product was isolated by 0.269 liters of carbon dioxide (4) and 0,108 g of water. Vapor density of oxygen is equal to 0.8125. Set the molecular formula of substance.

CHAPTER 2

LABORATORY EQUIPMENT. GLASSWARE AND INSTRUMENTS

Familiarity with the basic rules of work in the chemical laboratory

The course does not provide students perform an experiment, but the future of the experimental chemist needs to know the basic rules of work in the chemical laboratory:

- On the bench during operation should not place any objects;
- In the laboratory should work in a cotton robe, hair should be removed;
- To take food in the laboratory is strictly prohibited;
- Before and after the operation should wash their hands;

- You need to work accurately, the result of the experience depends on the purity of the experiment;
- All experiments with toxic and odorous substances carried out in a fume hood;
- Chemicals take only a spatula, tweezers or a spoon (no hands!);
- Unspent not pour reagents and pour back into those vessels, where they were taken;
- On heating solutions and substances should be used in the holder tube. Opening the tube should be directed away from yourself and other employees;
- Do not lean over the vessel in which the heating or boiling liquid;
- If necessary, determine the odor emitted by the reaction gases must flick of his hands to blow gas from the opening of the reaction vessel to her and gently breathe;
- Upon dilution of the concentrated acids and alkalis in small portions to surge acid (or concentrated alkali solution) in water, but not vice versa;
- In contact with a concentrated solution of acid on your skin wash the burn with running water for several minutes. After this process the burned area 3% solution of baking soda;
- When concentrated solutions of alkali burns rinse burned area with running water for several minutes. After this process the burned area 1% solution of acetic acid or boric acid, and again with water;
- With thermal burns cool the affected area, which place it under running cold water. After cooling, grease ointment for burns;
- In contact with any solution of the reagent in the eyes, rinse immediately with plenty of water, then immediately consult a doctor;
- With all the issues that arose immediately contact the teacher or technician.

Laboratory glassware - special and specialized containers of various design, scope, and are made from a variety of materials resistant to aggressive environments. If necessary, the laboratory ware has the necessary heat resistance, transparency and other desired physical properties.

Before application of laboratory glassware it should be well washed and sterilized. To do this, wash it ruffs or in the washing machine with soap and soda solution, a solution of trisodium phosphate or washing powder. Clean dishes are washed in running water and dried in an oven. If necessary to achieve sterility laboratory glassware wrapped in heavy paper and sterilized in aerosterile at 160-180 °C 45-60 min. or in an autoclave at 120 °C 20-30 min.

Laboratory glassware used for analytical work, storage of chemicals and substances, preparations for the biological and chemical analyzes of inorganic and organic synthesis.

Classification of glassware:

By appointment

1. General Purpose Laboratory Glassware: glassware, which must always be in the lab, and without which it is impossible to carry out most of the work (tubes, funnels, beakers, conical flasks, flat-bottomed flask and others.)
2. Laboratory glassware for special purposes: glassware, which is used for any purpose (deflegtogrammy, refrigerators, cap, round bottom flasks, etc.).
3. Laboratory measuring utensils: glassware, designed for measuring volumes of liquids (measuring cylinders, pipettes, burettes, volumetric flasks, and others).

By Material:

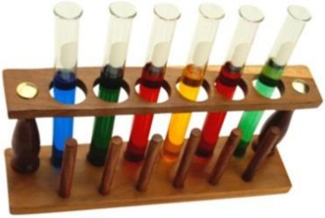
1. Laboratory Glassware of ordinary glass: bottles for storage solutions, beakers and others.
2. Laboratory glassware from a special chemically and thermally resistant glass: the tube, glass, round bottom flasks and others.
3. Laboratory Glassware of quartz: flasks, test tubes, beakers, cups.
4. Laboratory Glassware Porcelain: glasses, crucibles, vyparitelnye cups, mortar and others.

Chemical laboratory equipment	
Labware	Allonge • Kipp's apparatus weighing bottle • • Burette • Funnel • Flask • The cell • Beaker • drying tube • Pipette • Tube • Retort • Dewar vessel Landolt • • • Glass Crucible
Apparatus for separation	Absorber • Distiller • rotary evaporator • Scrubber • Filter • Chromatograph • Centrifuge • Desiccator • Soxhlet extractor
measuring instruments	Hydrometer • Balance • viscometer • calorimeter • pH • Indicators pycnometer • Spectrophotometer • Thermometer • • photocolorimeter eudiometer
Various equipment	Vacuum Pump • Water bath • Fume hood • Bunsen burner • Mass Spectrometer • Microscope • Oven • • Chemical reactor alcohol stove • Refrigerator • Tripod
Security	Safety glasses • Fire extinguisher • Gloves • Respiratory • Bathrobe

When conducting chemical experiments use different utensils and equipment. In the first lab students need to meet her (dishes demonstrate and explain its purpose).

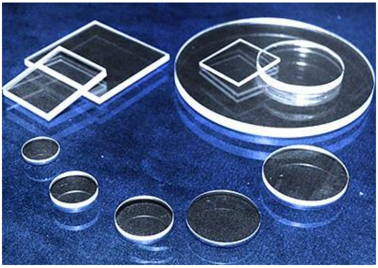
Glassware:

- The tube - this is an essential laboratory ware, glass and made of polyethylene, intended for carrying out a variety of experiments;



- Glass rod various thickness and length is used for mixing liquids;

- A watch-glass is used for the study of solids, it is covered in the synthesis of glasses;



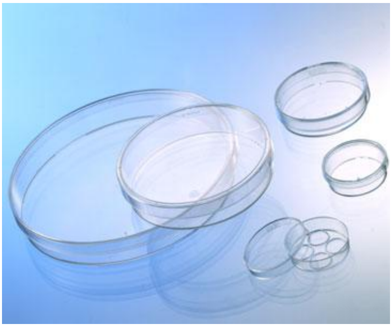
- Funnel used for transferring liquids and for filtration;

- Various volume beaker for the preparation of solutions and carrying out chemical reactions, either at room temperature or under heating;

- Flat-bottomed flask is used for cooking and storage solutions;

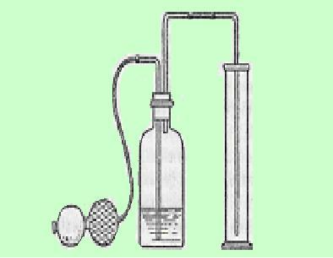
- Round-bottom flask - for syntheses;

- Petri dishes used for drying various substances;



- Cooling of the mold used for the collection of fluids and gas under water;

- Cylinder - for collecting gases.



Measuring glass:

- The measuring cylinder is used to measure a fairly large volume of liquid;

- Pipette is used to accurately measure the volume of liquid;

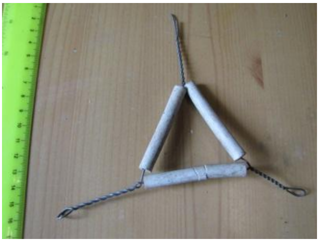
- Volumetric flask is indispensable for the preparation of solutions exact concentration.

Porcelain Tableware:

- Mortar and pestle is designed for grinding solids, stirring mixtures;

- A crucible for calcination substances used for various syntheses at high temperatures;

- Triangle needs to secure crucibles cups on a tripod ring;



- cup of evaporated designed for evaporating the solution in a water or sand bath;

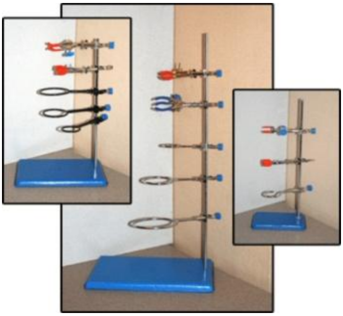
- Spatula take bottles of various reagents.

Equipment:

- Tube rack is needed for experiments in test tubes;

- Holder for tubes - to secure the tubes when heated;

- A metal tripod with legs - for fixing devices in the experiment;



- Spoon to burn - to burn materials

- Asbestos grid - for heating substances on a hot plate;

- Alcohol stove - heating substances;

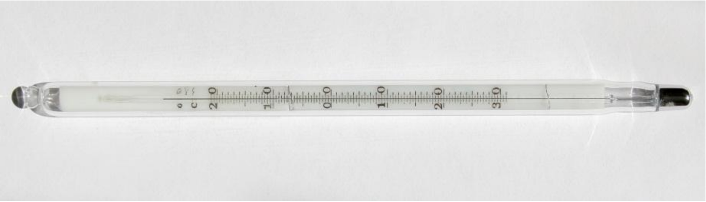
- Electric stove - heating substances;

- Chemical drying cabinet - for drying substances;

- Muffle furnace - calcination substances of synthesis at high temperature;

- Scales - Weighing substances;

- Mercury thermometer - to determine the temperature.



Familiarity with the basic operations in the chemical laboratory

When meeting with the basic operations in the laboratory demonstrates the execution of work, called utensils and equipment used. At the initial stage of training is conducted familiarity with simple operations:

- Determination of the color solid. Put substance crystals on a watch glass, consider carefully (to determine the color of the sulfur, carbon, copper, sodium chloride, nickel chloride, copper sulphate and other substances);

- Determination of odor volatiles. A slight movement of his hands to blow gas from the vessel to her throat and gently inhale (to identify the smell of ammonia, sulfur oxide (IV), acetic acid and other substances);

- Heating substances in vitro. Heat can only small amounts of substances not more than 1/3 of the tube. It is necessary to secure the tube holder or tripod foot in a slightly tilted position, the opening of the tube should be directed away from yourself and from other employees. Carefully small flame of a spirit lamp to warm up the whole tube, and then all of its contents;

- Heating on a hot plate. The heating can be carried out only in flat-bottomed pot over heat-resistant asbestos grid;

- Evaporating the solution is carried out in a water vyparitelnoy cup or a sand bath;

- Filtration through a funnel used for the chemical separation of the solid matter from the solution. The operation used paper (smooth or pleated) filter. Smooth filter made from filter paper, a suitable range for the diameter of the twice folded in half, or cut from a piece of paper on the hopper size. The resultant cone is inserted into the funnel and is wetted, the region of the filter must be below the top of the funnel for about 5 mm. Glass funnel with filter is placed in a ring tripod so that the lower end thereof in contact with a wall of glass, in which the solution is filtered. Filterable mixture was transferred to a filter on a glass rod. Pleated filter is used to speed up filtering, it is made from a smooth, deep wrinkles on the edge of the filter should be about 5-7 mm.

- Drying in the oven is only applicable for stable substances recommended temperature of 60-80 ^{0}C. The drying is carried out on a watch glass or cup of liquid evaporation, dried material must not adhere to the glass rod and the vessel wall.

CHAPTER 3. CHEMICAL TEXTS

Read the text

CHEMICAL PRODUCTION

Chemical industry - industry, including production of hydrocarbons, minerals and other raw materials by its chemical processing.

Chemical industry identified as a separate branch of the beginning of the industrial revolution. The first plant for the production of sulfuric acid - an essential mineral acids used by man, were built in 1740 (UK, Richmond), in 1766 (France, Rouen), in 1805 (Russia, Moscow), in 1810 (Germany, Leipzig). To meet the needs of developing textile and glass industry began producing soda ash. First soda factories appeared in 1793 (Paris, France), in 1823 (UK, Liverpool), in 1843 (Germany, Schonebeck-on-Elbe), in 1864 (Russia, Barnaul). With the development in the middle of the XIX century. agriculture emerged artificial fertilizer plants: in 1842 in the UK, in 1867 in Germany, in 1892 in Russia.

Raw communications industry contributed to the emergence of the early formation of the UK as a world leader in the chemical industry, for three-quarters of the XIX century. Since the end of the XIX century. with the growth needs of the economy in organic substances in the chemical industry leader becomes Germany. Due to the rapid process of concentration of production, the high level of scientific and technological development, active trade policy to Germany beginning of XX century. conquering the world market of chemical products.

In the US, the chemical industry started to develop later than in Europe, but by 1913 the volume of chemical production and the United States have taken hold since the 1st place among the world's nations. [citation needed 626 days] contribute to this mineral-rich, well-developed transport network, a strong domestic market. Until the end of the 80s the chemical industry of the EU countries in general calculus again exceeded production volumes in the United States.

Sub-sectors of the chemical industry

Examples	**subsector**
Inorganic chemistry	Production of ammonia, soda production, sulfuric acid production
Organic chemistry	Acrylonitrile, phenol, ethylene oxide, urea
Silicate	Ceramics Industry
Petrochemicals	Benzene, ethylene, styrene
Agrochemicals	Fertilizers, Pesticides (Insecticides, Herbicides)
Polymers	Polyethylene, Bakelite, Polyester
Elastomers	rubber, neoprene, polyurethane
Explosives	Nitroglycerin, ammonium nitrate, nitrocellulose
Pharmaceutical Chemistry	Medications
Perfumes and cosmetics	coumarin, vanillin, Camphor

Oil refining

The crude oil from a well is used in virtually pure form. Here is a place where it is converted to the necessary human products - Refinery (Refinery). It is here that the raw material is delivered by pipeline, rail or sea tankers, after processing to obtain gasoline, jet fuel, fuel oil, diesel oil, lubricating oil, paraffin feedstock for petrochemical plants.

So, after a long or short trip oil refinery entered the tank. What's next? First, it was removed from mechanical impurities, and dissolved gases purified of excess salt and water to elektroobessolivayuschih plants. At this stage determine the properties of materials.

It would seem that at the current level of technological progress, you can easily determine the chemical composition of crude oil. But the problem is that recognize hundreds and hundreds of chemical compounds in a plant laboratory - an extremely difficult task. Accordingly, oil is divided into fractions by zavisimocti boiling point and density. The laboratory "training" distillation to know the quantity of gasoline, kerosene, lubricating oil, paraffin oil and may be derived from received the plant oil. (Petroleum vary greatly in chemical composition, therefore can be obtained from one more lubricants and waxes, other - more gasoline.) And only thereafter proceed to the industrial distillation.

This interesting process takes place in a distillation column - a special apparatus for the separation of oil into fractions. If you've ever passed or passed the refinery, you've probably seen these enormous structures: the height of this column may exceed 60 m. As a true piece of art technology, it allows you to divide a substance having a boiling point differs by less than 6°C.

Oil heated coil before 320-390 ^{o}C fed to the column as a mixture of hot liquid and steam. There, a pair of heavy and light fractions and then successively condensed and deposited on special plates - can be from 30 to 60. The result is a naphtha (boiling 30-160 ^{o}C), naphtha, also known as naphtha (105-160 ^{o}C), kerosene (160-230 ^{o}C), gas oil (230-400 ^{o}C) and fuel oil remaining after the removal of the remaining fractions.

Gasoline and naphtha is then subjected to catalytic reforming. When the temperature and pressure 320-520 ^{o}C 15-40 atmospheres in the presence of platinum catalysts prepared with high gasoline octane and aromatic hydrocarbons - benzene, toluene, xylene and others. The latter are used as feedstock for the petrochemical industry. Furthermore, during the reforming process, hydrogen is released, which can be used, for example, hydrotreating.

On hydrotreated kerosenes and gas oils fed to a hydrogen atmosphere using a catalyst to remove sulfur, nitrogen, metals and other undesirable impurities. Kerosene, which depending on its properties are divided into air, and the lighting tractor after purification can be used for other purposes. A gas oil is sent to blending or to receive it from the diesel fuel, or to catalytic cracking (the so-called large hydrocarbon molecules split into two or more under the temperature of about 500 ^{0}C, and, of course, catalysts).

Fuel oil until the end of the XIX century was discarded as a waste product. Now it is used as a liquid fuel oil or used as raw material for further processing - the vacuum distillation. Heavy oils can not be distilled at atmospheric pressure - when necessary for their boiling heat begins the destruction of molecules. A vacuum conditions of the distillation may be carried out at low temperature -

about 400 °C. The result is a product that is suitable for processing into motor fuel, oils, waxes and ceresins and heavy residue - tar. Blowing hot air tar, bitumen obtained. The distillation residue cracking and also produce coke.

At various refinery provides a different set of processes. Mandatory distillation of crude oil hydrotreating and catalytic reforming. For this set of output of light oil products (gasoline and jet fuel) is about 40% of the total production. This scheme is considered to be a simple refinery. However, in the face of rising prices for oil and oil products, as well as stricter environmental requirements has acquired particular importance is the increase in the output of light oil products. Therefore, today's modern industries actively introducing new technologies. Application of catalytic cracking, hydrocracking and visbreaking and hydrodesulfurization processes, coking and thermal cracking let you receive more than 90% light products that meet the highest environmental standards.

Refining process leads to the release into the atmosphere of a variety of chemical compounds, noisy and heavy scents, and could cause a fire and explosion hazard. It is therefore very stringent requirements imposed today and to accommodate the refinery. In accordance with modern environmental standards, the plant should be located at a reasonable distance from residential areas and close to transport arteries, which deliver raw materials and products are taken. Because many refineries require large amounts of steam and cooling water, it is important to be near a body of water - the river and the sea is better. Plants often have a number of ports to facilitate the transportation of finished petroleum products by means of maritime transport.

Exercises:

1. Translate into Kazakh
2. Tell about chemical production

Read the text

INTERESTING FACTS

At the beginning of our era oil was distilled to reduce the unpleasant smell. In Russian and foreign medical manual 15-17 centuries recommending oil as a means to treat inflammation, the drive is capable of petroleum refining method of the Roman physician Cassius Felix and Arab scholar Avicenna.

Russian researchers believe that Russia's first and the world's oil refining company built in 1745 on the river Ukhta brothers Chumelovy. It did kerosene and lubricating oils. In the West, however, believe that the world's first oil distillation on an industrial basis engaged Ignacio Lukashevich, who worked in 1854-56 years near the town of Jaslo in the Austro-Hungarian Empire (present-day Poland).

Famous engineer, author of the tower on Shabolovka Shukhov made an enormous contribution to the development of the oil industry. He not only built the first oil pipeline in Russia and the tanker, but also created the world's first installation of thermal cracking of oil, along with assistant SP Gavrilov. In other words, the Russian engineers invented an industrial process for producing motor gasoline. The technology was patented in 1891.

During most of the 20th century oil refinery in the Iranian city of Abadan was the largest in the world. He was seriously injured during the Iran-Iraq war. Today, the largest oil refinery believe Centro de Refinación de Paraguaná in Venezuela, which produces 956,000 barrels of oil per day.

"Oil island" at Lake Emenningen in Sweden is considered the oldest oil refinery that has survived to the present day. Per August Elounda built this plant in 1875 and a year later received a permit for processing 1,000 barrels of oil per year. The company was halted in 1902 and today is part of the historical exposition Ecomuseum "Bergslagen".

Exercises:

1. Translate into Kazakh.
2. Write the essay.

Read the text

NATURAL GAS

Natural gas is a mixture of gases generated by the anaerobic decomposition of organic matter in the bowels of the earth, thus belongs to the group of sedimentary rocks and minerals being. In-situ in the ground or in situ natural gas is in gaseous state in the form of separate gas accumulations - deposits in the form of a gas cap gas fields, as well as dissolved in the oil or water.

Under normal conditions, providing 101,325kPa and + 200C, the natural gas is entirely in the gaseous state, whereas under other conditions may have a crystalline form of a natural gas hydrate. Even in 1813, chemist Sir Humphry Davy concluded on the basis of their analysis of what mine gas is a mixture of methane with a small amount of N_2 and carbon dioxide CO_2, making it qualitatively identical to that stands out from the marshes.

Preparation of natural gas for transportation

Coming from natural gas wells is required to prepare before sending directly to consumers in the form of chemical plants, boilers, combined heat and power and city gas network. This is due to the presence in its composition, in addition to the desired components which differ in type for different users, and also different impurities that can obstruct the transport as well as subsequent use of the gas.

For example, the gas contained in water vapor under certain circumstances provoke the formation of hydrates or condensate accumulating in places subsequently bends pipelines and thereby obstructing gas line advancement. Furthermore, hydrogen sulfide provokes an accelerated corrosion in the gas facility, in particular in pipes and other vessels exchangers. Apart from gas treatment also requires the preparation of the pipeline, in most cases, provided by a special nitrogen plants used to create an inert medium in the pipe.

Currently, the preparation of the gas is carried out under various schemes, one of which provides for the construction in the vicinity of the gas fields of special complex gas - GPP, through cleaning and drying gas in special absorption columns. At present the scheme of gas purification used in the Urengoy field. In that case, if the composition of the gas contained in a large amount of hydrogen sulfide, or helium, its purification is carried out on special gas processing plants, the sulfur recovered from the gas and helium. Such an experience of gas cleaning is available on the Orenburg field.

Transportation of natural gas

1. The pipeline

In the current situation the primary method of transporting gas to a pipeline directly to consumers, providing transportation of gas at a pressure of 75 atmospheres through the pipes with a diameter of 1.4 m. As we move gas through the pipes lose potential energy due to friction between the gas and the pipe wall, and also due to frictional forces between the layers of gas energy loss dissipated as heat.

It is therefore equipped with a pipe at regular intervals a special compressor stations - CS carrying out gas compression to a pressure of 55 to 120 atmospheres, followed by cooling. Construction and maintenance of gas pipeline involves more than high financial costs, with the proviso that in today's realities, this method of gas transportation on short and medium distance remains the cheapest and, accordingly, appropriate in terms of initial investment and organization.

2. Using gas tankers

Currently, except for pipeline transportation widely used method of delivering gas to its destination via special tankers - LNG, is designed as a special vessels transporting the liquefied gas in special insulated containers at low temperatures up to the level of -600^0C-500 ^{0}C(sometimes below). The liquefaction is carried out by cooling the gas under elevated pressure in view of the fact that this method provides a degree of compression of the gas to 600 times, depending on requirements.

Transportation of gas through the gas tankers involves laying a gas pipeline directly from the gas fields to the nearest sea coast, as well as construction on the banks of the terminal, providing gas liquefaction and injection into tankers, which should also be available from the organizer of the enterprise. It should be noted that the construction spetsterminala is much cheaper than conventional ports. Standard capacity of modern gas tankers is from 150 to 250 thousand cubic meters, depending on the type of vessel.

Currently, this method of transporting gas is more economical, unlike the pipeline, starting with the distances to the direct consumer of 2-3 thousand kilometers, as provides the basic financial costs of transportation and not on handling. But unlike the pipeline method provides a higher initial investment in infrastructure. As an advantage of the method of the tanker transportation of gas can also be considered a higher level of security, since the transportation and storage of liquefied natural gas is much safer than compressed.

According to statistics, the international supply of gas through pipelines amounted to 502 billion cubic meters, and in liquefied form - 178 billion cubic meters.

Other methods of transportation

Currently, there are other methods of conveying gas, in particular by means of railway tanks, respectively, in a liquefied state. There were also projects of gas transportation by airships or gas hydrate state, which for various reasons have not found a use.

Ecology

In terms of environmental safety, natural gas is the most pure form of fossil fuel, as during burning it emits a minimum amount of harmful substances, in contrast to other types of fuel. In spite of that burned in the previous 50 years, mankind a lot of fuel, including natural gas, has led to a slight increase in carbon dioxide in the atmosphere, which is also a greenhouse gas. At present, on that basis, many scholars suggest the risk of the greenhouse effect, followed by a significant warming.

Which resulted in 1997 was the signing of most countries of the Kyoto Protocol to limit greenhouse effect. Currently, this protocol has joined 181 world power, which accounted for over 61%

of global emissions of harmful substances. In the next stage followed by implementation tacit global alternative program, whose purpose was to overcome the effects of the acceleration of technological ecological crisis. At the heart of this program laid the establishment of adequate energy pricing, depending on their caloric fuel, considering the definition of the cost based on the cost of the energy produced in the final consumption of energy source units.

Why should we recycle gas?

The formation of natural gas comes from coal period, i.e. the period of formation of tar and coal seams horizons. Its composition is not uniform, natural gas, and includes the following components: propane, butane, methane, and other standard impurities, the calculation that the methane content of natural gas varies from 70 to 99% (approximately).

Natural gas processing methods involve primary stage - in order to extract the draining of water vapor gaseous fraction and sulfur.

Methods of processing natural gas

All existing techniques for processing natural gas based on a catalytic synthesis process to give a main component of natural gas methane hydrogen. Due to the fact that hydrogen is not shirokovostrebovanny product in the chemical industry, the more it is used as a raw material for producing ammonia, which in turn demand more than the raw material in the same chemical.

The explanation of this can be derived from ammonia chemicals such as:

Nitric acid;

Ammonium nitrate, which is used for the production of fertilizers and explosives,

Aniline, which is the basis for the production of dyes.

The methanol produced by the synthesis from carbon monoxide and hydrogen, which is one of the main components of the various chemical industries

Ethane, which is the second most important component of natural gas, which serves as the basis for the production of plastics.

Exercises:

1. Translate into Kazakh.
2. Write the essay.

Read the text

PRODUCTION OF NATURAL RUBBER

Natural rubber is obtained by coagulating latex (latex) rubber plants. Depending on which tissues accumulate rubber, rubber plants, divided into:

- Latex - rubber in the milky juice,
- Parenchymal - rubber in the roots and stems,
- Hlorenhimnye - rubber in the leaves and young shoots of green tissues.

Industrial importance latex trees, which not only accumulate rubber in large numbers, but it is easy to give. Of these, the overriding - Hevea brasiliensis (Hevea Brasiliensis), which gives 96% of world production of rubber.

Hevea, heveya (Hevea), genus of evergreen trees monoecious family Euphorbiaceae. About 12 species, tree height of 30-40 meters, leaves ternate, flowers are small, unisexual, collected in paniculate inflorescences. The fruit korobochkovidny. Seeds are oval, large (up to 3 cm), with a dense brown shell, quickly lose their germination. Milky sap contains rubber, which is used for tapping trees with 10-12 years of age. Since one tree was prepared from 4.3 to 7.5 kg of rubber per year.

Hevea grown on plantations and separate over 13 years (7 to 20) is used for the production of rubber. Then the old trees are cut down and go to the production of furniture.

Sap of the rubber tree is called "latex". Its composition is as follows: 65-70% water, 25-30% natural rubber, 01.02% protein, 1% minerals.

Latex is produced when cutting out a V-shaped wedge in the tree trunk. He is going into special collectors portions of 45-60 grams.

Latex collected from dozens of tanks poured into a large pan, which settles a long time.

As a result of settling the juice turns into a tight and very solid rubber mass.

Next, this mass was passed through a press to squeeze out water.

The result is a preform of rubber, which is then dried at elevated temperatures, whereby the mass becomes darker (the photograph preform is left).

Rubber plants grow best no further than 10 degrees from the equator to the north and south, as very demanding on the warm wet climate and fertile soil. The band width of 1300 km on either side of the equator is known as "rubber belt." Herbaceous latex rubber plants of the family Asteraceae (kok-sagyz, Crimea saghyz and others), growing in the temperate zone and containing a small amount of rubber in the roots, industrial irrelevant.

Development of the industry since the end of the XIX century, greatly increased the demand for rubber, so besides the Amazon forest, new plantations gevey. Young trees from South America planted in Malaysia, Indonesia and Ceylon, where they settled down perfectly and give a great harvest. Now 30% of the world is going on rubber plantations. Hectares of plantations of rubber trees Brazilian gives from 950 to 2000 kg of rubber per year. Currently, the leading countries in the production of rubber are Indonesia, Malaysia, Thailand and Sri Lanka.

Preparation of synthetic rubbers such as isoprene new butadiene and ethylene is conducted in successive reactors battery through teshyuperedayuschuyu whose surface had a significant portion of the heat of reaction and mixing devices provide the necessary degree of homogenization. Since these processes are accompanied by the release of large amounts of heat, the determination of the minimum number of reactors and their design characteristics that provide poddernanie given reaction temperature, is one of the main objectives of the optimization process.

Exercises:

1. Translate into Kazakh.
2. Write the essay.

Read the text

PREPARATION OF SYNTHETIC RUBBER

Preparation of synthetic rubber and non-food materials, particularly of petroleum gases by dehydrogenation becoming more practical. Significant interest is the process of dehydrogenation of butane-butylene mixtures, which should be an important method for the preparation of butadiene.

Synthetic rubber, general purpose x-number of special rubber is usually associated with the production of monomers. Butadiene obtained by dehydrogenation of butane and butene, isoprene - dehydrogenation of isopentane and isoamylenes. Ethylene and propylene (the desired new species of copolymer rubbers) can be obtained by pyrolysis of hydrocarbons, a cracking gas from isobutylene and isobutane dehydrogenation.

Synthetic rubber (over 3 million tons per year) employs more than 100 plants in 22 countries.

For the synthetic rubber as the monomers used 1 3-butadiene, isoprene, chloroprene, styrene, silicone compounds. Using different monomers, changing the polymerization conditions, a synthetic rubber, not inferior, and in some properties superior to natural.

For synthetic isoprene rubber is more valuable than butadiene, although because of the greater difficulty of its production started to produce synthetic rubber based on butadiene.

For synthetic rubber, isoprene is more valuable than butadiene, although because of the greater difficulty of its production began to produce synthetic rubber based on butadiene. Isoprene is used to obtain by co-polymerization of butyl rubber isobutylene with a small amount of isoprene.

For synthetic isoprene rubber is more valuable than butadiene, although because of the greater difficulty of its production started to produce synthetic rubber based on butadiene.

For synthetic rubber is necessary to perform two mandatory conditions: to ensure the formation of polymer straight chain; adjust the polymerization process so as to keep the spatial characteristics corresponding to (cis-trans) isomers.

The method of synthetic rubber by Lebedev was so perfect that even in 1932 (this year was launched the first domestic-synthetic rubber plant), this new industry has been developing vigorously. Synthetic rubber have been widely used in the national economy.

The process for producing a synthetic rubber comprises two stages: synthesis of monomers and polymerization or polycondensation of monomers.

The problem of synthetic rubber originated in Russia.

The process of obtaining synthetic rubber (CK) in chemical plants usually consists of two stages: the synthesis of monomers and polymerization.

Exercises:

1. Translate into Kazakh.
2. Write the essay.

Read the text

TECHNOLOGY OF PRODUCTION OF MINERAL FERTILIZERS

Mineral fertilizers are classified according to their agrochemical values, the number and type of nutrients in the soil water solubility, physiological effect on soil fertilized etc.

Fertilizers containing nutrients as compounds directly assimilated by plants, known as direct. Fertilizers are used to mobilize the nutrients available in the soil, are called indirect.

Direct fertilizer may contain one or more nutrients. In large quantities for sowing introduced three main nutrients: nitrogen, phosphorus and potassium. On the content of these elements and mineral fertilizers are divided into one-sided (or simple) and complex. Fertilizers containing three elements, called triple or complete.

The main group is isolated micronutrient fertilizers, which include elements of Zn, Cu, Mn, B and other consumable plants in small quantities.

By degree of solubility in soil water soluble fertilizers are divided into (nitrogen and potassium) in the soil and soluble acids (most phosphates). Water-soluble fertilizers rapidly leached from the soil, and phosphate fertilizers in the soil stored for a longer time.

The shape of the fertilizer produced by conventional and granulated. Recent best kept, their incorporation into the soil easily mechanized.

The main mineral fertilizers - nitrogen, phosphate and potash - are called by the content of the main nutrients.

Nitrogen fertilizers - mineral and organic substances used as a source of nitrogen for plant nutrition. Nitrogen in the nitrogen fertilizers may be present in several forms: ammonia, nitrate, mixed (ammonium nitrate Ratna amide). This feature is the basis of the classification of nitrogen fertilizers.

Production of ammonium nitrate

By ammoniacal fertilizers include liquid ammonia (82% N), ammonia water (20-22% N), ammonium sulphate (21% N), ammonium chloride (26% nitrogen). Nitrate fertilizers are: sodium nitrate (16% N), potassium nitrate (14% N), calcium nitrate (16% N). Ammonium nitrate fertilizer - ammonium nitrate (34% N); amidnyeudobreniya - calcium cyanamide (35% N, technical grade 19-22% N); urea, or urea (47% N). Along with these nitrogen fertilizers applied mixed fertilizers also contain nitrogen (ammonium phosphates, nitrophoska).

Ammonium nitrate (ammonium nitrate) NH_4NO_3 - ballastless fertilizer ammonium and nitrate form, containing about 35% nitrogen.

The production process consists of ammonium nitrate neutralization of nitric acid (50-55%) with gaseous ammonia:

$$NH_3 + HNO_3 \rightarrow NH_4NO_3 + 149\ kJ.$$

Then, the resulting solution was evaporated and granulated ammonium nitrate. The interaction of gaseous ammonia and nitric acid is chemisorption processes occurring in the diffusion region. Neutralization is accompanied by high heat.

Most schemes used nitrogen partial evaporation due to the heat of neutralization. The bulk of the water is evaporated in the converter, into which ammonia gas is continuously introduced through the sparger, and - nitric acid.

Ammonium nitrate solution has a concentration of about 70 to 80%. He through doneytralizator (optional neutralization with ammonia) comes in a three-part vacuum evaporator. By using the separated steam in the neutralizer solution is adjusted to a concentration of 98-99% NH_4NO_3.

The resulting melt is fed through a separator nitrate in the granulation tower (height 30-35 m). The melt is sprayed rotating disk, and it drops, falling into the current of cold air freeze. Then the granules (2-3 mm diameter) are sent for drying and packaging.

Urea

Carbamide (urea) $(NH_2)_2CO$ - most valuable nitrogen fertilizer. Urea is also used in agriculture as feed for livestock. In industry, it is prepared from urea resin, reaching the production of valuable plastics, chipboard, synthetic adhesives, compositions for impregnating fabrics, etc. Urea is used in the pharmaceutical industry in the purification of petroleum products, and I urilona preparation of synthetic fibers, etc.

The raw material for the production of urea are carbon dioxide and ammonia. Urea synthesis proceeds in two stages. The first stage is the formation of carbamic acid, ammonium (carbamate):

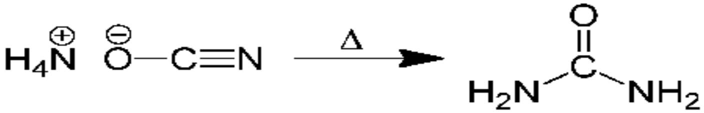
$$CO_2 + 2NH_3 \rightarrow NH_2 - COONH_4 + 150kJ.$$

Carbamate then dehydrates to form urea:

$$NH_2 - COONH_4 \rightarrow CO\ (NH_2)_2 + H_2O - 258\ kJ.$$

Total carbamide is a heterogeneous process in the "D - F" flowing in the kinetic region.

Synthesis of urea:



In industrial synthesis of urea is carried out at 180 ... 200 °C, a pressure of 20 MPa with 100% excess ammonia. This synthesis takes place in a pressure column. In the distillation column from the urea melt distills the excess ammonia and decomposition products of ammonium salts of carbonic acid.

Urea solution is evaporated in an evaporator, and then crystallized in crystallizer, the crystals are separated from the mother liquor in the filter equipment or granulated in the granulation tower. Gaza after distillation sent to the regeneration and the further use for the production of ammonium nitrate.

For liquid nitrogen fertilizers are either solutions containing ammonia water (ammonia water) or a solution comprising ammonia besides urea or ammonium nitrate.

Phosphate fertilizers - fertilizers containing phosphorus. By phosphorus fertilizers are superphosphate, triple superphosphate, precipitate, ammonium phosphate, diammonium phosphate, ortho and potassium metaphosphate tomasshlak, phosphate and bone meal, etc.

The raw material for the production of phosphate fertilizers are apatite, phosphates, bone, sulfuric and phosphoric acid. Apatite - a mineral, which is part of igneous rocks, phosphorus - rock of sedimentary origin. In these natural phosphate phosphor is in an insoluble form, mainly in the form fluorapatite $Ca_5F(PO_4)_3$ or tricalcium $Ca_3(PO_4)_2$.

For digestible plant fertilizer applied in any soil, it is necessary to translate natural insoluble phosphates in the water-soluble salts or easily digestible. This translation is performed decomposition of acids or heat (such as sublimation of phosphorus).

Methods of processing phosphate ores in artificial fertilizers can be divided into the following groups:

1. decomposition of natural phosphates acids (sulfuric, nitric, phosphoric, hydrochloric less). This yields mainly water-soluble fertilizers - superphosphate, triple superphosphate;

2. hydrothermal processing of natural phosphates - steaming to give tsitratnorastvorimyh limonnorastvorimyh or so-called fluorine-free phosphate;

3. The decomposition of natural phosphates by melting or sintering them at high temperatures with the salts of sodium, potassium, magnesium and other alkaline earth metals. The result is nitratno- or lemon-soluble fertilizer - termofosfaty, processed phosphates.

Basic and most common phosphate fertilizers - superphosphate and triple superphosphate.

The chemical industry produces simple superphosphate, which is basically a mixture of calcium phosphate $Ca(H_2P0_4)_2$ and gypsum $CaS0_4$, as well as triple superphosphate - hydrated calcium monophosphate $Ca(H_2PO_4)_2 *H_2O$.

Potash

Potash fertilizers - substances used for plant nutrition. Basic nutrients in them is potassium. The potassium content in fertilizers determines the amount of K_2O per cent.

The most important types of potash fertilizers: potassium chloride, KCl (58-62% K_2O), potassium sulfate K_2SO_4 (45-50% K_2O), potassium, magnesium K_2SO_4-$MgSO_4$ (26-28% K_2O), potassium salt mixed (30-50% K_2O) obtained by mechanically mixing finely chopped sylvinite ore technical KCl.

Potash fertilizers are divided into three groups: concentrated, raw and mixed.

Concentrated potassium fertilizers are products of the factory processing of potash ores. These include potassium chloride, potassium sulfate, potassium and magnesium concentrate, potassium sulfate, magnesium (magnesium potassium).

Raw potash fertilizers are natural potassium ore milled - kainite, sylvinite. Mixed potash - potassium salt is obtained by mixing raw potash concentrated, typically with potassium chloride - 30% and a 40% potassium salt.

Potassium chloride is a concentrated potash. Is a white crystalline substance and is readily soluble in water. The nutrient content of K_20 is at 52-62%. The main raw material for the production of potassium chloride are natural potassium salts sylvinite and carnallite. Sylvinite is a mixture containing about 30% potassium chloride and 70% sodium chloride, carnallite ($KC1 -MgCl_2*6H_20$) comprises besides potassium chloride and magnesium chloride.

Feedstock comprises from 15 to 22% based on potassium K_2O. For the production of potash should be allocated from the minerals potassium chloride, to which it is included.

Preparation of potassium chloride from sylvite carried Halurgy methods, or a combination of flotation method.

Technology for producing potassium chloride

Halurgy method is based on the different solubility of potassium and sodium chlorides in long heating and cooling systems:

Upon receipt of potassium chloride sylvinite treated at elevated temperatures with a saturated salt solution. When this solution was enriched KCl, NaCl and a portion passes into a precipitate and is separated by filtration. The solution was then cooled. It was isolated from potassium chloride crystals which are separated from the mother liquor and dried. The mother liquor was again sent to the dissolution of sylvite. The resulting product contains 52-60% K_2O.

Flotation - A common method of mineral processing department gangue particles. The method is based on the difference in wetting the solids with water.

To create conditions of unequal water wettability of the individual components of rock used a variety of chemical compounds - flotation reagents (flotation reagents). They selectively enhance or weaken the wettability and adhesiveness to the air bubbles suspended mineral particles.

Introduced into the pulp flotation reagents called collectors (collectors), adsorbed surface of certain minerals (minerals), forming a hydrophobic adsorption layer.

Repellent particles of potassium chloride, wettability is lower wettability of sodium chloride, stick to the air bubbles rise to the surface of the pulp into the foam and removed along with it. Sodium chloride falls to the bottom of the apparatus.

The flotation process is carried out in the flotation machine, where the pulp is mixed and aerated, which is dispersed into small bubbles. By the method of mixing and aeration of the pulp flotation machines are divided into mechanical, and pneumatic pneumomechanical. Widespread use have pneumomechanical flotation machines, in which pulp mixing is carried out at the same time the impeller and compressed air.

Exercises:

1. Translate into Kazakh.
2. Write the esse.

Read the text

CHEMICAL INDUSTRY AND ENVIRONMENTAL PROTECTION

Start using coal was an important step in the development of chemical and technological activities. In the second half of the XIX century there was a large coke industry. Development of glass, soap industry, bleaching of fabrics, the number of which has increased significantly hampered by imperfect methods of production of soda and sulfuric acid. In 1791, a Frenchman Leblanom proposed inexpensive method of producing soda from available raw materials (rock salt, coal, limestone). This year is considered the date of occurrence of the chemical industry. Soda production is largely determined the structure of the chemical industry of the XIX century. In the second half of the XIX century began production of the first plastics, synthetic fibers, synthetic rubber. The development of chemistry and chemical technology (catalysis, electrolysis, electric) significantly changed the structure of the chemical industry. By the middle of the XIX century the attention of the chemical industry focuses primarily as chemical science on minerals. But since that time the study of organic compounds is beginning to attract more and more attention of chemists.

Beginning of XX century. marked in the chemical industry great success in the use of nitrogen in the air.

Development of organic synthesis industry and petrochemicals led to a significant increase in demand for chlorine, as an essential step chlorination until many processes. Chemical Industry of industry inorganic substances (soda, sulfuric acid, hydrochloric acid, and then the production of fertilizers) has become an industrial petrochemical synthesis. This process is accompanied by changes in raw material base - at first only rock salt, limestone, pyrite, then Chilean nitrate, phosphate, potash. With the development of organic chemistry the most important raw material of chemical industry becomes coal. There is a coke industry.

However, with the development of the chemical industry increased pollution problems, the question of environmental protection, etc.

1. Raw materials of chemical industry, communication with the environment

The raw material base of the chemical industry varies depending on natural and economic characteristics of individual countries and regions. In some areas - coal, coke oven gas, in others - oil, associated petroleum gas, salt, pyrites, gas waste ferrous and nonferrous metallurgy, in the third - table salt and others.

Commodity factor affects the specialization of territorial combinations of chemical plants. Chemical production with the improvement of technological methods may in turn affect the resource base.

The chemical industry is related to many industries. It is combined with the refining, coking coal, ferrous and non-ferrous metallurgy, forestry industry.

Essential for placing chemical industries are raw, energy and consumer factors. Raw materials for the chemical industry is crucial, its share in the cost of finished products ranges from 45 to 90%. For example, the cost of raw materials per 1 ton of caprolactam up to 8 m, acetylene - 4.5, ammonia from coke -5.5 m.

Specific consumption of raw materials more units observed in soda, nitrogen fertilizer industries in the production of synthetic rubber, plastics and other products. In organic synthesis industry for the same product immediately takes a few raw materials.

In the chemical industry than in other industries, water is used. For the production of 1 ton of fibers need to 25 times more water than for melting 1 ton of iron, and ten times larger than for smelting 1 t of copper, lead or zinc. In general, application rates of water in chemical industry range from 50 m^3 in the production of chlorine and soda - 6000 m^3 in the production of synthetic fibers.

Vodoёmkosti factor severely limits options when placing the chemical industry. This is all the more important because a lot of raw materials found in shallow areas.

In many industries, the chemical industry there is a high demand for fuel and energy. For example, for the production of synthetic rubber based on acetylene must be 15 th. KWh, and phosphorus-20 rd ths. KWh per 1 ton of product. In the production of many kinds of synthetic products is absorbed thermal energy - steam. Therefore, it is part of the chemical production is guided only by the fuel and energy factor.

2. The chemical industry and environmental issues

Chemical pollution - solid, gaseous and liquid substances, chemical elements and compounds of artificial origin that enter the biosphere, in violation of the established nature of the cycle of matter and energy.

The most common pollutants are harmful gases: sulfur oxides (sulfur) - SO_2, SO_3; hydrogen sulfide (H_2S); carbon disulfide (CS_2); oxides of nitrogen (N) - Nox; benzpyrene; ammonia; chlorine; fluorine compounds; hydrogen sulfide; hydrocarbons; synthetic surface -active substances; carcinogens; heavy metals; carbon monoxide - CO, CO_2.

By the end of XX century. pollution waste, emissions, waste water of all types of industrial production, agriculture, utilities cities have become global and put humanity on the brink of ecological disaster.

The modern way of life, which is largely unchanged due to the wide use of chemical products, has become a dangerous source of pollution of the biosphere. Household wastes contain significant amounts of synthetic or artificial substances which are not digested in nature. So long eliminated from the natural geochemical cycles. Incineration of waste is often not possible due to the fact that the environment is polluted with toxic products of combustion (soot, polycyclic aromatic hydrocarbons, organochlorine compounds, hydrochloric acid, etc.). Therefore, there are landfill waste tires and plastic packaging. These dumps are good ecological niches for rats and related microorganisms.

Not excluded cases of fires that can transform entire regions into a zone of ecological disaster (reduced transparency of the atmosphere, toxic combustion products, etc.). Therefore, the acute problem of creating polymers that are naturally self-destruct, and quickly returned to normal geochemical cycle. A special group of the production of chemical warfare agents, medicines and plant protection products, as a synthesis of biologically active substances.

Primarily associated with a significant risk of the manufacturing process, as the staff is constantly working in an atmosphere with a high concentration of these substances. Significant problems associated with storing, and as it turned out now, and with the destruction of chemical warfare agents. Plant protection chemicals or pesticides that are designed specifically for spraying in the biosphere.

The total number of these poisons can hardly be called as constantly releasing new and discontinued production of the old, who have been in practice very harmful to them or have adapted those kinds of pests against which they are applied. But some of their number had already exceeded 1,000 compounds, mainly chlorine, phosphorus, arsenic, and organic mercury.

Since hydrocarbons released into the atmosphere and fuel combustion and from the petroleum refining industry and of the gas extraction industry.

Sources of pollutants are diverse, as are numerous types of waste and the nature of their impact on the components of the biosphere. The biosphere is contaminated solid waste, air emissions and wastewater metallurgy, metalworking and machine-building plants. Enormous harm caused water sewage pulp and paper, food processing, wood processing, petrochemical industry. Development of road transport has led to the pollution of the atmosphere of towns and transport links with heavy metals and toxic hydrocarbons and constant growth scale maritime caused almost universal pollution of seas and oceans of oil and oil products. The massive use of fertilizers and plant protection chemicals has led to toxic chemicals in the atmosphere, soil and natural waters, pollution of water bodies in nutrients, watercourses and agricultural products (nitrates, pesticides, etc.). When mining operations on the surface of the earth extracted millions of tons of different, often phytotoxicity rocks forming piles and piles that raise dust and burning. In the operation of chemical plants and thermal power plants also produced huge amounts of solid waste (cinder, slag, ash, etc.), which are stored on large areas, making a negative impact on the atmosphere, surface and ground water, soil cover (dust, isolation gases, etc.).

On the territory of Ukraine is 877 chemically hazardous facilities and 287 000 objects used in the manufacture highly toxic substances or their derivatives (in 140 cities and 46 towns). Chemical production capacity has also led to an increase in the amount of industrial waste that pose a threat to the environment and people.

Chemical-technological transformation of nature by man, next to the mechanical change of landscape and structure of the earth's crust, is the main means of the negative impact on the biosphere. Therefore there is a need to analyze the chemical and technological activities of mankind: the identification of its historical and cultural forms, scope and structure.

Chemical activity of mankind is very diverse and accompanies him almost from the outset znaryadiynoi practice. Strictly speaking, the chemical processing of nature is an integral feature of all living things.

Exercises:

1. Translate into Kazakh
2. Write the essay

ADDITIONAL MATERIALS

It is also *essential* that you memorize some common polyatomic ions. Polyatomic ions behave as a unit. If you need more than one of them, enclose them in parentheses when you write formulas. You need to know their names, formulas, and charges. If you learn the nine that follow, you can get many others from applying two simple patterns.

Name of polyatomic ion	**Formula and charge**
Ammonium ion	NH_4^+
Acetate ion	$C_2H_3O_2^-$
Cyanide ion	CN^-
Hydroxide ion	OH^-
Nitrate ion	NO_3^-
Chlorate ion	ClO_3^-
Sulfate ion	SO_4^{2-}
Carbonate ion	CO_3^{2-}
Phosphate ion	PO_4^{3-}

Naming Acids

How do you know it's an acid? The compound's formula begins with an H, and water doesn't count! Naming acids is extremely easy if you know your polyatomic ions. There are three rules to follow:

- **H + element**: When the acid has *only* an element following the H, use the prefix *hydro*-, followed by the element's root name and an -*ic* ending. HCl is hydrochloric acid; H_2S is hydrosulfuric acid. When you see an acid name beginning with *hydro*-, think: Caution, element approaching! HCN is an exception since it is a polyatomic ion without oxygen, so it is named hydrocyanic acid.
- **H + -*ate* polyatomic ion**: If the acid has an -*ate* polyatomic ion after the H, that makes it an -*ic* acid. H_2SO_4 is sulfuric acid.
- **H + -*ite* polyatomic ion**: When the acid has an -*ite* polyatomic ion after the H, that makes it an -*ous* acid. H_2SO_3 is sulfurous acid.

Acids have enough H^+ added to the anion to make the compound neutral. Supply either the acid's name or its formula to complete the table below:

Acid formula	Acid name
HCl	hydrochloric acid
HClO	Hypochlorous acid
$HClO_2$	Chlorous acid
$HClO_3$	Chloric acid
$HClO_4$	Hyperchloric acid (or perchloric acid)
HNO_3	nitric acid
HBr	Hydrobromic acid
H_3PO_4	phosphoric acid
H_3PO_3	Phosphorous acid
HCN	Hydrocyanic acid
H_2SO_4	sulfuric acid
H_2CO_3	Carbonic acid
HJ	Hydroiodic acid
HF	hydrofluoric acid
HNO_2	nitrous acid
H_2SiO_3	silicic acid
CH_3COOH	acetic acid
HCOOH	formic acid
H_2S	hydrosulphuric acid
$HMnO_4$	Permanganic acid
H_2SO_3	sulfurous acid

Naming Binary Molecular Compounds

How will you know if it’s a molecular compound? Well, it will be a combination of nonmetals, both of which lie near each other on the periodic table. Use the following set of prefixes, and don’t forget the -*ide* ending to the name.

Subscript	**Prefix**
1	*mono*- (usually used only on the second element, such as carbon monoxide or nitrogen monoxide)
2	*di*-
3	*tri*-
4	*tetra*-
5	*penta*-
6	*hexa*-
7	*hepta*-
8	*octa*-
9	*nona*-
10	*deca*-

If the second element's name begins with a vowel, the *a* at the end of the prefix is usually dropped. N_2O_5 is dinitrogen pentoxide, *not* dinitrogen pentaoxide. PCl_5 is phosphorous pentachloride, not phosphorous pentchloride.

Vocabulary

To absorb – абсорбировать, поглощать, впитывать
Abundant – распространенный
Accessible – доступный
Accident – случай, случайность
To accompany – сопровождать
To account (for) – обьяснять
Accuracy – точность
Acetate – ацетат
Acetic acid – уксусная кислота
Acetone – ацетон
Acetylide – ацетиленистое соединение металла
Acidification – подкисление
Acyl halide – галогенангрид карбоновой кислоты
Acrylic fibers – акриловые волокна
Actinoids – актиноиды
Activation energy – энергия активации
Addition – добавка, добавление
Addition reaction – реакция присоединения
Adenosine – адинозин
Adjacent – примыкающий, соседний, смежный
To adopt – принимать
Adverse – вредный, неблагоприятный
Aerosol – аэрозоль
Affinity – сродство, родственность, близость
Alcohol – спирт
Aldehyde – альдегид
Aliphatic – алифатический
Alkali metals – щелочные металлы
Alkaline – earth metals – щелочноземельные металлы
Alkaline solution – щелочной раствор
Alkanes – алканы
Alkanes – алкены
Allotropic – аллотропический
Allowable – допустимый
Alloy – сплав

Alteration – изменение, деформация
Aluminium – алюминий
Ambient – внешний, окружающий
Amide – амид
Ammonia – аммиак
Ammonium nitrate – нитрат аммония
Amorphous – аморфный
Amount – количество
Amphoteric – амфотерный
Anglesite – англезит
Anhydrite – ангидрит
Anhydrous – безводный
Annual – ежегодный
Anomalous – аномальный
Anthracite – антрацит
Antimony – сурьма
Apatite – апатит
Applied field – приложенное поле (электрополе)
Approach – подход, приблежение (о методе)
Aqueous – водный
Aragonite – арагонит
Arc – дуга
To arrange – располагать
Arsenic – мышьяк
Arsenide – арсенид
Arsenious oxide – оксид мышьяка
Atomic number – атомный номер
Attractive – притягательный
Average – средний
Azeotrope – азеотроп (раствор, система)
Baking powder – пекарный порошок
Barium – барий
Basalt – базальт
Bauxite – боксит
Bearing metals – баббит
Bed – пласт

Benzene – бензол
Benzonoid ring – бензоноидное кольцо
Beryllium – берилий
Bismuth – висмут
Bismuthinite – висмутин, висмутовый блеск
Bleachiing powder – отбеливающей порошок
To block – блокировать
Boiling point – температура кипения
Boron – бор
Boundary – пограничный, граница
Brass – латунь
Breadth – ширина
Brittle – хрупкий
Bromine – бром
Bromide – бромид
Buckyball – фуллерен
Buckytube – нанотрубка
Burette – бюретка
To burn – гореть
Burning – горение
Calcium – кальций
Cancer treatment agent – препарат для лечения рака
Car – exhaust gases – выхлопные газы
Carbon – углерод
Carbon dioxide – диоксид углерода
Carbon monoxide – моноксид углерода, угарный газ
Carbonaceous – углеродистый, каменноугольный
Carbonate – карбонат
Carbonic acid – угольная кислота
Carboniferous – каменноугольный, угленосный, карбоновый
Carbonize – обугливать
Carbonyl chloride – карбонил хлорид
Carboxyl group – карбоксильная группа
To cast – лить, отливать
Cast – iron – чугун
Catalyst – катализатор

Catalic reactor – каталитический реактор
To catalyze – катализировать
Cathode – катод
Caustic potash – гидроксид калия
Cesium – цезий
Chain – цепь, цепная, разветвленная
Charcoal – древесный уголь
Charge – заряд, заряжать
Chlorate – хлорат
Chlorine – хлор (газ)
Chromate – хромат
Chromic acid – хромовая кислота
Chromium – хром
Cinder – зола
Clay – глина
Cluster – кластер
Coagulation – коагуляция
Coal – уголь
Cobalt – кобальт
Coke – кокс
Colloids – коллоиды
Combustion – горение
Composition – состав
Compound – соединение
Condensation reaction – реакция конденсирования
Conductivity – проводимость
Conductor – проводник
Consistent – последовательный, совместимый, твердый, плотный
To consume – поглощать, потреблять
To contain – содержать
Contaminant – загрязнитель
To contaminate – загрязнять
To contribute – способствовать
Conventional – общеприятный, стандартный, традиционный
To convert – преобразовывать
To cool – охлаждать

To coordinate – координировать
Copolymer – сополимер
Copperas – купорос
Corona discharge – коронообразный разряд
Corroding lead – ржавеющий свинец
Corrosion resistance – коррозионная устойчивость
Coworkers – соавторы
Crude – сырой, необработанный, сырая нефть
Crystalloids – кристаллоид, кристаллические вещества
Curie point – точка Кюри
Current – струя, поток, течение
To cut – резать, отрезать, срезать
Cutting tool – режущий инструмент
Cyanide – цианид
Cyanohydrins – цианогидриды
Cycle – цикл, круг
Cyclical – циклический
Cyclopropane – циклопропан
Data – данные
Decade – десятилетие
To decant – фильтровать, декантировать
Decline – склон, уклон: идти к концу, клониться, падение, понижение
Declining – склоняющийся, изчезающий
To decompose – разлагать
Deficient – недостаточный, неполный
Definitive – окончательный, безусловный
Dehydration – дегидратация
Deliquescence – расплывание за счет атмосферной влаги
Deliquescent – растворяющийся
Density – плотность
To depend on – зависеть (от)
To deplete – истощать
Depletion – исчерпывание, истощение
Deposit – месторождение
Depression – снижение

Depth – глубина
Destructive distillation – сухая перегонка
Detection – определение, обнаружение
Detection limit – предел обнаружения
Determination – определение, нахождение
To develop – развивать, разрабатывать
Device – прибор
Diamond – алмаз
Diazotization – диазотирование
Dichromate – бихромат
Diesel oil – жидкая смазка, дизельное масло
Diethyl ether – диэтиловый эфир
Dipole – диполь
Direct current – постоянный ток
Disadvantage – вред, ущерб
Discoloration – изменение цвета
To discover – открыть, обнаружить
Dressed – обработанный
Drilling – бурение, высверливание
Ductile – плавкий, ковкий, тягучий
Dull – тусклый
Dyestuff – краситель
To educe – выделять
Efficient – эффективный, производительный
Effort – усилие, попытка, достижение
To elapse – протекать, истекать
Electric field – электрическое поле
Electrical double layer – двойной электрический слой
Electrical resistance – электрическое сопротивление
E.M.F. – Э.Д.С, электродвижущая сила
Emission – эмиссия, излучение, выделение
Emphasize – придавать особое значение, подчеркивать
Empty – пустой
Emulsion – эмульсия
Enamel – эмаль, покрывать эмалью
Enclosure – ограда, ограждение, огороженное место

Ester – сложный эфир
Esterification – этерификация
Ethanal (acetaldehyde) – этановый альдегид (ацетальдегид)
Ethan amide – этанамид
Etbane – этан
Etlranoic acid – этановая кислота
Ethanol – этанол
Ether – эфир
Ethereal – эфирный
Ethoxide – этилат
Ethoxyethane – диэтиловый эфир
Ethyne (acetylene) – этин (ацетилен)
To evolve – развивать, развертывать, выделять, испускать
Example – пример, образец, случай, служить примером
Excellent – превосходный, отличный
Exceptionally – исключительно, необычно, неповторимо
Excess – избыток
To exhale – выделяться, испаряться, выделять
Exhaust – выхлоп, выхлопная (труба)
To expand – увеличиваться, расширяться
Explosive – взрывчатое вещество
External – внешний
Extinction – затухание, потухание, тушение
To extract – экстрагировать, извлекать
Extremely – весьма
Fairly – справедливо, довольно, в известной степени, сносно
To fall – падать
Fat – жир, растительный жир, жирный
Fatty acids – жирные кислоты
To favor (favour) – благоприятствовать
Feasibility – возможность
Feldspar – полевой шпат
Fermentation – ферментация
Ferromagnetic – ферромагнитный
Ferrous alloys – сплавы черных металлов
Fertilizer – удобрение

Fibrous – волокнистый
To fill – наполнять, насыщать, заполнять
To find – находить
Fine particles – тонкодисперсные частицы
Fire – extinguisher – огнетушитель
Flakes – хлопья
Flake – слой
To flake – падать, расслаиваться
Flame – пламя
Flame blow off – срыв пламени
Flammability – воспламеняемость, огнеопасность
Flammable – воспламеняемый, огнеопасный
Float – пробка, поплавок
To float – плавать, всплывать
Flow rate – скорость потока
Flow reactor – поточный реактор
Fluid – жидкость, жидкий
Fluorescence – флюоресценция
Fluoride – фторид
Fluorine – фтор
Fluorite – флюорит
Flux – флюс
Focus – фокус, внимание
To form – образовывать
Fossil fuel – ископаемое топливо
Framework – структура
Francium – франций
Fuel – топливо
Fuel – rich flame – пламя, обогащенного топлива
Fullerene – фуллерен
Fullerite – фуллерит
Fume – дым, пар
To fuse – расплавлять, плавить
Fusible alloys – плавкие сплавы
Fusion – плавка, расплавление
Gap – промежуток, интервал

Gasoline – бензин
Gel – гель
Gemstone – драгоценный камень
Geodesy – геодезия
Geodetic – геодезический
Getter – геттер, газопоглотитель
Giant – гигантский
To give – давать
To give off – выделять
To give rise – приводить к образованию
To govern – управлять
Glue – клей, клеить
Graphite – графит
Greenhouse gas – тепличныйгаз
Greenhouse effect – парниковый эффект
Grinding – измельчение
Gunpowder – порох
Gypsum – гипс
Haematite – красный железняк
Hafnium – гафний
Halloysite – галлозит (алюмосиликат)
Halogen – галоген
Halon – галлон
Hardness – твердость
Hazardous – опасный
Heat – тепло
Heating – нагревание
Heat-resisting alloy – жаростойкий сплав
Hemihydrate – полугидрат
Hence – следовательно
Heptahydrate – гептагидрат
Heterogeneous – гетерогенный
Hexagon – гексагональный
Hexahydrate – гексагидрат
Hexaquocopper (II) – гексааквомедь(II)
High-strength alloy – высокопрочный сплав

Hole – дыра, отверстие, яма
Homogeneous – гомогенный
Human-induced damage – вред (ущерб) наносимый человеком
Hybrid – гибрид
Hydrocarbon – углеводород
Hydrocarbon flame – углеводородное пламя
Hydrochloric acid – хлористоводородная (соляная кислота)
Hydrogen bond – водородная связь
Hydrogen bromide – бромид водорода
Hydrogenation reaction – реакция гидрогенизации
Hydrogencarbonate – гидрокарбонат
Hydrolysis – гидролиз
Hydroscopic – гидроскопический
Hydroxide – гидрооксид (анион или об основаниях)
Hydroxyl group – гидроксильная группа
Igneous – огненный, пирогенный
Ignition – воспламенение, сжигание
Ilmenite – ильмент
To impart – давать, придавать, сообщать, передавать
Impermeable – непроницаемый, герметичный
Impurity – примесь
Incandescence – белый накал, накаливание
Inception – начало
Incidence – сфера действия, охват
To include – включать
Incomplete – неполный
To incorporate – включать
To increase – увеличивать
To induce – индуцировать, вызывать
Industrially – на производстве
Industrial atmosphere – производственная воздушная зона
Inefficiency – неспособность, неэффективность
Inevitable – неизбежный, неминуемый
Inflammable – легко воспламеняющийся, горючий
Inflammatory – возбуждающий
Infrared spectroscopy – инфракрасная спектроскопия

To ingest – глотать
To inhale – вдыхать
Inhibition – ингибирование, торможение
Inner – внутренний
To insert – вставлять, помещать
Insertion – вставление, включение
Inside – внутренняя сторона, внутри, внутренний
Instead – вместо
Interaction – взаимодействие
Interstitial – промежуточный
Invar – сплав железа с никелем
To invent – изобретать
To investigate – исследовать
Iodate – иодат
Iodide – иодид
Iodine – иод
Ionization energy – энергия ионизации
Iron – железо
To isolate – изолировать, обособлять, отделять
Kaolin – каолин
Kaolinit – каолинит
Kainite – каинит
Laminar flow – ламинарный поток
Lanthanum – лантан
Lanthanoids – лантаноиды
Laser – лазер
Lattice – решетка
Layer – слой
Lawrencium – лоуренсий
Leach – выщелачиватель, выщелачивать
Lead – свинец
Limestone – известняк
Limewater – жесткая вода, известковая вода
Liquid – жидкий, жидкость
Litharge – оксид свинца
Lithium – литий

To lose – терять, утрачивать
Low-melting-point casting – легкоплавкие сплавы
Lungs – легкие
Lustrous – блестящий
Magnesium – магний
Mainly – главным образом
Manganate (VII) (permanganate) – манганат (VII) (перманганат)
Manganese – марганец
Manure – удобрение, навоз
Marble – мрамор
Marine – морской
To measure – измерять
To melt – таять
Melting point – температура плавления
Member – член
Membrane – мембрана
Mercury – ртуть
To be mentioned – быть упомянутым, быть названным
Mesoporous – среднепористый
Methanal – метановый альдегид
Methane – метан
Methanides – метаниды
Methanoate – метанат
Methanoic acid (formic acid) – метановая кислота (муравьиная кислота)
Methanol – метанол
Methyamine – метиламин
Methylene – метилен (радикал)
Methylethylamine – метилэтиламин
Microgravity – микрогравитация
Migrate – мигрировать
Mine – рудник, шахта, копь
Minor – незначительныый, второстепенный
Miscible – способный, смешиваться
Mist – легкий туман, дымка
To mix – смешивать

Mixture – смесь
To moderate – умерять, сдерживать
Modification – модификация, изменение
Moist – сырой, влажный
Moisture – влага, сырость
Molten – расплавленный
Monoxide – монооксид
Montmorillonite – монтмориллонит
Mordant – едкий, протрава
Mortality – смертность
Mortar – ступка
Mortar and pestle – ступка и пестик
Nanotubes – нанотрубки
Natural (gas) – природный газ
Negative – отрицательный
Nettle – крапива, обжигаться крапивой
Neutron – нейтрон
Nitrate – нитрат
Nitre – селитра
Nitric acid – азотная кислота
Nitride – нитрид
To nitrify – нитрифицировать
Nitrile – нитрил
Nitrite – нитрит
Nitrogen – азот
Nitrogen cycle – азотный цикл
Nitrogen-fixing bacteria – бактерия, связывающая азот
Nitrous acid – азотистая кислота
Noble gas – благородный газ
Non-ferrous – цветной (о металлах)
Non-ferrous alloys – сплавы цветных металлов
Nonstoichiometric – нестехиометрический
Nuleophtles – нуклеофилы
Nucleus (pl. nuclei) – ядро
Oil – масло, нефть, смазать
Ore – руда

To oxidize – оксилять
Oxidizing acid – оксляющая кислота
Oxygen – кислород
To ozonize – озонировать
Palladium – палладий
Paraffin oil – парафиновое масло
Paraffin wax – парафиновый воск
Partially – частично
Particle – частица
Peat – торф
Perchloric acid – хлорная кислота
To permit – разрешать
Peroxide – пероксид
Petroleum – (природная, сырая) нефть, нефтяная
Pig- iron – чугун в чушках
Phothosynthesis – фотосинтез
Plagioclase – плагиоклаз (минерал)
Plastic – пластик, пластмасса, пластичный
Platy – плоский, пластинчатый (о структуре)
Poisonous – ядовитый
To polarize – поляризовать
Polyhedral – полиэдрический
Porosity – пористость
Porous – пористый
Potash – карбонат калия
Potassamide – амид калия
Potassium – калий
Potassium bromide – бромид калия
Potassium hydroxide – гидроксид калия
Potting – производство глиняных или керамических изделий
Powder – порошок
Precipitate – осадок, осаждать
Preparation – приготовление
Pressure – давление
To prevent – предотвращать
Previously – предварительно

Primary alcohols – первичные спирты
Primary amides – первичные амиды
To produce – производить, получать (на производстве)
To promote – способствовать
To propagate – распространять
Propanamide – пропан амид
Propane – пропан
Property – свойство
Proton – протон
Proton-acceptor – акцептор протона
Pungent – едкий, жгучий
Pyridine – пиридин
Pyroxene – пироксен (минерал)
Quantitative – количественный
Radium – радий
Rate – скорость
Raw materials – сырье
Reactant – реаген, вещество участвующее в реакции
Reactive – химический активный
Roactivity – реакционная способность
Reagent – реагент, реактив (химическое соединение)
Reagent paper – лакмусовая бумага
To reduce – восстанавливать (в химической реакции)
Reducing agent – восстановитель
Reduction – восстановление
To refer to – относиться, ссылаться
Refinery – очистительный завод
Reforming – риформинг (нефтепродуктов)
Refractory – огнеупорный материал, тугоплавкий
Refrigeration – охлаждение, замораживание
Reletive atomic mass (r.a.m) – относительная атомная масса
Reserve – резерв, запас, зап сберегать
Resin – смола
Respiration – дыхание
Rubber – резина, каучук, покрывать резиной
Safety – безопасность

Salicylate – салицилат, эфир салициловой кислоты
Sand – песок, гравий
Saturation – насыщение
Scandium – скандий
Scum – пена, накипь, шлак
Secondary alcohol – вторичный спирт
Selective – выборочный, селективный
Shallow – поверхостный
Shape – вид, форма
Sheen – пластина
Shock tubes – ударные
Slit-Shaped – щелеобразный
Smaltite – смальтит (минерал)
Sodium – натрий
Soft – мягкий
Soil – почва
Sol – золь
Solid lubricant – смазывающий материал твердой консистенции
Solubility – расворимость
Soluble – растворимый
Solute – растворенное вещество
Solution – раствор
Solvation – сольватация
Solvent – растворитель
Soot – сажа
Soot formation – сажеобразование
Sparingly soluble – плохо растворимый
Specific gravity – удельный вес
Stable – устойчивый
Stainless steel – нержевеющая сталь
Starch – крахмал
Steam – пар
Stinging – жгучий, острый
Stirring – помешивание, взбалтывание
Stock solution – основной раствор
Stream – поток, струя

To strike (struck) – зажигать
Strong – сильный, прочный
Strontium – стронций
To sublime – сублимировать
Sulphate – сульфат (VI)
Sulphide – сульфид
Sulphide galena – галенит (минерал), сульфид свинца
Sulphite – сульфит (IV)
Sulphur – сера
Sulphuric acid – серная кислота
Sum – сумма
Superacid – суперкислота
Super oxide – супероксид
Support – поддержка, основа, подложка
To suppress – подавлять
To surround – окружать
Suspended – взвешенный
Tar – деготь
Ternary – тройной, трехкомпонентный
Tertiary alcohol – третичный спирт
Tetrachloromethane – тетрахлорметан
Tetrahedron – тетраэдр
Thermal conductivity – термическая проводимость
Thorium – торий
Tiles – черепица, кафель
Tin – олово
Transition – переход
Transition elements – переходные элементы
Transparent – прозрачный
Trend – направление
True (solution) – истинный раствор
Tunable – настраиваемый, перестраиваемый
Tungsten – вольфрам
To undergo – испытывать, подвергаться
Unique – уникальный
Univalent – одновалентный

Unknown – неизвестный
Urea – мочевина
Urea-formaldehyde resins – мочевиноформальдегидные смолы
Value – значение
Vapour – пар
Velocity – скорость
Vigorously – сильно, энергично
Viscose – вискоза (шелк вискозный)
Vitriol – медный, железный купорос
Volatile – летучий, легко испаряющийся
Voltage – напряжение (электрическое)
Warming – потепление
Wax – воск
Whitewash – известковый раствор для побелки, побелька
Wine stone – винный камень
To withstand – выдержать, пройти
Woody-fiber – древесное волокно
Wrought iron – сварочное железо
Xanthate – ксантат
Zinc – цинк
Zirconium – цирконий

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CHEMICAL TEXTS.

Zh.Tursinova., Myrzakhmetova N.O., Abdraimova M.R., Nurbekova M.A.

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