Східноєвропейський національний університет імені Лесі Українки
Інститут іноземної філології
Кафедра іноземних мов природничо-математичних спеціальностей

ENGLISH WITH DICTIONARIES USE
FOR THE STUDENTS OF CHEMISTRY

Луцьк – 2014

УДК 811.111(075)
ББК 81.432.1–923.7
К 43
Рекомендовано до друку вченою радою Східноєвропейського національного університету імені Лесі Українки (протокол № 11 від 24 квітня 2014 року)

Рецензенти:

Приходько В. Б. – кандидат філологічних наук, доцент кафедри іноземних мов Луцького національного технічного університету

Гончарук С. В. – кандидат філологічних наук, доцент кафедри практики англійської мови Східноєвропейського національного університету імені Лесі Українки

Бляшевська А. В. – кандидат педагогічних наук, доцент, голова циклової комісії викладачів іноземних мов Луцького педагогічного коледжу

К 43 English with Dictionaries Use for the Students of Chemistry – Англійська мова з використанням словників для студентів хімічного факультету: навч. посіб. / Уклад. В. В. Кирикилиця, О. П. Яциняк, – Луцьк: Вежа-Друк, 2014. – 120 с.

Навчальний посібник «English with Dictionaries Use for the Students of Chemistry» укладений відповідно до вимог робочих навчальних програм курсу «Англійська мова (за професійним спрямуванням)» для студентів І та ІІ курсів хімічного факультету. Посібник складається з восьми змістових модулів, добірки текстів для самостійної роботи, статей для реферування та тематичного глосарію.

Кожний модуль поділений на чотири частини, до трьох з яких входить текст або інше завдання фахового орієнтування та комплекс вправ лексико-граматичного і комунікативного характеру, виконання яких передбачає використання словників різних типів; четверта частина містить пояснення граматичних явищ, які трапляються в модулі, і вправи на їх закріплення на базі фахової лексики.

Призначений для студентів спеціальності «Хімія» та суміжних спеціальностей різних форм навчання, а також для хіміків-фахівців, які прагнуть поліпшити знання англійської мови за фахом.

УДК 811.111(075)
ББК 81.432.1–923.7

PREFACE

The present manual is intended as a practical aid for the chemistry students with a very diverse level of English and designed to meet the needs of the course “Profession-oriented English language study” at the Faculty of Chemistry.

The purpose of this book is to systematize and enrich the vocabulary of the students on the themes of chemistry and to encourage them to learn new terminology.

The manual contains 8 modules with profession oriented texts for reading and discussion and a lot of lexico-grammatical and communicative exercises that can help the students to learn special vocabulary. The learner will find a large number of chemical terms and notions in each module of the manual.

Grammar is included with the aim of demonstrating and explaining grammatical rules by means of examples taken directly from the texts. For the more advanced students, grammatical exercises in this material can serve for revision while the beginners might need more supplementary materials.

The material of the manual can be used not only by the students of the chemical faculty but it can also serve as a source of educational and practical information for the students of the related specialities and chemical experts who are interested in improving their knowledge of profession-oriented English.

MODULE 1. **WHAT IS CHEMISTRY?**

Part 1. Text. Chemistry as a Branch of Science

Task 1. Before reading the text discuss the following questions:

1. Why did you choose to study at the faculty of chemistry at Lesia Ukrainka East European National University?
2. How much do you know chemistry? Can you define it?
3. What is interesting about chemistry for you?
4. What was your first encounter with chemistry?
5. Do you remember your first chemical experiment?

Task 2. Find the proununciation of the new words from the text in a dictionary and learn them:

property – *властивість*
substance – *речовина*
primary – *основний*
to define – *визначати*
molecule –*молекула*
to abandon – *відмовлятися*
voltaic – *гальванічний*
cell – *елемент*
to equilibrate – *урівноважувати*
constituent – *складовий*
alkali – *луг*
oxide – *оксид (окис)*
solution – *розчин*
hypothesis – *припущення*
hydrogen – *водень*
synthesis – *синтез*
simultaneously – *одночасно*
triumph – *тріумф*
collaboration – *співробітництво*
inert – *інертний*

The simplest and shortest definition of chemistry is "scientific study of **matter**, its properties, and **interactions** with other matter and with energy". An important point to remember is that chemistry is a science, which means its **procedures** are systematic and **reproducible** and its **hypotheses** are tested using the scientific method. Chemists, scientists who study chemistry, **examine** the properties and composition of matter and the **interactions** between substances. Chemistry is closely related to physics and to biology. As is true for other sciences, mathematics is an **essential tool** for the study of chemistry. Chemistry is a branch of science concerned with the **properties,** composition, and structure of substances and the changes they undergo when they combine or react under specified conditions. Chemistry can be divided into branches according to either the substances studied or the types of study conducted. There are more than 30 different branches of chemistry.

The primary division of the first type is between inorganic and organic chemistry. Divisions of the second type are physical and analytical chemistry. The original **distinction** between organic and inorganic chemistry arose as chemists gradually realized that compounds of biological origin were quiet different in their general properties from those of mineral origin; organic chemistry was defined as the study of substances produced by living organisms. However, when it was **discovered** in the 19^{th} century that organic molecules can be produced artificially in the laboratory, this definition had to be abandoned. Organic chemistry is most simply defined as the study of the compounds of carbon. Inorganic chemistry deals with the study of materials not derived from living organisms. However it now includes all substances other than the hydrocarbons and their derivatives.

Physical chemistry is concerned with the physical properties of materials, such as their electrical and magnetic behavior and their interaction with electromagnetic fields. Subcategories within physical chemistry are thermochemistry, electrochemistry and chemical kinetics. Thermochemistry is the **investigation** of the changes in energy and entropy that occur during chemical reactions and phase transformations. Electrochemistry concerns the effects of electricity on chemical changes and interconversions of electric and chemical energy such as that in a voltaic cell. Electrolysis may be an example of it. Chemical kinetics is concerned with the details of chemical reactions and of how equilibrium is reached between the products and reactants.

Analytical chemistry is a collection of techniques that allows exact laboratory determination of the composition of a given sample of material. In qualitative analysis, all the atoms and molecules present are identified, with particular attention to trace elements. In quantitative analysis, the **exact** weight of each constituent is obtained as well.

Synthetic chemistry deals with the methods by which complex bodies may be built from simpler substances. The so-called polymers are a new type of material. It is the product of organic synthesis. These materials possess truly remarkable properties which in some respect are similar to the properties of natural metals. Sometimes synthetic plastics combined with natural elements might have even more valuable properties than natural ones have.

Electrochemical theories of chemical combinations were developed by Humphry Davy and J. J. Berzelius. Davy discovered the alkali metals by passing an electric current through their molten oxides. Michael Faraday discovered that a **definite** quantity of charge must flow in order to deposit a given weight of material in solution. Amedeo Avogadro introduced the hypothesis that equal volumes of gases at the same pressure and temperature contain **the same** number of molecules. William Prout suggested that all elements are composed of hydrogen atoms. Organic chemistry developed extensively in the 19^{th} century prompted in part by Friedrich Wohler's synthesis of urea (1828), which disproved the belief that only living organisms could produce organic molecules.

The periodic table of the elements is the culmination of a long effort to find regular, systematic properties among the elements. Periodic laws were put forward almost simultaneously and independently by J.L. Meyer in Germany and D.I. Mendeleev in Russia (1869). An early triumph of the new theory was the discovery of new elements that fit the **empty** spaces in the table. William Ramsay's discovery, in collaboration with Lord Rayleigh, of argon and other inert gases in the atmosphere extended the periodic table. At the end of the 19^{th} century the discovery of the electron by J.J. Thomson and of radioactivity by A.E. Becquerel revealed close connection between chemistry and physics.

(повтор с.4) An important point to remember is that chemistry is a science, which means its procedures are systematic and reproducible and its hypotheses are tested using the scientific method. Chemists, scientists who study chemistry, examine the properties and composition of matter and the interactions between substances. Chemistry is closely related to physics and to biology. As is true for other sciences, mathematics is an essential tool for the study of chemistry.

Task 3. Answer the questions on the text:

1. How many meanings of the word chemistry are mentioned in the text?
2. Which definition of chemistry is the clearest for you?
3. Which branches of science are, according to the text, closely related to chemistry? Do you agree?
4. Why, according to the text, is chemistry a science? What criteria are mentioned?

5. Do you think that mathematics is an essential tool for the study of chemistry, as the text says? Do you as the students of chemistry need to study mathematics?
6. How many different branches of chemistry are there?
7. What does inorganic chemistry deal with?
8. What does organic chemistry deal with?
9. What is the subject of electrochemistry?
10. What methods does synthetic chemistry deal with?

Task 4. Find synonyms to the words in bold **from the text:**

similar, qualities, to invent, research, precise, difference, vacant, certain.

..........., ..., ..., ..., ..., ..., ..., ...

Task 5. Translate the derivative words and define the ways of word formation:

period – periodic,	to arrange – arrangement,
system – systematic,	to exist – existence,
peculiar – peculiarity,	to predict – prediction,
similar – similarity,	to discover – discovery,
chemical – chemistry – chemist,	to know – knowledge,
to depend – dependent – dependence,	to contain – container,
to define – definite – definition,	important – importance.

Part 2. Text. Alchemy

Task 6. Read the text and give Ukrainian equivalents of the expressions *in italics* from the text.

Alchemy in the Middle Ages was a mixture of science, philosophy and mysticism. At the heart of **medieval** alchemy was the idea that all matter was composed of four **elements**: earth, air, fire and water. With the right combination of elements, any substance on earth might be formed. This included **precious metals** as well as elixirs **to cure** disease and **prolong** life. Alchemists believed that the "transmutation" of one **substance** into another was possible; thus we have the **cliche** of medieval alchemists **seeking to** *"turn lead into gold"*.

Goals:

• To find the *"philosopher's stone,"* an elusive substance that was believed to make possible the creation of an *elixir of immortality* and the transmutation of common substances into gold.

• In the later Middle Ages, to use alchemy as a tool in the **advancement** of medicine.

Achievements:

• Medieval alchemists produced **hydrochloric acid**, **nitric acid**, **potash** and **sodium carbonate**.

• They were able to identify the elements **arsenic**, **antimony**, and **bismuth**.

• Through their experiments, medieval alchemists **invented** and **developed** laboratory devices and procedures that are, in modified form, still used today.

• The practice of alchemy **laid the foundation** for the development of chemistry as a scientific discipline.

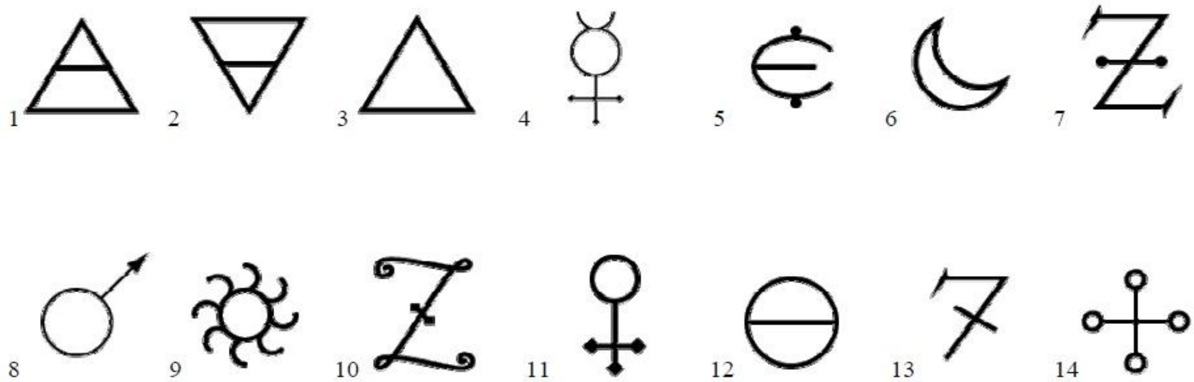
There were often many symbols for an element. For a time, the astronomical symbols of the planets were used **to denote** the elements. However, as alchemists came to be **persecuted**, particularly in medieval times, secret symbols were invented. This led to a great deal of **confusion**, so you will find some **overlap** of symbols. The symbols were in common use through the 17th century; some are still in use today.

Task 7. Find the meaning and pronunciation of the words in bold **in a dictionary and write down all the chemical terms from the text into your vocabulary.**

Task 8. Answer the questions on the text:

1. What is alchemy?
2. What is the difference between alchemy and modern science?
3. Have you ever read a book or seen a film that dealt with alchemy?
4. Are there any famous alchemists you know?
5. Were the goals of alchemy achieved?
6. What are the goals of modern chemistry?
7. What was the meaning of the word “element” in the Middle Ages? Is it different now?
8. What symbols do we use for elements today?

Task 9. Look at the symbols above that alchemists used. Can you guess which elements they symbolize? One element can have several symbols.



copper tin mercury gold silver air earth fire iron salt

Task 10. Write a short report for your groupmates explaining the difference between alchemy and modern science. When writing reports follow the standart format:

1) title; 2) purpose; 3) short paragraphs giving facts; 4) opinions/comments; 5) conclusion.

Part 3. Text. The Greatest Chemist of the World

Task 11. Read the text and find the meaning and prounounciation of the following words and expressions in a dictionary:

outstanding	to commemorate
law	diverse
nuclear charges	selflessly
contribution	to devote to
to predict	varied
fission	extraction
artificially	investigation

Modern chemical science is based on the achievements of such an outstanding scientist as D. I. Mendeleyev. The name of Dmitry Ivanovich Mendeleyev is inseparably associated in everyone's mind with one of the fundamental scientific laws – the law of periodicity of chemical elements and the Periodic System based on this law. His greatest discovery the Periodic Law is one of the corner stones of modern chemical theory. It can be simply stated as follows: the properties of the elements are a periodic function of the nuclear charges of their atoms. The Periodic System of chemical elements that was published in 1869 has long since been rightfully placed among the greatest history-making contributions to the study of nature.

It allowed the existence of yet undiscovered elements to be predicted in advance. Many outstanding researchers owe to it, to a considerable degree, the ideas of their experiments, calculations, hypotheses and theories. Take the English scientist Frederick Soddy and Henry Moseley, for instance, who found the regularities of radioactive transformations. Or the New Zealander Ernest Rutheford and the Dane Niels Bohr, who "designed" the famous planetary model of atom. Or the German Otto Hahn, who discovered the fission of the uranium nucleus. Or the American Glenn Seaborg who led a group of researchers that obtained, in laboratory conditions, a number of elements, including mendelevium.

Mendelevium, one of the transuranium elements (№ 101), which has been artificially produced, was named in honour of the greatest Russian scientist, as Seaborg himself stressed, not only because Mendeleyev laid the foundation of the modern science of atoms, but also because he drew a special attention to uranium (№ 92), which at the time has closed his periodic table. The once "final" uranium was followed by a long train of transuraniums.

The Joint Nuclear Research Institute – the international research center in Dubna (not far from Moscow) – has a laboratory which has become the cradle of many transuraniums. They include joliotium (№ 102), rutherfordium (№ 103), kurchatovium (№ 104) and nielsbohrium (№ 105), names by which the scientists commemorated the great physicists, from Rutherford and Bohr to Frederick Joliot Curie and Igor Kurchatov.

"The greatest chemist of the world" – this is Mendeleyev's fame among the people following his footsteps. Yes, he, the founder of modern chemistry and, to a larger degree, of modern physics, considered physical chemistry his main subject, while he successfully dealt with problems in many diverse areas, from mathematics and astronomy to meteorology, from philosophy to economics, from technology to arts.

Mendeleyev selflessly devoted himself to nature exploring. He also devoted much of his efforts to teaching, to the rearing of a new scientific generation, to the spread of knowledge and to the improvement of the educational system. Finally, he concentrated much of his attention on the deep processing of oil. He laid the foundation of petrochemistry.

These are only a few aspects of his varied activities.

Task 12. Answer the questions on the text:

1. What is the greatest Mendeleyev's contribution to science?
2. What can the Periodic Law be simply stated?
3. Which scientists can owe their ideas to Mendeleyev's law of periodicity of chemical elements?
4. What is interesting about such a transuranium element as mendelevium?
5. What are the most important aspects of Mendeleyev's varied activities?

Task 13. Insert prepositions if necessary. If you are not sure that it is the required preposition, check it in a dictionary :

D. I. Mendeleyev, the great Russian scientist, was born ... Tobolsk, Siberia, ... 1834. ... the age of sixteen he entered the Institute … Pedagogy ... St. Petersburg, from which he graduated ... 1855. Two years later he presented his thesis ... the degree ... Master ... science ... chemistry and … some years abroad he was given his Doctor's degree. ...1856 he worked as a professor of the University ... St. Petersburg where he gave a course ... lectures ... theoretical, organic and technological chemistry. He was warmly loved ... his students ... the University.

Mendeleyev's greatest discovery was the Periodic Law, which was published … 1869. Mendeleyev was interested not only... chemistry. He made great contributions ... the studying ... petroleum extraction and aeronautics. He was greatly interested ... shipbuilding and investigation of the Polar regions. Once Mendeleyev ascended all … himself ... a balloon to watch a solar eclipse. He put ... the idea ... an investigation … the upper layers ... the atmosphere which he called the great weather laboratory. Mendeleyev was a great patriot. He looked ... work as man's duty and calling. The Russian people are justly proud … their great son, the genius ... science Dmytro Mendeleyev.

Task 14. Find the following words and expressions in the text in Task 11 and translate the following sentences:

внесок в науку,	йти чиїмись слідами,
передбачати,	увічнювати,

закладати основи,	мати справу з,
привертати увагу,	безкорисливий,
присвятити себе чомусь,	зусилля.

1. Сучасна хімія зробила величезний крок вперед порівняно з хімією минулого століття.

2. Величезний внесок у розвиток вітчизняної хімії зробили такі вчені, як Микола Зінін, Олександр Бутлеров, Микола Бекетов і багато інших.

3. Без хімії неможливо уявити собі життя сучасного суспільства.

4. Українські хіміки спрямовують багато зусиль у науково-технічний прогрес.

5. Основи сучасної хімії і, значною мірою, сучасної фізики заклав Д. І. Менделєєв.

Task 15. Make up a dialogue about chemistry and the outstanding chemists and dramatize it with a partner.

Part 4. GRAMMAR: Singular and Plural of Nouns

RULE: Some words which retain their original Greek and Latin forms make their plurals according to the rules of Greek and Latin with English pronunciation.

	singular ending	*plural ending*
Latin words:	alga	algae
	radius	radii
Exception:	corpus	corpora
	curriculum	curricula
Greek words:	synthesis	syntheses
	hypothesis	hypotheses
	phenomenon	phenomena
	criterion	criteria
Some of these words have double plural form:		
	formula	formulae *or* formulas
Some words follow the English rules:	dogma	dogmas

Exercise 1. Change the following sentences from plural to singular.

1. What criteria did the scientists use?
2. The formulas represent the molecular structures of the substances.
3. The investigated phenomena are not frequent.
4. The analyses of the results did not prove his hypotheses.
5. Electrolysis is used for purifying certain metals.

Exercise 2. **Find the nouns related to chemistry in any direction of the diagram. Then check the plural of these nouns in a dictionary and write them down.**

W	U	Y	E	R	U	S	S	E	R	P	M	H	H
S	R	Z	A	E	B	E	A	K	E	R	G	E	K
X	K	D	R	E	O	I	L	T	D	M	A	X	O
E	I	F	P	A	R	T	I	C	L	E	S	P	I
C	M	L	L	D	O	O	H	H	I	T	S	E	L
N	N	A	G	K	N	E	N	A	Q	A	A	R	D
A	B	S	D	O	M	O	E	R	U	L	M	I	P
T	I	K	A	I	E	T	B	G	I	E	R	M	U
S	M	B	C	L	C	C	O	E	D	S	B	E	T
B	E	A	A	L	K	A	L	I	V	S	J	N	V
U	L	A	B	S	G	E	E	B	N	E	L	T	K
S	T	S	A	E	F	R	O	P	K	V	R	O	I

Exercise 3. Write the plural form of the words in *italics*.

1. Even the best psychiatrists sometimes make mistakes in their *diagnosis* and treatment.

2. Nuclear energy is produced using the heat generated by splitting the *nucleus* of atoms of certain elements.

3. Atoms emit or absorb *quantum* of equal energy.

4. Chemical *equilibrium* may be classified into two groups, namely homogenous and heterogenous *equilibrium*.

5. After analyzing the *datum*, they were able to draw conclusions.

Exercise 4. Define which nouns are in Plural and which ones are in Singular:

Datum, radius, nuclei, phenomena, bases, analysis, libraries, phenomenon, basis, nucleus, data, radii, library, analyses.

Exercise 5. Some English words look like plural but are used with a verb in singular. Can you think of any examples?

e.g.: Mathematics is an essential tool for studying other sciences.

MODULE 2. **FUNDAMENTAL CONCEPTS OF CHEMISTRY**

Part 1. Text. Chemistry Basics

Task 1. Read the text and find the meaning and pronunciation of the following words in a dictionary:

an atom	atomic number	a chemical
a particle	an ion	ionic
a proton	an isotope	a neutron
a nucleus	nuclei	to bond
a molecule	molecular	neutral
an electron	electrical charge	magnitude

As we said, chemistry is the study of matter and the interactions between different types of matter and energy. The fundamental building block of matter is the atom. An atom consists of three main parts: protons, neutrons, and electrons. Protons have a positive electrical charge. Neutrons have no electrical charge. Electrons have a negative electrical charge. Protons and neutrons are found together in what is called the nucleus of the atom. Electrons circle around nucleus.

Chemical reactions involve interactions between the electrons of one atom and the electrons of another atom. Atoms which have different amounts of electrons and protons have a positive or negative electrical charge and are called ions. When atoms bond together, they can make larger building blocks of matter called molecules.

All matter consists of particles called atoms. Here are some **useful** facts about atoms:

• Atoms cannot be divided using chemicals. They do consist of parts, which **include** protons, neutrons, and electrons, but an atom is a basic chemical building block of matter.

• Each electron has a negative electrical charge.

• Each proton has a positive electrical charge. The charge of a proton and an electron are **equal** in magnitude, yet opposite in sign. Electrons and protons are electrically attracted to each other.

• Each neutron is electrically neutral. In other words, neutrons do not have a charge and are not electrically **attracted** to either electrons or protons.

• Protons and neutrons are about the same size as each other and are much **larger** than electrons.

• The mass of a proton is essentially the same as that of a neutron. The mass of a proton is 1840 times **greater** than the mass of an electron.

• The nucleus of an atom contains protons and neutrons. The nucleus carries a positive electrical charge.

• Electrons move around **outside** the nucleus.

• Almost all of the mass of an atom is in its nucleus; almost all of the volume of an atom is occupied by electrons.

• The number of protons (also **known** as its atomic number) determines the element. Varying the number of neutrons results in isotopes. Varying the number of electrons results in ions. Isotopes and ions of an atom with a constant number of protons are all variations of a single element.

• The particles within an atom are bound together by powerful forces. In **general**, electrons are **easier** to add or remove from an atom than a proton or neutron. Chemical reactions largely involve atoms or groups of atoms and the interactions between their electrons.

Task 2. Make opposites of the words written in bold above.

Task 3. Read the text and fill in the gaps with the expressions from the box in appropriate forms. Use each expression only once.

chemical formula, chemical equation, proton, neutron, element, electron, atomic nucleus, molecule, cation, anion, ion, chemical compound, chemical reaction, chemical bonds, atomic number

An **atom** is a collection of **matter consisting of** a positively **charged core** (the ....) which **contains** .... and .... and which **maintains** a number of electrons to **balance** the positive charge in the nucleus. The atom is also the smallest **portion** into which an .... can be divided and still **retain** its properties, made up of a **dense**, positively charged nucleus surrounded by a system of ....

The most basic chemical **substances** are the chemical **elements**. They are building blocks of all other substances. An element is a class of atoms which have the same number of protons in the nucleus. This number is known as the ....of the element. For example, all atoms with 6 protons in their nuclei are atoms of the chemical element **carbon**, and all atoms with 92 protons in their nuclei are atoms of the element **uranium**. Each chemical element is made up of only one kind of atom. The atoms of one element **differ** from those of all other elements. Chemists use letters of the alphabet as symbols for the elements. In total, 117 elements have been observed as of 2007, of which 94 occur naturally on Earth. Others have been produced **artificially**.

An .... is an atom or a **molecule** that has lost or **gained** one or more electrons. Positively charged .... (e.g. **sodium** cation Na^+) and negatively charged .... (e.g. **chloride** Cl^-) can form **neutral salts** (e.g. **sodium chloride** NaCl).

Electrical forces at the atomic level create .... that join two or more atoms together, forming .... Some molecules consist of atoms of a single element. **Oxygen** molecules, for example, are made up of two oxygen atoms. Chemists represent the oxygen molecule O2. The 2 indicates the number of atoms in the molecule.

When atoms of two or more different elements **bond together**, they form a .... Water is a compound made up of two **hydrogen** atoms and one oxygen atom. The................ .... for a water molecule is H2O.

Compounds are formed or broken down by means of .... All chemical reactions **involve** the **formation** or **destruction** of chemical bonds. Chemists use .... to express what **occurs** in chemical reactions. Chemical equations consist of chemical formulas and symbols that show the substances **involved in** chemical change. For example, the equation

$$C + O2 \longrightarrow CO2$$

expresses the chemical change that occurs when one **carbon** atom **reacts**, or bonds, with an oxygen molecule. The reaction produces one molecule of **carbon dioxide**, which has the formula CO2.

Task 4. Find out the meaning and pronunciation of the chemical elements and compounds in bold **from the text of Task 3 in a dictionary and rewrite them into your vocabulary.**

Task 5. Make a plan of the text "Chemistry Basics"and retell its content.

Part 2. The Atomic Theory.

Task 6. Read the text, rewrite the pronunciation of the following words from a dictionary and memorize them:

to subdivide – *підрозділяти*
to arrange – *влаштовувати*
to separate – *відділяти, розділяти*
a ratio – *відношення, пропорція*
to grind (into power) – *розтерти (в порошок)*
to obtain an image – *отримати зображення*
to perform experiments – *проводити експерименти*
a fluorescent screen – *флуоресцентний екран*
a solution – *розчин*
a compound – *сполука*
stable – *стійкий*
equal – *рівний*

If we divide an element into small parts and then subdivide these parts into still smaller ones, we will reach a stage at the end when it will be impossible to continue this process of division.

A grain of sand can be broken into smaller pieces, then ground into powder, and still the substance will be recognized as sand by its properties. If the process is continued far enough, the simplest particle recognizable as sand will be obtained: a molecule. A molecule of sand can be broken down into two simpler substances, the elements silicon and oxygen. The molecule of sand consists of 3 atoms, one of silicon and two of oxygen.

Molecules and atoms are very small particles. With very powerful microscopes it is now possible to obtain an image on a fluorescent screen or on a photographic plate which shows how these particles are arranged. The diameter of an atom of hydrogen (the simplest element) is about one ten thousand millionth of a meter. Water is the compound consisting of hydrogen and oxygen and has twice as many hydrogen atoms as oxygen atoms in a molecule: thus we write its formular as H_2O. If adrop of water (0.05 cm^3) were magnified up to the size of the earth, then each molecule of water would be nearly as big as football.

However, the atom is not the limit of division. As science progressed, more and more experiments were performed which the theory could not explain adequately. At the end of the 19th and at the beginning of the 20th century some important discoveries were made which studied the existence of the electron and the proton. And at last in 1932 the neutron was first discovered and described. These three subatomic particles are very important and their properties are studied by scientists.

The proton and the neutron have roughly the same mass, i. e. that of a hydrogen atom, but the electron is much lighter. The proton and the electron have equal and opposite electrical charges, that of the proton is positive whereas the neutron has no charge.

The neutrons and protons in an atom are in the central nucleus and this is therefore positively charged. The atomic number of an atom of an element is the number of positive charges on the nucleus, i. e. the number of protons. It is the most important property of an element. The nucleus has practically all the mass of an atom but it is very small, being about a thousand million millionth of a metre across. The electrons are in various energy levels (orbits) around the nucleus. In an atom of an element there are as many electrons as protons and hence as a whole the atom is neutral.

There are about 280 stable nuclides, combinations of neutrons and protons, with electrons to balance the nuclear charge. Atoms of the same element differing in the neutron content of their nuclei, and therefore in their masses, are called isotopes. Isotopesare thus nuclides belonging to the same element. Isotopes are present in constant proportions in most samples of elements, hence the average relative atomic mass is constant.

Hydrogen consists mostly of the isotope having just one proton in the nucleus, together with a small proportion of a second isotope having one proton and one neutron in the nucleus, and a very small proportion of a third isotope having one proton and two neutrons in the nucleus. Three quarters of the elements consist of several isotopes but only in the case of hydrogen they have separate names and symbols: the first isotope is protium ("hydrogen"), the secondis deuterium ("heavy hydrogen") and the third, a radioactive one, is tritium.

In many compounds, particularly those of carbon, the ratio of the numbers of atoms that have combined, is not simple. Many of these compounds have important electrical properties as semiconductor devices, e. g. transistors and thermistors.

Task 7. Answer the questions on the text:

1. What does the division of an element lead to?
2. What do we call the smallest particle of matter?
3. How many atoms does the molecule of sand consist of?

4. What is the diameter of an atom of hydrogen?
5. Is the atom the smallest particle of matter?
6. When was the neutron discovered?
7. What are the characteristics of the proton, the electron and the neutron?
8. Which is the most important property of an element?
9. What are nuclides?
10. Which compounds have important electrical properties?

Task 8. Complete the following paragraph with appropriate prepositions:

To arrive at the electron configurations ..... atoms, you must know the order ..... which the different sublevels are filled. Electrons enter available sublevels ..... order of their increasing energy. A sublevel is filled or half-filled before the next sublevel is entered. For example, the *s* sublevel can only hold two electrons, so the 1*s* is filled at helium ($1s^2$). The *p* sublevel can hold six electrons, the *d* sublevel can hold 10 electrons, and the *f* sublevel can hold 14 electrons. Common shorthand notation is to refer ..... the noble gas core, rather than write out the entire configuration. For example, the configuration ..... magnesium could be written $[Ne]3s^2$, rather .... writing out $1s^2 2s^2 2p^6 3s^2$.

Task 9. Explain "the planetary model of atom".

Task 10. Make up a dialogue about the most important points in chemistry and act it out with a partner for someone who has never met chemistry before.

Part 3. Text. Compound

Task 11. Read the text and try to guess the meaning of the following words in bold:

Compound in chemistry is a **substance** composed of atoms of two or more elements in chemical combination, occurring in fixed, definite proportion and arranged in a fixed, definite structure. A compound has unique properties that are distinct from the properties of its elemental **constituents** and of all other compounds. One familiar chemical compound is water, a **liquid** that is nonflammable and does not support **combustion**. It is composed of two elements: **hydrogen,** an extremely flammable gas; and oxygen, a gas that supports combustion. A compound differs from a mixture in that the components of a **mixture** retain their own properties and may be present in many different proportions. The components of a mixture are not chemically combined; they can be separated by physical means. A mixture of hydrogen and **oxygen** gases is still a gas and can be separated by physical methods. If the mixture is ignited, however, the two gases **undergo** a rapid chemical combination to form water. Although the hydrogen and oxygen can occur in any proportion in a mixture of gases, they are always combined in the exact proportion of two atoms of hydrogen to one atom of oxygen when combined in the compound water. Another familiar compound is sodium chloride (common salt). It is composed of the silvery metal sodium and the greenish **poisonous gas** chlorine combined in the proportion of one atom of sodium to one atom of chlorine. Water is a molecular compound; it is made up of electrically neutral molecules, each containing a fixed number of atoms. Sodium chloride is an ionic compound; it is made up of electrically **charged ions** that are present in fixed proportions and are arranged in a regular, geometric pattern (called crystalline structure) but are not grouped into molecules. The atoms in a compound are held together by **chemical bonding**.

A compound is often represented by its chemical formula. The formula weight of a compound can be determined from its formula. The **molecular weight** of a molecular compound can be determined from its molecular formula. Two or more distinct compounds that have the same molecular formula but different properties are called isomers. Compounds are formed from simpler substances by chemical reactions.

Task 12. Answer the questions:

1. What is a compound?
2. What are the properties of a compound?
3. What is a difference between a compound and a mixture?
4. What are the familiar examples of a compound?
5. What is a compound represented by?

Task 13. Make a plan of the text "Compound" and retell it.

Task 14. Translate the following sentences paying attention at the words in bold**:**

1. There exist **at least** two modifications of sulphur.
2. This mixture consists of **at least** three constituents.
3. Nitrogen and oxygen are **both** necessary for breathing.
4. Hydrogen peroxide acts **both** as an oxidizing and as reducing agent.

5. According to the law of conservation of matter, it can **neither** be created **nor** destroyed.

Task 15. Summarize the basic facts about chemistry in the form of the report.

Part 4. GRAMMAR: Word Formation

We can form	**nouns**	**with SUFFIXES**	***-er, -or, -ing, -ion, -ness, -ity***
	adjectives		***-ful, -less, -ous, -al, -ive***
	verbs		***-ify, -ise/-ize***
We can form words with PREFIXES			***bi-, mono-, multi-, poly-, dis-, in-, un-, de-, over-, ultra-, super-, re-, mis-***

Exercise 1. Combine the words in brackets with suitable SUFFIXES to complete the sentences. Choose from the following suffixes:

-er, -or, -ing, -ion, -ness, -ity

1. A .... (boil) is a closed vessel in which water or other fluid is heated.

2. .... (compress) is the reduction in size of data in order to save space or transmission time.

3. In chemistry, the .... (dense) of many substances is compared to the .... (dense) of water.

4. .... (transmit) is the act of passing something on.

5. Combustion process is also called .... (heat).

6. .... (hard) is the characteristic of a solid material expressing its resistance to permanent deformation.

-ful, -less, -ous, -al, -ive

1. It can be................ (use) to write a summary of your argument first.

2. Metals containing iron are called .... (ferrum).

3. You can ask him if you want to but it's .... (use). He doesn't want to talk about it.

4. Hydrogen and oxygen are .... (chemistry) elements.

5. If any material is .... (conduct), it means it conducts electric current.

-ify, -ise/-ize

1. I think this plan is too complicated. You should __________ (simple) it.

2. There used to be some disputes between the 2 countries but recently they have managed to ____________ (normal) their relations.

3. I hope you ________________ (real) that you are wrong.

4. When a liquid substance becomes solid, it ______________ (solid).

Exercise 2. Match the following PREFIXES with their meanings:

bi-, mono-, multi-, poly-, dis-, in-, mal-, un-, de-, over-, ultra-, super-, re-, mis-

number:

degree or size:

negativeness:

reverse:

repetition:

Exercise 3. Now match the following words with appropriate prefixes. Some words can be combined with several prefixes.

.........lingual	.........expected	.........atomic	.........compose
.........advantage	.........function	.........hydrate	.........violet
.........accuracy	.........cellular	.........frost	.........ive
.........understand	.........charge	.........flow	.........take

Exercise 4. Form words by means of PREFIXES with negative meanings un-, in-, il-, im-, ir-:

organic –	possible –	digestible –
soluble –	regular –	effective –
happy –	legal –	saturated –

Exercise 5. Find in a dictionary words of different parts of speech with the same root:

Verb	*Adjectives*	*Noun*	*Adverb*
to digest –	digest _ _ _, _ _ digest_ _ _ _,	digest_ _ _;	
to taste –	tast_, tast_ _ _ _,	_ _ _ _ _, taste_;	
to saturate –	saturate_, _ _ _ _ _saturate_;		
to connect –	connect_ _ _,	connect_ _ _;	
to act –	act_ _ _,	act_ _ _ _ _, act_ _ _,	act_ _ _ _ _;
to create –	creat _ _ _,	creat _ _,	creat _ _ _ _ _;
to differ –	differ_ _ _.		

MODULE 3. **PERIODIC TABLE OF ELEMENTS**

Part 1. Periodic Law.

Task 1. Read the text, rewrite the pronunciation of the following words from a dictionary and memorize them:

recurrence – *повернення, повторення*
to identify – *ототожнювати*
octive – *октава*
to device – *винаходити*
to predict – *провіщати, передбачати*
discrepancy – *відповідність*
reliable – *надійний*

Periodic Law is a statement of a periodic **recurrence** of chemical and physical properties of the elements when the elements are arranged in order of increasing atomic number. The atomic number is the number of positive charges, or protons, contained in the atomic nucleus or, equivalently, the number of negative charges, or electrons, outside the nucleus in a neutral atom. Such an arrangement in the form of a table in which the groupings of elements having similar properties are easily **identified** is called the periodic system or the periodic table. The periodic law can be explained on the basis of the electronic structure of the atom, which is believed to be the main factor underlying the chemical properties and many of the physical properties of the elements. In turn, the electronic structures of atoms have been successfully accounted for by the quantum theory.

D. I. Mendeleev was the first to state the periodic law close to its present form. He proposed in 1869 that the properties of elements are periodic functions of the atomic weight and grouped the elements accordingly in a periodic system. The Periodic system is of great importance for modern science.

Before the work of Mendeleev, however, a number of chemists had noticed certain relationships between the properties of elements as their atomic weight. In 1829 J.W. Dobereiner stated that there existed some three-element group, or triads, in which the atomic weight of the middle element was the average of the other two and the properties of this element lay between those of the other two. For example, calcium, strontium, and barium form a triad; lithium, sodium, and potassium, another.

The English chemist J.A. Newlands found (1863-1865) that if the elements are listed according to atomic weight starting with the second, the 8^{th} element following any given element has similar chemical properties, and so does the 16^{th}. This became known as the law of **octaves.** About the same time, A. E. de Chancourtois arranged the elements according to increasing atomic weight in the form of a vertical helix with eight elements in a turn, so that elements having similar properties fell along vertical lines. Mendeleyev's system came a few years later. Working independently and not aware of Mendeleyev's work, Lothar Meyer arrived at a similar system, publishing the results about a year after Mendeleyev's. When Mendeleyev **devised** his periodic table a number of positions could not be fitted by any of the known elements. Mendeleev suggested that these empty spaces represented undiscovered elements and by means of his system accurately **predicted** their general properties and atomic weights. Those vacant spaces led Mendeleyev to predict the existence of six undiscovered elements (scandium, gallium, germanium, polonium, etc.). He predicted not only the existence of these elements but their physical and chemical properties as well. Mendeleyev's Periodic Law was the beginning of a new era in the history of chemistry.

In spite of its great success, his system had some **discrepancies.** Arranged strictly according to atomic weight, not all elements fell into their proper groups. Better arrangement could be made if the positions of certain neighboring couples were interchanged. For example, to suit the chemical order of the table, the inert gas argon should come before the chemically active metal potassium.

The work (1913-1914) of H. G. Moseley on the X-ray spectra of elements led to the present form of the periodic law. He found that the wavelength of the X-radiation of elements decreased with increasing atomic weight. However, the relationship was not a strict one. He assigned a new set of numbers, called atomic numbers, to the elements he had studied, so that there was a relation between the wavelength and the atomic number. It was found that although the atomic number of an element is roughly half its atomic weight, the atomic weight does not always increase with increasing atomic number. The discrepancies occur just for those elements where Mendeleev's law failed. Based on atomic number, the periodic law now has no expectations. Although all the missing elements in the periodic table have been found (with the aid of the periodic table itself), the table retains its usefulness to the chemist as a **reliable** check for disputed or uncertain data concerning some of the known elements.

Task 2. Answer the questions:

1. Who invented the law of periodicity of chemical elements?
2. How can the Periodic Law be defined?
3. How can the Periodic Law be explained?
4. What other chemists tried to arrange the elements in the table?
5. What did Lothar Meyer invent?
6. What system did Mendeleyev suggest?
7. When do the discrepancies for the elements in the table occur?
8. What did H. G. Moseley assign?

Task 3. Translate the following words and define their suffixes:

period – periodic, system – systematic, similar – similarity,
chemical – chemistry – chemist, to discover – discovery,
to depend – dependent – dependence, to know –knowledge,
to define – definite – definition, important – importance,
to arrange – arrangement, to exist – existence.

Task 4. Fill in the blanks with the necessary words from the box:

weights	properties (2)	laws	rows	number	elements	states (2)

1. A chemist is to know thoroughly the states of matter and the physical ………….. which govern the behaviour of matter in various ………….. .
2. Considering all the ……………… together we may see that there are certain groups that have very similar chemical ………………… .
3. In the charts we can see that the elements are arranged in horizontal ……….. of ten in the order of increasing atomic ………… .
4. Matter can exist in the three physical ………….. , namely, solid, liquid or gaseous.
5. Because atoms are so very small their ………….. must be extremely large.

Task 5. Translate into English:

1. Саме Д. І. Менделєєв першим відкрив закон залежності властивостей

елементів від їх атомної маси.

2. Декілька вільних місць в таблиці змусили Менделєєва передбачити існування шести невідкритих елементів.

3. Менделєєв передбачив не тільки існування невідкритих елементів, але також їх фізичні і хімічні властивості.

4. У Періодичній таблиці символи елементів подаються з їх атомною масою.

5. Періодичний закон Менделєєва став початком нової ери в історії розвитку хімії.

6. Періодична система має велике значення для сучасної науки.

Part 2. Periodic Table

Task 6. Before reading the text about Periodic Table think how much you know about the periodic table. Then read the text and explain the meaning of the underlined words.

The most convenient presentation of the chemical elements is in the periodic table of the chemical elements, which groups elements by atomic number. Due to its ingenious arrangement, groups or columns, and periods, or rows of elements in the table either share several chemical properties, or follow a certain trend in characteristics such as atomic radius electronegativity, etc. Lists of the elements by name, by symbol, and by atomic number are also available.

Dmitrii Mendeleyev was the first scientist to create a periodic table of the elements similar to the one we use today. This table showed that when the elements were ordered by increasing atomic weight, a pattern appeared where properties of the elements repeated periodically. This periodic table is a chart that groups the elements according to their similar properties.

Why do you think Mendeleyev made a periodic table? Many elements remained to be discovered in Mendeleyev's time. The periodic table helped predict the properties of new elements.

Compare the modern periodic table with Mendeleyev's table. What do you notice? Mendeleyev's table didn't have very many elements, did it? He had question marks and spaces between elements, where he predicted undiscovered elements would fit.

Remember changing the number of protons changes the atomic number, which is the number of the element. When you look at the modern periodic table, do you see any skipped atomic numbers that would be undiscovered elements? New elements today aren't discovered. They are made. You can still use the periodic table to predict the properties of these new elements.

The periodic table helps predict some properties of the elements compared to each other. Atom size decreases as you move from left to right across the table and increases as you move down a column. Energy required to remove an electron from an atom increases as you move from left to right and decreases as you move down a column. The ability to form a chemical bond increases as you move from left to right and decreases as you move down a column.

The most important difference between Mendeleyev's table and today's table is the modern table is organized by increasing atomic number, not increasing atomic weight. Why was the table changed? In 1914, Henry Moseley learned you could experimentally determine the atomic numbers of elements. Before that, atomic numbers were just the order of elements based on increasing atomic weight. Once atomic numbers had significance, the periodic table was reorganized.

Elements in the periodic table are arranged in periods (rows) and groups (columns). Atomic number increases as you move across a row or period.

Rows of elements are called periods. The period number of an element signifies the highest unexcited energy level for an electron in that element. The number of elements in a period increases as you move down the periodic table because there are more sublevels per level as the energy level of the atom increases.

Columns of elements help define element groups. Elements within a group share several common properties. Groups are elements which have the same outer electron arrangement. The outer electrons are called valence electrons. Because they have the same number of valence electrons, elements in a group share similar chemical properties. The Roman numerals listed above each group are the usual number of valence electrons. For example, a group VA element will have 5 valence electrons.

There are two sets of groups. The group A elements are called the representative elements. The group B elements are the nonrepresentative elements.

Each square on the periodic table gives information about an element. On many printed periodic tables you can find an element's <u>symbol</u>, atomic number and atomic weight.

Task 7. Answer the following questions:

1. Why was the Periodic Table created?
2. Can you compare the modern periodic table with Mendeleyev's table?
3. What is the difference between Mendeleyev's table and today's table?
4. What way are elements in the periodic table arranged?
5. What is on the Element key?

Task 8. Translate the expressions in the box and use them to fill the gaps in the text about the Periodic Table:

symbol, atomic weight, name, atomic number, group, row, alkali metals, halogens, noble gases, lanthanides, actinides, alkaline earth metals

The most convenient presentation of the chemical elements is in the periodic table of the chemical elements, which groups elements by ………….. …………... Due to its **ingenious** arrangement, columns, or ………….., and ………….., or periods, of elements in the table either share several chemical properties, or follow a certain trend in characteristics such as atomic radius, electronegativity, electron affinity, etc.

The main value of the periodic table is the ability to predict the chemical properties of an element based on its **location** on the table. The properties vary differently when moving vertically along the ……. of the table, than when moving horizontally along the ……... .

The periodic table was first <u>devised</u> in 1869 by the Russian chemist Dmitri Mendeleev. Mendeleev intended the table to illustrate **recurring** ("periodic") trends in the properties of the elements. The layout of the table has been **refined** and extended over time, as new elements have been <u>discovered,</u> and new theoretical models have been <u>developed</u> to explain chemical behaviour. Various layouts are possible to **emphasize** different aspects of behaviour; the most common forms, however, are still quite similar to Mendeleev's original design.

Task 9. a) What are the synonyms of the words in bold in Task 8? Use a dictionary.

ingenious –

location –

recurring –

to refine –

to emphasize –

b) Find the difference between the underlined words from the text. Are they synonyms? Use a dictionary to help you.

to devise –

to discover –

to develop –

Task 10. Make up a dialogue about Periodic Table and act it out with a partner.

Part 3. Chemical Elements

Task 11. Read the text and answer the following questions:

1. How are elements classified?
2. Which elements are metals?
3. What are properties of metals?
4. Can you name any non-metals and metalloids (semi-metals)?
5. Do you know any of their typical properties and practical applications?

Elements are classified according to their properties. The major categories of elements are the metals, nonmetals, and metalloids (semi-metals).

You see metals every day. Aluminium foil is a metal. Gold and silver are metals. If someone asks you whether an element is a metal, metalloid, or non-metal and you don't know the answer, guess that it's a metal.

Metals share some common properties. They are lustrous (shiny), malleable (can be hammered), and are good conductors of heat and electricity. These properties result from the ability to easily move the electrons in the outer shells of metal atoms.

Most elements are metals. There are so many metals, they are divided into groups: alkali metals, alkaline earth metals, and transition metals. The transition metals can be divided into smaller groups, such as the lanthanides and actinides.

Task 12. Learn the words for chemical elements:

Aluminium Br.	/ˌæljuˈmɪniəm/	Al
Aluminum Am.	/əˈluːmɪnəm/	Al
Argentums	/ˈɑːdʒentəm/	Ag
silver	/ˈsɪlvəʳ/	Ag
Antimony	/ˈæntɪməni/	Sb
arsenic	/ˈɑːsənɪk/	As
Astatine	/ˈæstətiːn/	At
boron	/ˈbɒrɒn/	B
barium	/ˈbærɪəm/	Ba
Bromine	/ˈbrəumiːn/	Br
carbon	/ˈkɑːbən/	C
calcium	/ˈkælsiəm/	Ca
Chlorine	/ˈklɔːriːn/	Cl
Chromium	/ˈkrəumiəm/	Cr
copper	/ˈkɒpəʳ/	Cu
fluorine	/ˈfluəriːn/	F
ferrum	/ˈferrəm/	Fe
iron	/aɪən/	Fe
hydrogen	/ˈhaɪdrɪdʒən/	H
helium	/ˈhiːliəm/	He
hydrargyrum	/haɪˈdrʌːdʒɪrəm/	Hg
Mercury	/ˈmɜːkjuri/	Hg
iodine	/ˈaɪədiːn/	I
kalium	/ˈkæliəm/	K
potassium	/pəˈtæsiəm/	K
Lithium	/ˈlɪθiəm/	Li
magnesium	/mægˈniːziəm/	Mg
manganese	/ˈmæŋgəniːz/	Mn
nitrogen	/ˈnaɪtrədʒən/	N
Sodium	/ˈsəudiəm/	Na
neon	/ˈniːɒn/	Ne
nickel, nickle	/ˈnɪkl/	Ni
Oxygen	/ˈɒksɪdʒən/	O
phosphorus	/ˈfɒsfərəs/	P
plumbum	/ˈplʌmbəm/	Pb
lead	/led/	Pb
platinum	/ˈplætɪnəm/	Pt
Radium	/ˈrɪdiəm/	Ra
sulphur Br., sulfur Am.	/ˈsʌlfəʳ/	S
silicon	/ˈsɪlɪkən/	Si
stannum	/ˈstænəm/	Sn
tin	/tɪn/	Sn
uranium	/juˈreɪniəm/	U
wolfram	/ˈwʊlfrəm/	W
tungsten	/ˈtʌŋstən/	W
zinc	/zɪŋk/	Zn

Task 13. Complete sentences with the verbs consist of, contain or include:

Example: *The periodic table* ***consists of*** *rows and columns.*
It ***contains*** *elements.*
Different elements ***include*** *carbon, sulphur, hydrogen, oxygen etc.*

1. The classic symptoms of exposure to toxic chemicals .... headaches, sorethroats, vomiting, etc.

2. The word's trees .... between 460-800 billion tones of carbon.

3. The local fauna .... wolves, snakes and a wide range of unpleasant insects.

4. The graphs do not .... information about the use of the cell.

5. Other greenhouse gasses .... carbon dioxide, methane and chlorofluorocarbons.

THE PERIODIC TABLE

Period	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	H 1 1.008 Hydrogen																	He 2 4.00 Helium
2	Li 3 6.94 Lithium	Be 4 9.01 Beryllium											B 5 10.81 Boron	C 6 12.01 Carbon	N 7 14.01 Nitrogen	O 8 16.00 Oxygen	F 9 19.00 Fluorine	Ne 10 20.18 Neon
3	Na 11 22.99 Sodium	Mg 12 24.31 Magnesium											Al 13 26.98 Aluminum	Si 14 28.09 Silicon	P 15 30.97 Phosphorus	S 16 32.07 Sulfur	Cl 17 35.45 Chlorine	Ar 18 39.95 Argon
4	K 19 39.10 Potassium	Ca 20 40.08 Calcium	Sc 21 44.96 Scandium	Ti 22 47.88 Titanium	V 23 50.94 Vanadium	Cr 24 52.00 Chromium	Mn 25 54.94 Manganese	Fe 26 55.85 Iron	Co 27 58.93 Cobalt	Ni 28 58.69 Nickel	Cu 29 63.55 Copper	Zn 30 65.39 Zinc	Ga 31 69.72 Gallium	Ge 32 72.61 Germanium	As 33 74.92 Arsenic	Se 34 78.96 Selenium	Br 35 79.90 Bromine	Kr 36 83.80 Krypton
5	Rb 37 85.47 Rubidium	Sr 38 87.62 Strontium	Y 39 88.91 Yttrium	Zr 40 91.22 Zirconium	Nb 41 92.91 Niobium	Mo 42 95.94 Molybdenum	Tc 43 (97.9) Technetium	Ru 44 101.07 Ruthenium	Rh 45 102.91 Rhodium	Pd 46 106.42 Palladium	Ag 47 107.87 Silver	Cd 48 112.41 Cadmium	In 49 114.82 Indium	Sn 50 118.71 Tin	Sb 51 121.76 Antimony	Te 52 127.60 Tellurium	I 53 126.90 Iodine	Xe 54 131.29 Xenon
6	Cs 55 132.91 Cesium	Ba 56 137.33 Barium	La 57 138.91 Lanthanum	Hf 72 178.49 Hafnium	Ta 73 180.95 Tantalum	W 74 183.85 Tungsten	Re 75 186.21 Rhenium	Os 76 190.2 Osmium	Ir 77 192.22 Iridium	Pt 78 195.08 Platinum	Au 79 196.97 Gold	Hg 80 200.59 Mercury	Tl 81 204.38 Thallium	Pb 82 207.2 Lead	Bi 83 208.98 Bismuth	Po 84 (209) Polonium	At 85 (210) Astatine	Rn 86 (222) Radon
7	Fr 87 223.02 Francium	Ra 88 226.03 Radium	Ac 89 227.03 Actinium	Rf 104 (261) Rutherfordium	Db 105 (262) Dubnium	Sg 106 (263) Seaborgium	Bh 107 (262) Bohrium	Hs 108 (265) Hassium	Mt 109 (266) Meitnerium	Unnamed Discovery 110 Nov. 1994	Unnamed Discovery 111 Nov. 1994	Unnamed Discovery 112 1996		Unnamed Discovery 114 1999		Unnamed Discovery 116 1999		Unnamed Discovery 118 1999

11	Ce 58 140.12 Cerium	Pr 59 140.91 Praseodymium	Nd 60 144.24 Neodymium	Pm 61 (145) Promethium	Sm 62 150.36 Samarium	Eu 63 152.97 Europium	Gd 64 157.25 Gadolinium	Tb 65 158.93 Terbium	Dy 66 162.50 Dysprosium	Ho 67 164.93 Holmium	Er 68 167.26 Erbium	Tm 69 168.93 Thulium	Yb 70 173.04 Ytterbium	Lu 71 174.97 Lutetium
13	Th 90 232.04 Thorium	Pa 91 231.04 Protacinium	U 92 238.03 Uranium	Np 93 237.05 Neptunium	Pu 94 (240) Plutonium	Am 95 243.06 Americium	Cm 96 (247) Curium	Bk 97 (248) Berkelium	Cf 98 (251) Californium	Es 99 252.08 Einsteinium	Fm 100 257.10 Fermium	Md 101 (257) Mendelevium	No 102 259.10 Nobelium	Lr 103 262.11 Lawrencium

Key:

- H — 3
- 1 — 4
- 1.008 — 5
- Hydrogen — 6

Labels: 1 (group number 1 IA), 2 (period column), 7, 8, 9, 10, 11, 13

Task 14. Put the expressions from the box in Task 8 into correct places in the Periodic Table.

Task 15. Be ready to speak on the topic “Periodic Table of Elements”.

Part 4. GRAMMAR: Modal Verbs

Rule	Example
Modal verbs are used to express:	
1) ***ability*** in the present (**can/be able to**), in the past (**could or was /were able to**);	She **can** do computer graphics. She **is able to** do computer graphics.
2) ***advice*** (**should, ought, had better**);	Mark **should** get a new job. He **ought to** read the jod ads. He**’d better** apply for more than one job.
3) ***necessity*** (**must, have to, have got to, need**); Have to is used for all tenses and forms;	You really **must** talk to your boss about a pay rise.
4) ***possibility*** (**may, could** (something is possible, but you are not certain about it), **might** (you are very doubtful and uncertain about it).	You **may** find him in the laboratory.

Exercise 1. Underline modal verbs in each sentence and translate the sentences:

1. Nitric acid may be used to oxidize hydrogen.
2. A chemist is to know thoroughly the states of matter and the physical laws which govern the behaviour of matter in various states.
3. The Periodic Law can be simply stated as follows: The properties of the elements are a periodic function of the nuclear charges of their atoms.
4. Because atoms are so very small their number must be extremely large.
5. Synthetic chemistry deals with the methods by which the complex bodies may be built up from simpler substances.
6. According to the law of conservation, matter can neither be created nor destroyed.
7. The students must have studied the conditions of chemical changes of these substances before starting their practical work.

Exercise 2. Write down the sentences in Past and Future Tenses and translate them:

1. In the chart we can see that the elements are arranged in horizontal rows of ten in the order of increasing atomic weights.
2. We must use a catalyst to accelerate the reaction.

3. We can remove all the impurities from water by the process called distillation.

4. The specialists must know the properties of the materials used for consruction.

Exercise 3. Write down the sentences in the interrogative forms:

1. All the laboratory vessels have to be carefully washed before doing experiments.
2. Electrolysis may be an example of electrochemistry.
3. Matter can exist in three physical states, namely, solid, liquid, or gaseous.
4. For concrete sand and stone must be proportioned and mixed.
5. Cement should be ground extremely.

Exercise 4. Replace modal worbs by another one with a similiar meaning if possible.

1. Students must make a great number of experiments to acquire good knowledge.
2. Heat can change the state of matter.
3. Metals may be subjected to physical and chemical changes.
4. Water must be decomposed to obtain oxygen.
5. You have to change the position of the device, its measurements are incorrect.
6. The device must have been tested under different temperature conditions.
7. The control work ought to have been done by our group well.

Exercise 5. Translate sentences with modal verbs, paying attention to Participle constructions.

1. Studying the atomic weights of elements, Mendeleyev found that they could be devided into nine groups.

2. Following the discoveries in the field of chemistry, we should mention some names of the outstanding scientists.

3. Being soluble in water this substance can be obtained by the evaporating of the water.

4. Our laboratory having been supplied with different new instruments, the students could do their practical work there.

5. Considering all the elements together, we may see that there are certain groups that have very similar chemical properties.

6. The satisfactory measurements having been obtained, scientists could finish their research.

MODULE 4. **STATES OF MATTER**

Part 1. Text. Four main states of matter.

Task 1. Read the following text. What is the meaning of the expressions in bold**?**

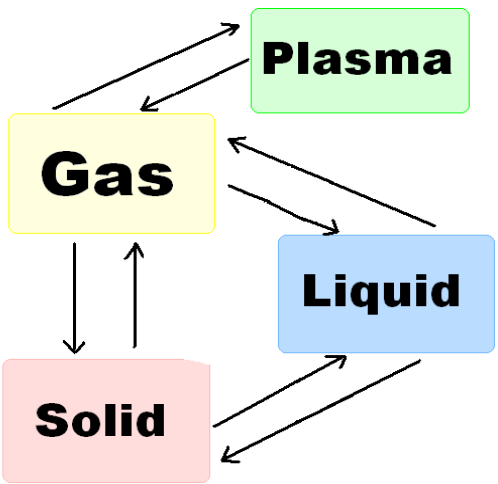
There are four main **states of matter: solids, liquids, gases** and **plasmas**. Each of these states is also known as a **phase**. Elements and compounds can move from one phase to another phase when special **physical forces** are present. One example of those forces is **temperature**. The phase or state of matter can change when the temperature changes. Generally, as the temperature rises, matter moves to a more active state.

Phase describes a physical state of matter. The key word to notice is physical. Things only move from one phase to another by physical means. If **energy is added** (like **increasing** the temperature or **increasing pressure**) or if energy **is taken away** (like **freezing** something or **decreasing pressure**) you have created a physical change.

One compound or element can move from phase to phase, but still be the same substance. You can see **water vapor** over a boiling **pot** of water. That vapor (or gas) can **condense** and become a **drop of water**. If you put that drop in the freezer, it would become a solid. No matter what phase it was in, it was always water. It always had the same chemical properties. On the other hand, a **chemical change** would change the way the water acted, eventually making it not water, but something completely new.

Task 2. What is a 'phase transition'? Insert the terms from the box into the phase transition scheme.

melting	condensation	deposition	vaporization
ionization	deionization	sublimation	freezing



Task 3. Choose the corrects answer:

1. What is the term used to describe the phase change as a liquid becomes a solid?

   evaporation condensation freezing

2. What term is used to describe the phase change of a solid to a liquid?

   freezing melting boiling

3. What is the term used to describe the phase change of a liquid to a gas?

   boiling condensation melting

4. Of gases, liquids, and solids, what is the densest state of matter?

   solids liquids gases plasmas

Task 4. Find the synonyms of the following expressions in the text.

phase of matter

rise of temperature

drop of temperature

Task 5. What is the meaning of the following words? Which changes of state do they correspond with?

melting point boiling point freezing point

Part 2. Text. Gases.

Task 6. Read the text, rewrite the pronunciation of the new words from a dictionary and learn them:

to collide – *стикатися*
elbow-room – *простір*
midge – *мошка, комар*
liquid – *рідина*
to slide – *сковзати*
syphon – *сифон*
piston – *поршень*
valve – *клапан*
to evaporate – *випаровувати*
acetylene – *ацетилен*
to soak – *намочувати*
porous – *пористий*
oxygen – *кисень*
poisonous – *отруйний*
welding – *зварка, зварювати*
to sustain – *підтримувати*
pneumonia – *пневмонія*
nitrogen – *азот*
chlorine – *хлор*
to bleach – *білити, знебарвлювати*
dioxide – *двоокис*
fizzy – *шипучий*
anaesthetic – *знеболювальний*
ammonia – *аміак, нашатир*
mixture – *суміш*
methane – *метан*

The behaviour of a gas is easily enough understood if we remember what it is. A gas is a very scattered assembly of molecules moving as fast as bullets but not getting very far before they collide with each other. Each molecule has a good big free space round it: in fact, a molecule of a gas has about a thousand times as much elbow-room as a molecule of a liquid or a solid. Well, anyone can see that if this is a true picture of a gas, it must be very light, because it is made up of very few molecules. Picture a swarm of midges in which each midge was about two inches from the next and you will have a fair notion of the amount of elbow-room in a gas. It follows from this that a gas will flow very easily, for the molecules will not get in each other's way, nor will they greatly attract or repel each other. For the latter reason, it should be easy to compress a gas: a solid or liquid is almost incompressible because the repulsions of the electrical charges of which its atoms are made up are far stronger than any forces we can apply. In the case of a gas, the molecules are much too far from each other to repel each other. Of course, the idea of a gas as a swarm of busy molecules is not much more than a hundred years old. Gases are so unlike any other kind of matter that many centuries elapsed before people made up their minds that they were matter at all.

One of the reasons why people before the eighteenth century knew hardly anything about gases was that they are difficult to handle. You can put a solid in a basket or a basin, you can pour a liquid into a jug, but a gas has to be handled in a special way. Suppose you have a bottle full of it. As soon as you uncork it, the gas molecules begin to spread into the air and the air molecules into the gas.

On the industrial scale, there are three favourite ways of storing gases. First, they are stored in gasometers over water, or under a sliding piston or diaphragm.

Secondly, gases are stored in cylinders under pressures as high as 1,800 lbs. per square inch. This squeezes a lot of gas into a little space.

Thirdly, some gases can be made into liquids by compressing them, and these are sold in strong glass syphons or iron cylinders. When the valve at the top of the syphon is opened, the liquid evaporates and the gas rushes out. One gas, acetylene, explodes when it is strongly compressed, so it is dissolved under moderate pressure in a liquid called acetone, just as carbon dioxide is dissolved under pressure in water to make soda water. When the cylinder of acetylene dissolved in acetone is opened, the acetylene comes bubbling out like the carbon dioxide from soda water. To prevent the acetone from being spilt, it is soaked up in porous material.

The selling of gas is now a big industry, and at least eighteen different kinds can be bought.

The great chemical works usually make their gases and use them on the spot. Oxygen is sold to engineers for welding with the oxyacetylene blowpipe, and to doctors for sustaining pneumonia patients.

Nitrogen, which does not burn, is sold for filling electric lamps and some other purposes. Hydrogen is sold for filling balloons and for various chemical purposes. Chlorine the green poison gas is sold for bleaching and for making various chemicals. Carbon dioxide is sold in cylinders for making fizzy drinks and soda-water, which are simply still drinks or water into which this gas has been forced under pressure. Ethylene and ethyl chloride are used as anaesthetics.

Acetylene is used for lighting. Liquefied ammonia (not the solution in water you buy at the chemist's) is used for refrigerators, and so is liquefied sulphur dioxide. Argon obtained from air is sold for filling electric light bulbs, and neon, a gas of which the air contains only one part in 55,000, is extracted from it and is used to fill those brilliant neon tubes which make the modern street so gay at night.

So there are at least thirteen familiar gases you can buy, packed in cylinders or 'syphons'. One more gas is familiar to us all, the coalgas, which is supplied to houses. This is a mixture of half-a-dozen gases. It is mostly hydrogen and methane the gas which causes explosions in coal mines, but it also contains the poisonous carbon monoxide and small amounts of several other gases.

Task 7. Answer the questions about gases:

1. Give the definition of a gas.
2. What are the properties of gases?
3. What are the three ways of storing gases?
4. Can you name any gases?
5. Where are they used?

Task 8. Fill in the blanks with the necessary words:

1. …….. is used in …… for welding with the oxyacetylene blowpipe and in ………... for sustaining pneumonia patients.
2. In medicine ……... and ………… are used as anaesthetics.
3. …………. and …………. are used for refrigerators.
4. Fizzy drinks and soda-water are simply still drinks into which ………….. is forced under pressure.
5. …….. is used to fill the brilliant neon tubes which make the modern street so amusing at night.
6. The gas which causes explosions in coal mines is ……………..
7. The green poison gas which is sold for bleaching and for making various chemicals is called …………
8. …………. is sold for filling electric lamps.

Task 9. Translate into English:

1. Гази не подібні до інших видів матерії, як наприклад, рідина чи тверде тіло.
2. На відміну від твердого тіла чи рідини, гази легко стискуються.
3. Газ легкий, але його неможливо втримати.
4. Гази зберігаються у спеціальних ємкостях під тиском.
5. Щонайменше 18 різних видів газів можна купити.

Task 10. Read the text about deuterium and heavy water without consulting a dictionary and retell it:

Deuterium is sometimes called *heavy hydrogen.* It is an isotope of hydrogen and makes up about one part in two hundred of that element. Normally found as a gas, deuterium has chemical properties very similar to those of hydrogen. Because the nucleus of a deuterium atom is roughly twice as heavy as the nucleus of a hydrogen atom, these gases have different physical properties (density, boiling point, etc.) through which they can be separated.

Heavy water is composed of deuterium and oxygen (rather than hydrogen and oxygen as in ordinary water). It is present in ordinary water in very minute quantities. It resembles ordinary water in appearance but it is rather more dense. It has a higher boiling-point and a higher freezing-point than ordinary water. Heavy water is used as a moderator in the production of atomic energy. It produces a slowing-down of neutrons emmited as the result of nuclear fission in an atomic pile.

Part 3. Water.

Task 11. Try to answer the questions about water before reading the text.Then write down the information about the new words from a dictionary and learn them.

1. What is water?
2. What are the properties of water?
3. Can water be compressed?
4. What purposes is water necessary for?
5. What forms of water can be found in nature?

Water is a chemical compound of oxygen and hydrogen, the latter gas forming two thirds of its volume. It is the most abundant of all chemical compounds, five seventh of the earth's surface being covered with water. As we know, water does not burn, on the contrary, it is generally used for putting out the fire. Therefore it seems remarkable that the two gases which it is composed of act in the opposite way: one of them - hydrogen - burns, the second oxygen - making things burn much faster than air does. Hydrogen is the lightest gas known, oxygen being slightly heavier than air.

Now, although these two gases, when taken separately, can be compressed into a much smaller space by pressure, water is one of the most incompressible substances known, the properties of a compound being unlike the properties of the elements of which it is made. By means of hydraulic accumulators water can be subjected to a tremendous pressure without appreciably reducing its volume.

But in spite of its resistance to compression, it has been calculated that at ocean depths water is compressed to such an extent that the average sea level is 35.6 metres lower than it would be if water were absolutely incompressible.

Water like air is never found quite pure in nature but contains various salts and minerals in solution. Salt water being heavier, some things will float in it which would sink in fresh water, hence it is easier to swim in salt water. When sea water freezes the salt separates from it, ice being quite pure.

The almost endless applications of water are such that without it all life would cease. Water is necessary for the existence of man, animals and plants, every living thing containing large amounts of water. Being a solvent of most substances it is indispensable in chemistry and medicine. When used in engineering its great resistance to compression enables it to transmit enormous power. When we drink water it is almost immediately coursing through our system, the body being purified of poison which is carried off in solution. When heated, water changes into an invisible gas; freezing it we get a solid block of crystals. When evaporated it forms clouds from where it falls on the earth as rain or snow, the soil absorbing the water which appears on the surface again in the form of streams to begin a new cycle of evaporation. In its various changes it is indestructible disappearing only to appear again in another form. It goes round and round, the total amount of water on the earth never changing.

Task 12. Read the fact file and fill in the gaps with the correct words from the box:

water cycle	raindrops	covered	distillation	human body
oxygen (2)	species	liters	bathtubs	food

1. A fully grown tree can drink enough water each day to fill four ………… .
2. …………are not tear-shaped. Scientists have discovered they resemble the shape of a small burger bun.
3. About 70 % of the …………..is water.
4. More than half of the world's animal and plant ……………live in the water.
5. Almost 75 % of the earth is………..in water.
6. We need to drink at least two ……….of water a day and we can only last a few days without water.
7. Most of our ………..consists of water. Tomatoes for example contain 95% water, apples 85 %, potatoes 80 % and beef 61 %.
8. We can remove all the impurities from water by the process called ....
9. Water must be decomposed to obtain ....
10. There are four stages in the ....: condensation, precipitation, accumulation and evaporation.
11. A molecule of water consists of two atoms of hydrogen and one atom of ....

Task 13. Translate the text about water as a constituent of food into English using the words and expressions from the box:

cell	solvent	evaporation	dehydration	kidney	solid food	soft drinks	intake

Без води життя неможливе. 2/3 людського тіла складається з води. Майже кожен процес в організмі відбувається у клітинах, де вода виступає розчинником. Потреба організму у воді є другою після потреби у повітрі. Людина може прожити декілька тижнів без їжі, але всього декілька днів без води. Вода поступає в організм у вигляді твердої їжі і напоїв і виходить з організму під час випаровування.

Водний баланс організму регулюють нирки. Великі втрати води можуть стати небезпечними. Якщо вміст води не поповнюється, результатом може стати обезводнення організму. Доросла людина повинна випивати хоча б один літр води в день, а під час виконання важкої роботи потребується більше води.

Task 14. Make up a dialogue about water, its importance and dramatize it.

Task 15. Make up a topic about states of matter.

Part 4. GRAMMAR: Active and Passive Voice

	Active	Passive
Present Simple	We **study** Chemistry at the university.	Chemistry **is studied** by us at the university.
Present Continuous	We **are studying** English now.	English **is being studied** by us now.
Present Perfect	We **have studied** Chemistry for two years.	Chemistry **has been studied** by us for two years.
Past Simple	We **studied** Chemistry at school.	Chemistry **was studied** by us at school.
Past Continuous	This time last week we **were studying** English.	English **was being study** by us this time last week.
Past Perfect	I **had not studied** Chemistry before I entered the Chemistry faculty.	Chemistry **hadn't been studied by me** before I entered the Chemistry faculty.
Future Simple	We **will study** Colloid Chemistry next term.	Colloid Chemistry **will be studied** by us next term.
Future Continuous	We **will be studying** Colloid Chemistry for the whole term.	------
Future Perfect	I **will have passed** the exam in chemistry at the end of ths term.	The exam in chemistry **will have been passed** by me at the end of ths term.

Exercise 1. Compare the following two sentences and answer the questions:

1) Why is the agent/doer not mentioned in the first one?

2) When is it not necessary to mention the doer?

3) When do we use Passive Voice?

This element **is called** hydrogen. Periodic Table **was devised** by Mendeleev.

Exercise 2. Find examples of Passive Voice in the texts "Water" and "Gases".

Exercise 3. Transform active sentences into Passive Voice. What are the rules for transforming active sentences into passive?

1. Students can use all the necessary equipment in the laboratories free of charge.
2. Chemists will produce a lot of new substances.
3. Our students make many experiments in the laboratory.
4. Lomonosov formulated and experimentally proved the law of matter conservation.

matter.

5. We are going to use two types of thermometers in our work.

Exercise 4. Find passive sentences in the text and transform them into active.

The Fourth State of Matter

There are three classic states of matter: solid, liquid, and gas; however, plasma is considered to be the fourth state of matter. The plasma state is not related to blood plasma, the most common usage of the word; rather, the term has been used in physics since the 1920s to represent an ionized gas. Lightning is commonly seen as a form of plasma.

Plasma is found in both ordinary and exotic places. When an electric current is passed through neon gas, it produces both plasma and light. Lightning is a massive electrical discharge in the atmosphere that creates a jagged column of plasma. Part of a comet's streaming tail is plasma from gas ionized by sunlight and other unknown processes. The Sun is a 1.5-millionkilometer ball of plasma. It is heated by nuclear fusion.

Scientists study plasma for practical purposes. In an effort to harness fusion energy on Earth, physicists are studying devices that create and confine very hot plasmas in magnetic fields. In space, plasma processes are largely responsible for shielding Earth from cosmic radiation, and much of the Sun's influence on Earth occurs by energy transfer through the ionized layers of the upper atmosphere.

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....

Exercise 5. Read the text and put the sentences below in the correct order. Then ask questions to each sentence.

Iron and Steel

Copper and tin were used before iron: they melt at a lower temperature, and can be mixed to form a useful metal called bronze.

Iron was probably first extracted from meteorites, perhaps around 3000 BC. Later, iron was extracted from iron ore (impure iron) around 2000 BC. The iron was first heated, then hammered to remove the impurities, then cooled. Finally, iron was heated again and shaped into tools or weapons.

Later, in India first of all, people found out how to make fires hot enough to melt iron (at a temperature of 1,539 C), by driving air through the fuel. This made it possible to produce steel. Steel is made from iron mixed with a little carbon (0.15% - 0.25%). Steel is harder than pure iron, and is less brittle (it does not break easily). Every motorist is the owner of a ton of steel.

..... a) Iron was used later than copper.

..... b) People got iron from meteorites.

..... c) Steel was first produced in India.

..... d) Bronze was made of iron.

..... e) Iron ore was heated to get iron.

..... f) Iron was melted by making fires hot enough.

MODULE 5. **INORGANIC CHEMISTRY**

Part 1. Types of Inorganic Chemical Reactions.

Task 1. Before reading the article study the mathematical expressions, chemical formulas and some punctuation marks.

Symbol	Name / Read as	Explanation	Examples
=	**equality** / is equal to; equals	*x* = *y* means *x* and *y* represent the same thing or value.	1 + 1 = 2
≠	**inequation** / is not equal to; does not equal	*x* ≠ *y* means that *x* and *y* do not represent the same thing or value	1 ≠ 2
<	**strict inequality** / is less than, is much less than, / is greater than, is much greater than	*x* < *y* means *x* is less than *y*.	3 < 4
+	**addition** / plus	4 + 6 means the sum of 4 and 6.	2 + 7 = 9
-	**sub(s)traction** / minus	9 − 4 means the sub(s)traction of	8 − 3 = 5
·	**multiplication** / times, multiplied by	3 · 4 means the multiplication of 3 by 4.	7 · 8 = 56
÷	**division** / divided by	6 ÷ 3 or 6 ⁄ 3 means the division of 6 by 3.	2 ÷ 4 = .5 12 ⁄ 4 = 3
⟶	**resulting in** / **give**(s), leads to, yields	Na+Cl → means Na and Cl give.....	$H_2 + Cl_2 \rightarrow 2HCl$

Note: chemical formulas can also be read with the help of spelling:
e.g. 2 $FeCl_3$ could be read as two molecules of [ef i: si: el θri:]

Mathematical expressions:

- 3^2 three squared, three to the power of two, three to the second (power)
- 3^3 three cubed, three to the power of three, three to the third (power)
- 3^4 three to the power of four, three to the fourth (power)
- $\sqrt[n]{z}$ the n-th root of z
- 3/5 three divided by five, three fifths

3.25 three point two five
4,034 four thousand and thirty four
524th five hundred and twenty-fourth

Some punctuation marks:

, comma
. full stop (GB), period (AM)
: colon
; semi-colon
! exclamation mark
? question mark
- hyphen
– dash
/ slash, stroke, oblique
´ ´ single quotes
" " double quotes, quotation marks, inverted commas
( ) brackets, parentheses
´ apostrophe

Elements and compounds **react with** each other in numerous ways. Almost every inorganic chemical reaction falls into one or more of four broad categories.

I. Combination Reactions

Two or more **reactants form** one **product** in a combination reaction. An example of a combination reaction is the formation of **sulfur dioxide** when sulfur is burned in air:

$$\mathbf{S\ (s) + O2\ (g) \rightarrow SO2\ (g)}$$

II. Decomposition Reactions

In a decomposition reaction, a compound **breaks down** into two or more substances. Decomposition usually results from **electrolysis** or **heating**. An example of a decomposition reaction is the **breakdown** of **mercury (II) oxide** into its component elements:

$$\mathbf{2HgO\ (s) + heat \rightarrow 2Hg\ (l) + O2\ (g)}$$

III. Single Displacement Reactions

A single displacement reaction is characterized by an atom or ion of a single compound **replacing** an atom of another element. An example of a single displacement reaction is the displacement of copper ions in a **copper sulfate solution** by zinc metal, forming **zinc sulfate**:

$$\mathbf{Zn\ (s) + CuSO4\ (aq) \rightarrow Cu\ (s) + ZnSO4\ (aq)}$$

Single displacement reactions are often subdivided into more specific categories, e.g., **redox reactions** – chemical reactions which involve oxidation and reduction.

IV. Double Displacement Reactions

Double displacement reactions also may be called **metathesis reactions**. In this type of reaction, elements from two compounds displace each other to form new compounds.

An example of a double displacement reaction occurs when solutions of **calcium chloride** and **silver nitrate** react to form **insoluble silver chloride** in a solution of **calcium nitrate**.

$$\mathbf{CaCl_2\ (aq) + 2\ AgNO_3\ (aq) \rightarrow Ca(NO_3)_2\ (aq) + 2\ AgCl\ (s)}$$

A **neutralization reaction** is a specific type of double displacement reaction that occurs when an **acid** reacts with a **base**, producing a **solution of salt and water**. An example of a neutralization reaction is the reaction of **hydrochloric acid** and **sodium hydroxide** to form **sodium chloride** and water:

$$\mathbf{HCl\ (aq) + NaOH\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)}$$

Remember that reactions can belong to more than one category. Also, it would be possible to present more specific categories, such as **combustion reactions** or **precipitation reactions.**

Task 2. Read the article and answer the following questions:

1. What are the main types of inorganic chemical reactions?
2. What is the difference between single and double displacement reactions?
3. What other types of inorganic reactions – apart from the 4 main ones – are mentioned in the article?
4. What is the difference between chemical reaction and chemical equation?
5. What is the difference between to break down and breakdown?
6. How do we call fluorides, chlorides, bromides and iodides?

Task 3. Translate the words in bold **from the article above and give definitions to the following expressions with the help of a dictionary:**

oxide	nitrate	iodide
chloride	hydroxide	fluoride
sulfate/sulphate	acid	bromide

Task 4. Divide the compound mentioned in the article into the following groups:

Binary compounds	Ternary compounds	Acids
....	....	....
....	....	....
....	....	....
....	....	....

Task 5. Check if you can read and write the expressions correctly:

a) **read the following:** 5,023; 15.012; 3/5; $6H_2O_2$; $3H_2SO_3$; $\sqrt[n]{1} = 1$;

45/173; 7^6; 15,123,014; 1.012; $2KClO_3 \rightarrow 2KCl + 3O_2$

b) **write in full:**

14.023 – ....

144th – ....

7/6 – ....

17x30 – ....

25,306 – ....

14^{-2} – ....

$4H_3PO_4$ – ....

13^{th} – ....

204x15 – ....

$3Cu+8HNO_3 \rightarrow H_2O+2NO+3Cu(NO_3)_2$ – ....

Part 2. Text. Nomenclature of binary and ternary compounds

Task 6. Read the text translate the words in bold **with a help of a dictionary.**

The nomenclature of inorganic chemistry is a systematic method of naming inorganic chemical compounds. Ideally, every inorganic compound should have a name from which an unambiguous formula can be determined.

Binary compounds are compounds consisting of two elements, the second name of which ends with **-ide** (chloride, oxide etc.). The formation of the whole name of the substance depends on whether or not the given binary compound contains a metal (if it contains a semimetal, the rules are the same as for metals).

When a binary compound contains a metal e.g $FeCl_2$ we today use the so-called **stock system** where we write the basic form of the first element (in our case iron) and the number of its **oxidation state** (identified by a Roman numeral) and then add the second element ending with **-ide.** Thus, **$FeCl_2$** is written as: **iron (II) chloride**, which is read as "iron two (normal number) chloride". The older system which today remains only in technical names used the suffixes **-ic** or **-ous**, the former referring to a higher oxidation state and the latter to a lower one. Thus $FeCl_2$ could be also called ferrous chloride (compare with $FeCl_3$ = ferric chloride). However, today this system only prevails in the nomenclature of oxoacids and their salts and will hopefully soon disappear completely as it requires to know what oxidation states the given element actually achieves before it can be used. In conclusion: endings -ous and -ic are still used in technical names usually in the combination with the Latin name of the given element but the stock system (which uses the English names of elements wherever possible) is strongly preferred for the systematic naming of inorganic binary compounds containing either a metal or a semimetal.

When the binary compound contains neither a metal nor a semimetal, we write not only the basic form of the first element but also of the second one and use Latin prefixes (mono-, di-, tri- etc.) to express the real number of atoms (not the oxidation state!!!), Thus, for example, **CO_2** is therefore called **carbon dioxide**. Similarly N_2O_3 is then called dinitrogen trioxide etc.

The main difference is that when a binary compound contains a metal or a semimetal we use Roman numerals after the name of the first element to express **its oxidation state**, but if there is no metal or semimetal in a binary compound we use Latin prefixes to express the **real amount of atoms** and place them **in front of** the name of the relevant element.

Ternary compounds are called compounds if there is **only 1 such compound (e.g.** Na_2CO_3 – sodium carbon**ate) or** if there are **2 such compounds (e.g.** $NaNO_2$ – sodium nitr**ite** $NaNO_3$ – sodium nitr**ate).**

Task 7. Rewrite from the text all the chemical terms formed with the suffixes -ide, -ic, -ous, -ate and preffixes mono-, di-, tri- .

Task 8. The 1st group of *binary compounds* are compounds containing a metallic element.

a) Which of the compounds mentioned in the article falls into the group of the compounds containing *metal with a fixed charge*?

.... –	$ZnCl_2$ – ....
K_2O – potassium oxide	ZnO – ....

b) What does the fact that the metallic element has a fixed charge mean?

c) 1. Which of the compounds mentioned in the article falls into the group of the compounds containing *metal with a non-fixed charge*?

2. Why does its name look different?

Fe_2O_3 – ferr**ic** oxide

FeO – ferr**ous** oxide

.... – ....

Hg_2O – mercury (I) oxide

So, according to this system:

Fe_2O_3 – ....

FeO – ....

CuS – ....

Cu_2S – ....

d) Which suffix means higher valence and which lower valence?

-ic – ....

-ous – ....

e) These are called 'trivial names'.

1. What does it mean?
2. Which names would you prefer to use? Trivial or systematic ones? Why?
3. Why is there no such problem with the 1st group – compound containing metal with a fixed charge?

Task 9. The 2nd group of *binary compounds* are compounds containing a non-metallic element.Complete the following:

CO – carbon **mono**xide

CO_2 – ....

OsO_4 – ....

N_2O_3 – **di**nitrogen **tri**oxide

N_2O_5 –...................................

Task 10. a) Which suffix means higher oxidation number and which lower oxidation number?

-ite – ....

-ate – ....

b) Which of the compounds are ternary compounds? Which of the 2 subgroups do they fall into? Complete the following:

Na_2BO_3 – ....

Na_2SO_3 – ....

Na_2SO_4 – ....

Part 3. Nomenclature of acids.

Task 11. Read about nomenclature of acids and create formulas for the names of the following compounds:

hydrobromic acid – ....

bromic acid – ....

sulphuric acid – ....

chlorous acid – ....

periodic acid – ....

Nonoxygenous acids

– without oxygen

– e.g. HCl – hydrogen is expressed by the prefix hydro + the name of the main element ending with –ic because they are only in one form (hydrochlor**ic** acid) or the same rule applies as for binary nonmetallic compounds (hydrogen chloride). Similarly HF is either hydrofluoric acid or hydrogen fluoride etc.

Oxoacids

– contain hydrogen, an element forming their name and oxygen

– here we meet the older and rather unfortunate way of naming substances which was briefly mentioned in the chapter about naming binary compounds containing a metal. As you may remember it uses the endings –ic or –ous, the former referring to a higher oxidation state and the latter to a lower one. So H_2SO_4 is called sulphur**ic** acid (higher oxidation state of sulphur) and H_2SO_3 is sulphur**ous** acid (lower oxidation state). The problem, as you probably feel, is that here you need to know what oxidation states that element really achieves or, more precisely, which oxoacids it really forms. However, it is still used this way although the IUPAC (organisation that sets rules for nomenclature) is taking steps to change it. If an element forms more than two oxoacids the prefixes **hypo-** and **per-** are employed. So

e.g. HClO is hypochlorous acid (**hypo-** refers to a lower oxidation state than the one marked with the ending **–ous**)

$HClO_2$ is chlorous acid

$HClO_3$ is chloric acid (**-ic** referring to a higher oxidation state than **–ous**)

$HClO_4$ is perchloric acid (**per-** meaning a higher oxidation state than an acid with just **–ic** at the end)

Salts of oxoacids are formed in a very similar way (using partly this older method and partly the stock system). Once we know the name of the acid we keep it and simply change the ending: **–ous** into **–ite** and **–ic** into **–ate**.

Oxidation state	**Cations and acids**	**Anions**
Lowest	hypo- -ous	hypo- -ite
	-ous	-ite
	-ic	-ate
Highest	per- -ic	per- -ate

Thus, for example, **NaClO** is called **natrium hypochlorite** (element natrium or sodium is obvious, we know the name of hypochlorous acid, so we just change its ending from –ous to –ite). Or **$Fe(ClO_3)_2$** is called **iron (II) chlorate** (we mark the oxidation state of iron in the same way as in the stock system of binary compounds with a metal, then we take the name of chloric acid ($HClO_3$) and change its ending from –ic to –ate).

Task 12. Which 2 groups do acids mentioned in the article falls into?

Task 13. Complete the following:

HCl –	HF – ....
H_2SO_4 –	HNO_3 – ....
HNO_2 –	H_2SO_3 – ....
N_2O_3 –	H_2CO_3 – ....
$CaCO_3$ –	KNO_3 – ....
$Fe(OH)_3$ –	$HBrO_3$ – ....
$Au(ClO_4)_3$ –	KOH – ....
Na_2S –	Na_2SO_3 – ....

Task 14. Which suffix means higher oxidation number and which lower oxidation number?

-ic – .... **-ous** – ....

Task 15. Be ready to speak on the tropic "Inorganic Chemistry".

Part 4. GRAMMAR: Phrasal Verbs

Rule	Example
1. A **phrasal verb** (also called a multi-word verb) consists of a **verb + particle**.	She **set up** an experiment.
2. Most phrasal verbs are **transitive** (they take direct object).	You should **go after** <u>your goals</u>.
3. Some transitive phrasal verbs are **inseparable** (this means that both noun and pronoun <u>objects</u> always go after the particle).	She **ran into** <u>her friend</u> at he library. She **came up *with*** <u>a brilliant idea</u>.
4. Most transitive phrasal verbs are **separable** (this means <u>direct objects</u> can go 1) after the particle or; 2) between the verb and the particle. ***Note:*** When the direct object is a pronoun, it must go between the verb and the particle.	 I just **dreamt up** <u>a new idea</u>. I just **dreamt** <u>a new idea</u> **up**. She **dreamt** <u>it</u> **up**.

Exercise 1. Can you find any phrasal verbs in the article of Tasks 1?

Exercise 2. Read the article. Underline the phrasal verbs. Circle the direct object.

Eureka

Did you know that two university dropouts thought up the idea of the first personal computer? What's more, they put it together in a garage. Inventions don't have to come out of fancy laboratories. Average people in classrooms, kitchens and home workshops often dream up new and useful ideas.

The ability to think of something new seems like magic to many people but in fact anyone can develop the qualities of an inventor. First, inventors follow their curiosity. The Swiss inventor George de Mestral wanted to find out the reason it was so hard to remove burrs from his dog's coat. His answer led to the idea for Velcro@, now used to fasten everything from trainers to space suits. Second, inventors use imagination to put things together in new ways. Walter Morrison watched two men throwing a pan to each other and thought up the Frisbee@, one of the most popular toys in the world. Perhaps most important, successful inventors don't give up. They continuously look up information about their ideas and try new designs out until they succeed.

Exercise 3. Read about one of the history's great inventors. Complete the information with the correct form of the appropriate phrasal verb from the box.

fiIl up	keep away	bring about	try out	set up	carry out	pay back	pick up

As a child, Thomas Alva Edison (1847–1931) tried out almost everything he heard about – he even tried to hatch goose eggs by sitting on them! Before he was twelve, he .... his first laboratory using money he had earnt himself. He had hundreds of bottles and he .... them .... with chemicals for his experiments. He labelled the bottles 'poison' to .... his family .... When he was fifteen, Edison .... a new skill. He had saved a child's life and the gтateful father, a telegтaph operator, ... Edison .... by teaching him telegraphy. After that, Edison was able to work at night and .... his experiments during the day. In 1869 Edison made a piece of equipment for a company that supplied prices to sold brokers. This .... his first useful invention – the stock ticker – for which he received $40000. He was then able to spend all his time working on his new inventions. During his lifetime, Edison was issued with 1093 patents!

Exercise 4. Read the conversations that take place in a school laboratory. Complete them with phrasal verbs and pronouns.

Example: A: Please **put on** your lab coats.
B: Do we really have to put them on? It's hot in here.

1. A: I can't **figure out** this problem.

   B: I know what you mean. I can't .... either.

2. A: Remember to **fill in** these forms.

   B: Can we .... at home or do we have to do it now?

3. A: Are you going to **hand out** the next assignment today?

   B: I .... a few minutes ago. Weren't you here?

4. A: I can't get this to work. We'd better **point** the problem **out** to the teacher.

   B: OK, I'11 .... to her.

5. A: Are we supposed to **hand in** our lab reports today?

   B: No. Please .... next week.

Exercise 5. Fill in the gaps with the correct form of the phrasal verbs below.
give off / look into / cut down on / cut down / give up / drive down

1. We're experiencing a huge demand for more environmentally friendly fuels and are committed to .... carbon dioxide emissions.
2. If the trees in the world's rainforests are ...., there will be disastrous environmental consequences.
3. Safety is an important issue for petro-chemical companies. Some of the chemicals they produce .... toxic fumes, so they have to ensure they are not spilt or released into the environment.
4. The U.S. government has refused to .... the amount of pollution the country produces.
5. It's too easy to criticise governments and companies for polluting – are you willing to .... using your car?
6. I think we should spend more money on research to .... alternatives to using petrol.

MODULE 6. **ORGANIC CHEMISTRY**

Part 1. Text. Carbon and organic nomenclature

Task 1. Read the paragraph and explain the meaning of the words in bold**. Use dictionary if necessary.**

Life on earth **depends on** the chemical element carbon, which is present in every living thing. **Carbon** is so important, it forms the **basis** for two branches of chemistry, **organic chemistry** and **biochemistry**. Carbon is the chemical basis for life.

The simplest organic compounds are **hydrocarbons**. Hydrocarbons contain only two elements, hydrogen and carbon. A **saturated hydrocarbon** or **alkane** is a hydrocarbon in which all of the carbon-carbon bonds are **single bonds**. Each carbon atom forms four bonds and each hydrogen forms a single bond to a carbon. The bonding around each carbon atom is **tetrahedral**, so all bond **angles** are 109.5°. As a result, the carbon atoms in higher alkanes are **arranged** in zig-zag rather than linear **patterns**.

In chemistry, a **derivative** is a compound that is formed from a similar compound if one atom is replaced with another atom or group of atoms. Different organic compounds containing similar carbon or non-carbon groups - so-called **functional groups** - within the molecules react similarly. This leads to the compounds being grouped in families according to the functional groups that they contain.

Task 2. Answer the following questions:

1. Whyat does life on earth depend on?
2. Why is carbon important?
3. What does the term ‘saturated hydrocarbons’ mean?
4. Which hydrocarbons are ‘unsaturated’?
5. What type of bonds do hydrocarbons have?
6. How do we form the names of cyclic carbohydrates?
7. What does the term ‘derivative’ mean?
8. What is a functional group?

Task 3. Read the 10 facts about carbon and match the 2 parts of each statement. Then explain the meaning of the words in bold.

1. Carbon is the basis for organic chemistry ....

2. Carbon is a nonmetal that can **bond with itself** and many other chemical elements, ...
3. **Elemental carbon** can take the form of one of the hardest substances (diamond) ....
4. Carbon is made in the interiors of stars, ...
5. Carbon compounds have **limitless** uses. In its **elemental form**, diamond is a **gemstone** and used for **drilling/cutting**; graphite is used in pencils, as a lubricant, and to protect against **rust**; ....
7. Carbon has the highest melting/sublimation point of the elements. The melting point of diamond is ~3550°C, ...
7. **Pure carbon** exists free in nature ....
8. The origin of the name 'carbon' comes from the Latin word carbo, for **charcoal**. ....
9. Pure carbon is considered non-toxic, ...
10. Carbon is the fourth most **abundant** element in the universe – ....

a ______ as it **occurs** in all living organisms.

b ______or one of the softest (**graphite**).

c ______ though it was not produced in the Big Bang.

d ______ and has been known since prehistoric time.

e ______ forming **nearly** ten million compounds.

f ______ hydrogen, helium, and oxygen are found in higher **amounts**, by mass.

g ______ although inhalation of **fine particles**, such as soot, can damage **lung tissue**.

h ______ The German and French words for charcoal are similar.

i ______ while charcoal is used to remove **toxins**, **tastes**, and **odors**.

j ______ with the sublimation point of carbon around 3800°C.

Task 4. a) How are the following names of hydrocarbons pronounced in English?

alkanes	**alkenes**	**alkynes**
methane	__	__
ethane	ethene	ethyne
propane	propene	propyne
butane	butene	utyne
pentane	pentene	pentyne
hexane	hexene	hexyne

b) Some of these carbohydrates also have trivial names. Match them.

ethylene propylene acetylene methylacetylene butylene

Task 5. Match the systematic and trivial names of the following carboxylic acids:

methanoic acid	propionic acid
ethanoic acid	formic acid
propanoic acid	butyric acid
butanoic acid	acetic acid
pentanoic acid	valeric acid
dodecanoic acid	stearic acid
hexadecanoic acid	lauric acid
octadecanoic acid	palmitic acid

Part 2. Carbohydrates, fats, proteins and their properties

Task 6. Read the paragraphs, rewrite the pronunciation of the following words from a dictionary and memorize them:

Carbohydrates

cellulose – *целюлоза, клітковина*
carbon – *вуглець*
hydrogen – *водень*
oxygen – *кисень*
glucose – *глюкоза*
fructose – *фруктоза*
breakdown – *розклад (речовини)*
maltose – *мальтоза*
lactose – *лактоза, молочний цукор*
hydrolysis – *гідроліз*
saccharose – *сахароза*
galactose – *цукор, галактоза*

For such activities as breathing, the heartbeat, the maintenance of body temperature and others any person needs energy. We can get it from protein, fat, alcohol. But from carbohydrates we get most of the energy that we need. There are three major carbohydrates in food: sugars, starches, cellulose and related materials.they all are compounds of carbon, hydrogen and oxygen and there chemical structures are based on a common unit (as a rule it is glucose). These units can be linked together in different ways and in different numbers. Classification of carbohydrates depends on the number of such units.

Sugare and starches are a major source of man's food energy all over the world.
Glucose , fructose and galactose are monosaccharides (or simple sugars), and they are the units of more complex carbohydrates. Glucose occur in fruit and plant juices and in the

blood of living animals.During digestion most carbohydrates in food convert to glucose. From partial hydrolysis of starch we can get glucose syrups (or liquid glucose). Fructose ocurs in some fruit and vegetables and especially in honey. It is the sweetest sugar that we know. Galactose does not occur in the free state, but it forms part of lactose.

Disaccharides consist of two monosaccharides linked together. They are sucrose, maltose and lactose. Sucrose is a chemical combination of gluctose and fructose. Maltose is a combination of two glucose units. It is formed during the breakdown of starch by digestion. Lactose is a combination of glucose and galactose. It occurs only tn milk.

Fats

triglyceride – *тригліцерид*
cholesterol – *холестерин*
carotene – *каротин*
include – *містити в собі*
value – *оцінка, цінність, оцінювати*
satiety – *насичення*
oilseed – *сім'я олійної культури*
palatable – *приємний на смак, смачний*

Fats include not only “visible fats” such as butter and margarine, cooking fats and oils, fat on meat, but also “invisible fats” which are found in milk, nuts, lean meat and other animal and vegetable foods. They are a better source of energy than carbohydrates, and are the form in which much ot the energy reserve of animals and some seeds is stored.

Like carbohydrates, fats consist of carbon, hydrogen and oxygen, though the proportion of oxygen is lower. Chemically, food fats consist mainly of mixtures of triglycerides. Each triglyceride is a combination of three fatty acids with a unit of glycerol (glycerine). The differences between one fat or oil and another are largely the result of the different fatty acids in each of them.

Oils are simply fats. They are liquid at room temperature. Usually it is a result of their higher content of unsaturated fatty acids. But on freezing they become solid.

Fats are solid at low temperatures and becorne liquid when they are heated. Fat makes our meals palatable. Foods rich in fat have a high satiety value, because it is digested comparatively slow. Oils and fats do not dissolve in water. Animal fats contain vitamins A and D, and varying amounts of cholesterol. Vegetable fats contain carotene (which is converted into vitamin A in the body) and vitamin E, but they have no cholesterol.

Mineral oils (such as liquid paraffin) are chemically different from food fats and oils, though they look similar. They are not utilized by the body, but can reduce the absorption of some nutrients.

Proteins

nitrogen – *азот*	tissue – *тканина;* ***connective tissue*** *сполучна тканина*
sulphur –*сірка*	coagulate – *згущати (ся), коагулювати*
phosphorus – *фосфор*	albumen – *яєчний білок; хім. альбумін*
lysine – *лізин*	gluten – *клейковина, рослинний білок*
methionine – *метіонін*	excess – *надлишок, надмір*
tryptophan – *триптофан*	gelatin – *желатин*

All living plants and animals contain a certain substance without which life is impossible. This is protein (from the greek word "proteios" means "first, primary"). All proteins are compounds of carbon, hydrogen and oxygen.But unlike carbohydrates and fats, they always contain nitrogen as well. Most proteins also contain pholsphorus. Proteins are necessarily present in all cells, where they help to regulate lhe processes of living. Protein has to be provided in the diet for the growth and repair of the body, but any excess of it is used to provide energy.

Proteins consist of chains of hundreds or even thousands of amino acid units. Only about 20 different amino acids are used, but the number of ways in which they can be arranged is almost endless. It i the specific and unique sequence of those units which give each protein its characteristic properties.

Some of proteins can dissolve in water and others in salt water, but certain proteins cannot dissolve at all. That is usually used in the preparation of wheat gluten, empolyed to improve the baking quality of home-produced wheats.

The action of heat on protein is complex. Proteins such as albumen in egg white harden and coagulate when heated, but still are easily digested. Individual amino acids are little affected by normal cooking processes, although some lysine can react with carbohydrates in the food and methionine can sometimes be reduced. In the preparation of gelatin when connective tissue from meat is boiled for many hours, all the tryptophan is destroyed.

Task 7. Put questions to the following sentences:

1. Vegetables play an important role in the human diet.
2. The body needs carbohydrates in order to use fat efficiently.
3. Fats liquid at room temperature are called unsaturated.
4. Every molecule of fat is derived from three molecules of fatty acids and one molecule of glycerol.
5. Sugars are stored in the stems and roots of plants as starch.
6. The properties of the fats are affected by polyunsaturated fatty acids.
7. All kinds of cheese are considered as rich sources of protein.
8. Vitamin B is called a complex vitamin because of its numerous constituents.
9. Vitamin C is easily destroyed by heat.
10. Vitamin A was found in green vegetables, eggs, butter, cream, carrots, cabbage and potatoes.

Task 8. Tranlate the following sentences into English:

1. Жир є важливим джерелом енергії для організму, а вуглеводи – основним.
2. Основні джерела вуглеводів – продукти рослинного походження.
3. Головною складовою частиною їжі є білки.
4. Молекула білка складається з 20 амінокислот.
5. Вітаміни А, Д, Е, К розчиняються в жирах, а інші – у воді.

Task 9. Read the text, find the meaning of the words in bold **in a dictionary and entitle it:**

About one third of the protein in the diet comes from plant **sources** and two-thirds from animal sources. The **amount** of protein in nuts and dried peas and beans is very high – about the same as in meat, fish and cheese. **Cereals** are also rich in protein: **wheat**, **maize** and rice are the main sources of protein for many people in the world. The amount of protein in most root vegetables is small, but potatoes give necessary amounts.

The amount and type of protein in the diet will not balance the needs for growth, **repair** and **maintenance** of the body. There always will be excesses of some amino acids and usually **an excess** of total protein. These will be changed into glucose in the liver or be directly oxidized to provide heat and energy. That is why it is important to know that diets contain necessary energy in the form of carbohydrate and fat before expensive proteins are added. These proteins can be utilized only when no other **nutrient** can be substituted.

As for newborn infants, they can absorb some proteins from their mother's milk, including **antibodies** which provide protection from infection. Some individuals can react to certain other food proteins. For example, those with **coeliac disease** react to gluten, others react to cow's milk protein. Some beans including soyabeans contain proteins which are **harmful** unless well cooked.

Task 10. Make up a dialogue about nutrients in food and dramatize it with a partner.

Part 3. Major minerals and trace elements in living organisms

Task 11. Read the text, rewrite all the new words into your vocabulary and find their meaning and pronunciation in a dictionary:

Minerals are inorganic elements. Most of them can be found in the body, but only fifteen of them are known to be essential and must be taken from food.

The main three functions of minerals are: l. They are constitituents of the bones and teeth. These include calcium, phosphorus and magnesium. 2. As soluble salts they help to control the composition of body fluids and cells. These include sodium and chlorine in the fluids outside the cells; and potassium, magnesium and phosphorus inside the cells. 3. They are essential adjuncts to many enzymes, and other proteins such as haemoglobin. Iron and phosphorus are necessary for the release and utilization of energy.

These seven elements (calcium, phosphorus, magnesium, sodium, chlorine, potassium and iron) are needed in the greatest quantities in the diet or are present in the largest amounts in the body tissues. These, together with sulphur, may be considered as the major minerals.

Iron. Healthy people contain about 3 to 4 g of iron, more than half of which is in the form of haemoglobin, the red pigment of blood. Also it is present in some organs such as the liver. If food has not enough iron to replace body's losses, anaemia may result. The absorption of iron from food is low. Most readily it is absorbed from meat (up to 25 per cent). Less than 5 per cent of the other forms of iron such as those in eggs and vegetables or added to flour is absorbed. The exact amounts depend on other factors in the diet, for example, it is increased by vitamin C, but decreased by the tannins in tea. Some other important sources of iron are eggs, cereal products, potatoes and vegetables.

Calcium. Calcium is the most widely distributed mineral in the body. All but about l per cent of it is in the bones and teeth. It gives them strength. About 10 g of calcium are essential for the contraction of muscles including the heart muscle, for nerve function, for the activity of several enzymes. Too little calcium in the body causes different diseases of bones and teeth. Only about 20-30 per cent of the calcium in the average diet is normally absorbed. Few foods besides milk and cheese, and most bread contain significant amounts of calcium. It is very important that these foods are included in the diet, especially for children whose needs are greatest.

Phosphorus. Phosphorus is the second widespread mineral in the body in the form of various phosphates, which perform a lot of essential functions. Calcium phosphates provide the strength of the bones and teeth. Inorganic phosphates are major constituents of all cells. Phosphates play an important role in the liberation and utilization of energy from food. They are also constituents of nucleic acids and some fats, proteins and carbohydrates. Because phosphorus is present in nearly all foods, its dietary deficiency is unknown in man. The main sources of phosphorus in the diet are milk and milk products, bread and other cereal products, meat and meat products.

Magnesium. Most of the magnesium in the body is present in the bones, but it is also an essential constituent of all cells. lt is necessary for the functioning of some of the enzymes which are involved in energy utilization. Magnesium is widespread in foods, especially those of vegetable origin because it is an essential constituent of chlorophyll.

Sodium and ***chlorine***. All body fluids contain salt (sodium chloride). These elements are involved in maintaining the water balance of the body. Sodium is also essential for muscle and nerve activity. Salt requirements are closely related to water requirements. Salt intake may, however, be restricted in certain kidney diseases, besides salt should not be added to infants' diets.

It is essential for life that the concentration of sodium and chloride in the blood is maintained within close limits, because an excess of (added) salt in the diet is readily absorbed. Control of sodium in the blood is achieved by its excretion through the kidneys.

Also it is lost through sweat. Sodium and chlorine are comparatively low in all not-processed foods, but salt is added to very many prepared foods. For example, salt is low in fresh meat but high in bacon, sausages, and most other products. Salt is added to butter, margarine, cheese, bread and some other foods during home cooking and on the plate.

Potassium. Potassium is present in the fluids within the body cells where its concentration is carefully controlled. Most of the potassium in the diet is absorbed and the excess is excreted through the kidneys. The main sources of potassium are vegetables, meat and milk.

The rest of the minerals, including cobalt, copper, chromium, fluorine, iodine, manganeze and zinc, are equally essential but needed in much smaller quantities. They are called ***trace elements.*** It's necessary to remember that a large excess of most of them can be poisonous. We do not know the exact roles of these minerals, because some of them have recently been found to be essential, but dietary deficiencies of some are still unknown. The utilization of one may be affected by the amounts of other elements present.

Cobalt can be used by man only in the form of vitamin B12.

Copper is associated with a number of enzymes. Its deficiency has been observed in malnourished infants. The main sources of copper in the average diet are meat, bread and other cereal products, and vegetables.

Chromium is involved in the utilization of glucose and widely distributed in foods.
Fluorine increases the resistance of bones and teeth to decay. Drinking water is an important source, but the natural content is often very low. The only other important sources of fluorine in the diet are tea, sea-food (especially fish whose bones are eaten) and, if eaten, fluoridated toothpaste.

Iodine is an essential constituent of hormones produced by the thyroid gland. The most important source of iodine is sea-food. Its amount in vegetable and cereal foods depends on the level in the soil. Because of the use of iodines in animal feed, milk and milk products, meat and eggs are important sources of iodine in the diet.

Manganese is associated with a number of enzymes. Tea is very rich in manganese, and plant products are in general much better sources of manganese than the animal products.

Selenium is needed for an enzyme in the red blood cells. The main dietary sources of it are meat, fish and cereal products.

Zinc is present in a wide range of foods, particularly in association with protein, and meat and dairy products are its excellent sources.

Task 12. Answer the following questions on the text:

1. Where can minerals be found?
2. What major minerals do you know?
3. What are the main functions of minerals?
4. What factors influence the absorbtion of iron?
5. What sources of iron do you know?
6. What mineral is the most widespread in the body?
7. What foods contain significant amounts of calcium?
8. What are the main functions of calcium in the body?
9. What are the main sources of phosphorus?
10. Is magnesium a trace or a major mineral?
11. Why is magnesium widespread in foods of vegetable origin?
12. What is the main function of sodium and chlorine?
13. What foods are rich in sodium and chlorine?
14. Are trace elements necessary to a man in large quantities?
15. What trace elements do you know?

Task 13. Tranlate the following sentences into English:

1. Мінеральні речовини – обов'язковий компонент їжі.
2. Поєднання фосфору з білком, жировими та іншими кислотами утворює сполуки високої біологічної активності.
3. Основні джерела надходження в організм магнію – зернові й бобові продукти, а також молоко.
4. М'ясні і рибні продукти, яйця, хліб, крупи – джерела надходження в організм багатьох мінеральних речовин.
5. Мікроелементи – це елементи, що містяться в рослинах, тваринах, мікроорганізмах, а тому і в харчових продуктах, у дуже малих кількостях.

6. Солі кальцію і фосфору є складовою частиною кісткової системи.
7. Потреба в жирах у дорослої людини становить 80–100 г на день.
8. Без їжі людина може прожити кілька тижнів, а без води всього кілька днів.
9. Відомо, що овочі є добрим джерелом білків і крохмалю.
10. Безсумнівно, молоко містить майже всі корисні поживні речовини.

Task 14. Match adjectives with the appropriate nouns:

connective	amounts
nutritional	combination
average	tract
digestive	tissue
important	value
necessary	source
chemical	diet

Task 15. Be ready to speak on the main functions of minerals and trace elements.

Part 4. GRAMMAR: Comparison of Adjectives

Rule	Example
1. Use a **comparative form of adjectives** to focus on a difference between people, places and things and **superlative** – to single out people, places and things from other people, places and things.	The report is **more important than** your other work. The report is the **most important** of all work.
2. The ways to form the **comparative** and **superlative** of adjectives are: 1) for 1-syllable adjectives and 2-syllable adjectives ending in –y for **comparative** use **adjective + –er;** for **superlative** use the + **adjective + –est;** 2) for most other adjectives of 2 or more syllables for **comparative** use **more/less + adjective;** for **superlative** use **the most/ the least + adjective.**	The new laboratory is **bigger than** the old one. The new laboratory is **the biggest** of all. The new laboratory is **more comfortable than** the old one. The new laboratory is **the most comfortable** of all.
3. Some adjectives have irregular **comparative** and **superlative forms.**	good – better – the best bad – worse – the worst

4. Use the **same comparatives** to talk about change – an increase or a decrease.	It's getting **harder and harder** to find an inexpensive equipment.
5. Use **a double comparative** to show cause and effect.	**The shorter** the queue, **the faster** the service.
6. You can use **as + adjective + as** to compare two people, places and things.	The new advert is **not as effective as** an old one.

Exercise 1. Find the adjectives in the paragraphs of Tasks 1 and 3 and rewrite them into your notebook. Answer the questions:

a) Which of the adjectives are positive, comparative and which superlative?

b) What are the 2 ways of forming comparative and superlative forms of adjectives in English?

c) How do we know which of the 2 ways to use?

d) Are there any exceptions to these rules?

Exercise 2. Make adjectives from the following nouns and their comparative and superlative forms if possible.

	Comparative	**Superlative**
chemistry –	....	....
molecule –	....	....
attention –	....	....
puzzle –	....	....
oxide –	....	....
pollutant –	....	....
liquid –	....	....
theory –	....	....
atmosphere –	....	....
laboratory –	....	....
experiment –	....	....
science –	....	....
atom –	....	....
gas –	....	....

Exercise 3. Use the necessary form of the adjective in brackets.

1. Liquid nitrogen is .... (light) than water.

2. Copper and silver are one of the .... (good) conductors of electricity.
3. Zink is .... (cheep) than other metals.
4. Lead is one of the .... (heavy) metals.
5. Water is one of the .... (common) things in our life.
6. The .... (many) experiments scientists make, the .... (great) is their knowledge of the structure of matter.
7. An atom is .... (small) than a molecule.
8. A molecule is the .... (small) part of a compound.
9. The equipment of our laboratory is .... (good) than yours.
10. The structure of matter is one of the .... (interesting) subjects.

Exercise 4. Read about Mendeleev's contribution to chemistry and society. Complete the gaps with the correct form of the appropriate adjective from the box.

many	undiscovered	light	social	empty (2)	chemical	equal	heavy

Mendeleev spent twenty years studying the .... elements. Before the end of 19th century he surprised the world with his Periodic Law. He placed all the elements in order, starting with the .... , hydrogen, and finishing his Table with uranium, the .... In his Table he made places for .... than 63 elements. But there were places in his Table which were still .... Were they always to remain .... ? Mendeleev predicted several .... elements.

Mendeleev was not only the scientist, he was also a .... reformer. He hated the tyranny and oppression of Czarist Russia; he thought women to be .... to men in their struggle for work and education.

Exercise 5. Translate the following phrases and make up sentences with them:

найпростіше завдання – ....

найцікавіша лекція – ....

глибші знання – ....

різноманітніші вітаміни – ....

найменша шкода для здоров'я – ....

більш корисна поживна речовина – ....

найкращі продукти – ....

MODULE 7. **CHEMICAL LABORATORY**

Part 1. Laboratory equipment

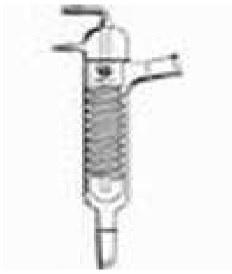
Task 1. Answer the following questions:

1. What comes to your mind when you hear the word *laboratory*?
2. Do you know the names of any items you can see below and which can be found in a common chemical laboratory?
3. You can see the pictures of the most frequently used pieces of glassware, porcelain vessels and tools and other utilities. Look at them briefly and say:
   a) which of them you know;
   b) which of them you have never seen;
   c) which of them you like to work with.

Task 2. Match the following expressions with pictures. What are their Ukrainian equivalents?

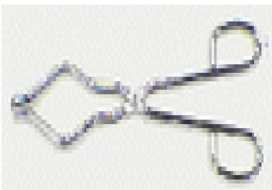
single neck flat bottom flask	Buchner funnel	crucible
Erlenmeyer flask	pH sticks	burette (buret)
graduated cylinder	mortar and pestle	tongs
filtering flask	oven	stand
three neck round bottom flask	bath	pH
beaker	buffers	ring
round bottom boiling flask	pipette	Buchner flask
separatory funnel	funnel	filter paper
test tube	pH meter	condenser
analytical balance	watch glass	Petri dish
volumetric flask	vial	

1.  **2.**  **3.**  **4.**  **5.** 

6. 
7. 
8. 
9. 

10. 
11. 
12. 
13. 

14. 
15. 
16. 
17. 
18. 

19. 
20. 
21. 
22. 

23. 
24. 
25. 
26. 

27. 
28. 
29. 
30. 
31. 

Task 3. a) Study the pictures and their description and then sort the used vocabulary into the following columns:

glassware	porcelain	tools and utilities	apparatuses	useful verbs
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....

b) Work with a dictionary: find expressions concerning the laboratory equipment that you still miss in the previous table and add them to the list.

Task 4. Make a competition in teams. Choose 5 items of the lab equipment, prepare their description (material, shape colour, usage). Take turns in describing and guessing the defined objects.

Task 5. You are supposed to equip a chemical laboratory for the first year training at our school. Your financial and space possibilities are limited, you have to agree on a list of 15 items that are indispensable. When discussing it with a partner, use various ways of expressing agreement or disagreement:

e.g.: I can't agree, it can be replaced by.... .
Absolutely. I agree with you, but... .

Part 2. Lab safety rules.

Task 6. Discuss the following questions and then draw at least four signs you would put on the door of a chemical laboratory to inform the laboratory workers how to behave inside. Let your colleague guess the meaning of your signs (Use the modal verbs to express prohibition, recommendation....).

1. Did you get any special training or preparation course before starting your laboratory sessions?
2. Did you have to pass any exam or obtain a credit connected with lab safety rules?
3. Have you ever witnessed any breaking of the safety rules in the lab. What happened?

Task 7. Decide whether the following safety rules and recommendations are a GOOD/ BAD or even DANGEROUS piece of advice.

1. If you want to dilute sulphuric acid, pour water slowly into the acid.
2. For work with unpleasant or dangerous vapours plug your nose with cotton properly.

3. If any chemicals get in your eyes, flush them with running water and inform the teacher or colleague what happened.

4. In case of fire try to find some good shelter (e.g. under the sink) and wait.

5. If you want to warm some meal in the lab, don't put it in the furnace together with any chemicals.

Task 8. Read about Lab Safety Rules and underline the expressions you are not familiar with. If you cannot guess their meaning from the context, consult a dictionary.

Lab safety rules

1. Conduct yourself in a responsible manner at all times in the laboratory.

2. Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ASK YOUR TEACHER BEFORE PROCEEDING WITH THE ACTIVITY.

3. Never work alone in the laboratory. No student may work in the science classroom without the presence of the teacher.

4. When first entering a science room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.

5. Perform only those experiments authorized by your teacher. Carefully follow all instructions, both written and oral. Unauthorized experiments are not allowed.

6. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.

7. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory. Never fool around in the laboratory. Horseplay, practical jokes, and pranks are dangerous and prohibited.

8. Always work in a well-ventilated area.

9. Observe good housekeeping practices. Work areas should be kept clean and tidy at all times.

10. Be alert and proceed with caution at all times in the laboratory. Notify the teacher immediately of any unsafe conditions you observe.

11. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water. Check with your teacher for disposal of chemicals and solutions.

12. Labels and equipment instructions must be read carefully before use. Set up and use the equipment as directed by your teacher.

13. Keep hands away from face, eyes, mouth, and body while using chemicals or lab equipment. Wash your hands with soap and water after performing all experiments.

14. Experiments must be personally monitored at all times. Do not wander around the room, distract other students, startle other students or interfere with the laboratory experiments of others.

15. Know the locations and operating procedures of all safety equipment including: first aid kit(s), and fire extinguisher. Know where the fire alarm and the exits are located.

16. Know what to do if there is a fire drill during a laboratory period; containers must be closed, and any electrical equipment turned off.

17. Any time chemicals, heat, or glassware are used, students will wear safety goggles. NO EXCEPTIONS TO THIS RULE!

18. Contact lenses may be not be worn in the laboratory.

19. Dress properly during a laboratory activity. Long hair, dangling jewelry, and loose or baggy clothing are a hazard in the laboratory. Long hair must be tied back, and dangling jewelry and baggy clothing must be secured. Shoes must completely cover the foot. No sandals allowed on lab days.

20. A lab coat or smock should be worn during laboratory experiments.

21. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the teacher immediately, no matter how trivial it seems. Do not panic.

22. If you or your lab partner is hurt, immediately (and loudly) yell out the teacher's name to get the teacher's attention. Do not panic.

23. If a chemical should splash in your eye(s) or on your skin, immediately flush with running water for at least 20 minutes. Immediately (and loudly) yell out the teacher's name to get the teacher's attention.

24. All chemicals in the laboratory are to be considered dangerous. Avoid handling chemicals with fingers. Always use a tweezer. When making an observation, keep at least 1 foot away from the specimen. Do not taste, or smell any chemicals.

25. Check the label on all chemical bottles twice before removing any of the contents. Take only as much chemical as you need.

26. Never return unused chemicals to their original container.

27. Never remove chemicals or other materials from the laboratory area.

Task 9. a) Did any of the rules surprise you?

b) Work in pairs or small groups and decide which of the rules are of the utmost importance.

c) Make a TOP TEN list. Explain why. Then report to the rest of the class.

Task 10. Make a summary of the most important laboratory safety rules concerning the following facts:

– dress code for a laboratory worker

– refreshment during the lab period

– working with chemicals

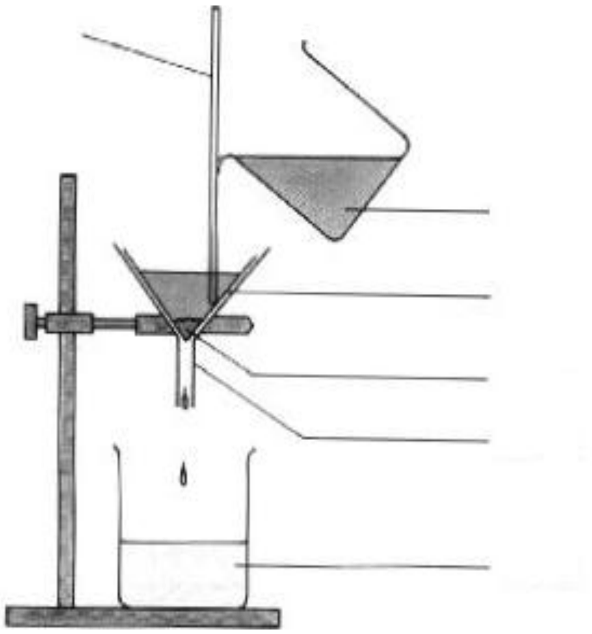
– working with hot glassware

– what to do in case of injury

– what to do in case of fire

Part 3. Describing Procedures.

Task 11. Fill the following schemes with suitable expressions. What are their Ukrainian equivalents?



Filtration

funnel

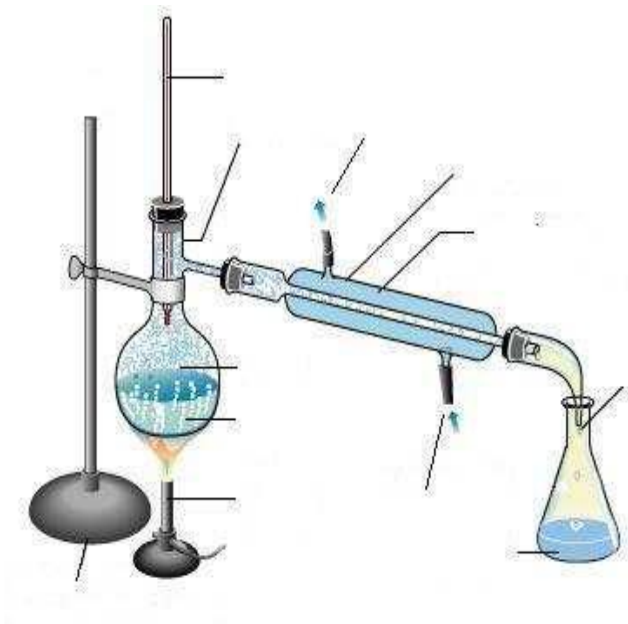
filter paper

mixture

residue

glass rod

filtrate



Distillation

Bunsen burner

condenser

cooling water

condensed water

thermometer

mixture

distillation flask

stand

water outlet steam

cold water inlet

distillate

Task 12. Read the instructions on how to produce aspirin and learn the new vocabulary. Make a list of all the items of laboratory equipment you need for this experiment.

yield – the quantity of product formed by the interaction of two or more substances

swirl – to move around or along with a whirling motion

excess – the fact of exceeding something else in amount or degree

suction – to draw out or remove by aspiration

loss – something that is lost

confirm – to acknowledge with definite assurance

verify – to prove the truth of, as by evidence or testimony; confirm

How to Make Aspirin – Acetylsalicylic Acid – Introduction and History

1. Accurately weigh 3.00 grams of salicylic acid and transfer to a dry Erlenmeyer flask. If you will be calculating, be sure to record how much salicylic acid you actually measured.

2. Add 6 mL of acetic anhydride and 5-8 drops of 85% phosphoric acid to the flask.

3. Gently swirl the flask to mix the solution. Place the flask in a beaker of warm water for ~15 minutes.

4. Add 20 drops of cold water dropwise to the warm solution to destroy the excess acetic anhydride.

5. Add 20 mL of water to the flask. Set the flask in an ice bath to cool the mixture and speed crystallization.

6. When the crystallization process appears complete, pour the mixture through a Buckner funnel.

7. Apply suction filtration through the funnel and wash the crystals with a few milliliters of ice cold water. Be sure the water is near freezing to minimize loss of product.

8. Perform a recrystallization to purify the product. Transfer the crystals to a beaker. Add 10 mL of ethanol. Stir and warm the beaker to dissolve the crystals.

9. After the crystals have dissolved, add 25 ml of warm water to the alcohol solution. Cover the beaker. Crystals will reform as the solution cools. Once crystallization has started, set the beaker in an ice bath to complete the recrystallization.

10. Pour the contents of the beaker into a Buckner funnel and apply suction filtration.

11. Remove the crystals to dry paper to remove excess water.

12. Confirm you have acetylsalicylic acid by verifying a melting point of 135°C.

Exercise 13. Fill in the gaps with the following words in their appropriate forms.

item,	glassware,	neck,	laboratory,	approximate,	boiling tube,
container,	mass,	weight,	experiment,	weigh	

1. Laboratory .... refers to a variety of equipment, traditionally made of glass, used for scientific .... and other work in science, especially in chemistry and biology .... There are many different kinds of aboratory glassware ....

2. A ....is essentially a scaled-up test tube, being about 50% larger in every aspect.

3. A bottle is a small .... with a .... that is narrower than the body and a "mouth."

4. Rounded numbers are only ....

5. .... is a measurement of how much matter is in an object; .... is a measurement of how hard gravity is pulling on that object. Your .... is the same wherever you are on Earth, on the moon, floating in space. But your .... depends on how much gravity is acting on you at the moment. You would .... less on the moon than on Earth.

Task 14. Match the verbs describing the process with the nouns.

transfer	excess water
mix	the crystals
remove	a funnel
dissolve	to a flask
pour through	loss of product
minimize	the solution

Task 15. Choose one of the experiments you really performed in the laboratory and write down the instructions of the procedure (minimum: 10 steps) .

Part 4. GRAMMAR: Conditional Sentences

Rule	Example
1. Use **zero conditional** sentences to talk about general truths and scientific facts; habits and recurring events.	**If** air **expands**, it **becomes** lghter. **If** you **practise** your English every day, you **can improve** quickly.
2. Use **first conditional** sentences to talk about what will happen under certain conditions in the future.	**If** there **is** enough oxygen in the air, it **will be** good for breathing.
3. If and **unless** can both be used in conditional sentences, but **unless** is used to state a negative condition.	**If** the education system **improves**, we **will have** an educated workforce. **Unless** the education system **improves**, we **won't have** an educated workforce.
4. Use **second conditional** sentences to talk about unreal, untrue, imagined or impossible conditions and their results in the present.	**If** I **had** more money, I **would travel** a lot.
5. Use **third conditional** sentences to talk about past conditions and results that never happen.	John **would have become** a chemist **if** he **had graduated** from the university.
6. Third conditionals are often used to express regret about what happened in the past.	I **would have been** happier if I **had become** a chemist.

Exercise 1. Complete the sentences with the correct form of the verb in brackets. Define the type of the conditional sentence.

a) 1. If there ..... not enough oxygen in the air (be), it would be unsuitable for breathing.

2. If you ..... see very clearly through a material (can), the material is transparent.

3. Unless the temperature .... (rise), the reaction will not increase.

4. If he had known about our experiment before, he .... us (help).

5. If we .... the results of our experiment (compare), we should get the necessary data.

6. If you cannot see through a material, it ..... opaque (be).

b) 7. If we .... this material (test) we .... it in our construction (use).

8. If a material .... easily (bend), it ..... flexible (be).

9. If you ......water into sulphuric acid (pour), heat .... (give off) and an explosion .... (take place).

10. The reaction .... place at a higher rate (take) if we .... the solution (heat).

11. If we ...... the solution (cool), the reaction .... (slow down).

12. If they .... their experiments (finish) they .... the data (tabulate).

Exercise 2. Read and answer the questions. Define the type of conditional sentences.

What happens to oil in water?

Fill the jar about two-thirds full with water.Add the teaspoon of cooking oil and watch what happens. Does the oil mix with water, or does it stay in a blob or two at the top of the water? Now shake the jar. The oil should spread out with small bubbles, as though “waves” were tossing it around. Add 2–3 drops of dishwashing liquid. Shake the jar again. Cleaning detergents break up oil into tiny droplets and spread it through the water.

1. What happens to oil in water if you add the teaspoon of cooking oil in it? If ....

2. What happens to oil in water if you shake the jar then? If ....

3. What happens to oil in water if you add 2–3 drops of dishwashing liquid and shake the jar again? If ....

Exercise 3. Read the abstract and make conditional sentences as in the example.

Albert Einstein is one of the most gifted scientists of all time. He is best known for his theory of relativity, which he developed when he was only twenty six and which changed the way scientists looked at space and time. His research made him an important force in the world of science. In 1921 he won the Nobel Prize in Physics.

Einstein’s genius changed the course since it was central to the development of atomic energy. Einstein was an outspoken believer in world peace, however, and he was deeply saddened when he realized the outcome of his research would be an atom bomb. He said at the time: “If only i had known, I’d have become a watchmaker”.

e. g.: If Einstein hadn't been a talented person, he wouldn't have become a scientist.

1. Albert Einstein / not be / dedicated scientist → he / not develop / theory of relativity / change the world.
2. Albert Einstein / not make / great research → he / not win / Nobel Prize / Physics.
3. Albert Einstein / know / outcome / research → he / become / watchmaker.

Exercise 4. Read the letter below and use the prompts to complete the paragraphs.

A I would appreciate it if you could tell me
B I would be very pleased if you could let me know
C I would be grateful if you could give me some further information

Dear Sir/Madam,

I'm interested in taking some chemistry university courses and 1) ....

First of all, I would like to know if you offer courses in organic and inorganic chemistry. I am a laboratory assistant and I feel I need to update knowledge in this field.

Secondly, would be possible for me to take courses in the evening? I usually get home around 7.00 pm so I will not be able to log on untill 7.30 or 8.00.

Furthermore, 2) .... whether I need any special equipment. I do have a PC with Internet access, but is this all I need in order to have live contact with the faculty?

Finally, 3) .... what the cost is. Would it be possible to pay for the courses on a monthly basis? I would also be interested in finding out if there is an enrolment fee.

Thank you in advance for your assistance. I look forward to your reply.

Yours faithfully,
Nick Preston

Exercise 5. Combine two sentences to make a third conditional one.

1. Mendeleiev made brilliant discoveries. Chemistry has made a great progress.

2. Ancient scientists could not explain many things which they observed. A great number of facts are still being discovered.

3. These two gases are mixed at high temperatures. A great amount of this chemical substance is produced.

4. Copper is a good conductor. It is widely used in industry.

5. Factories emit a lot of sulphur. Filters can be used to remove the sulphur before it reaches the atmosphere.

MODULE 8. **EVERYDAY CHEMISTRY**

Part 1. Chemistry in modern life.

Task 1. Read the text, find the meaning and pronunciation of the new words in bold **from the text in a dictionary and memorize them:**

Chemistry and Chemical Industry in Modern Life

Everybody knows that chemistry with its today's possibilities is a young science. But its history began several thousand years ago. A great number of facts which are still useful in modern chemistry, were discovered in **ancient** Greece, Rome and especially **Egyp**t. But that knowledge was purely practical. They could not explain many things which they were observing in the material world. They prepared **medicines** from plants but could not tell what elements they consisted of.

Today, chemistry is revolutionizing the material conditions of life of **contemporary** society. Its **impact** on the development of production is accounted for by the fact that many new technological methods are based on the chemical transformation of matter, the use of catalysis, **synthetic** materials and other achievements of chemistry and chemical industry. Those methods as a rule **promote** the growth of output and improve its quality, allow a more intensive use of **equipment** and cut costs on material and labour.

Everybody knows that chemistry is an extremely useful thing. We **are aware of** the fact that none of the key industries can develop without chemistry. This applies to machine-building, rocketry, agriculture, light and building industry, medicine, national defence, etc. There are other sciences (biochemistry, molecular biology, geochemistry, astrochemistry, etc.) which have been considerably affected by the progress of chemistry.

We all realize that the successes of contemporary chemistry have been amazingly great. Take, for instance, the chemistry of polymers.

Scientists, who are working **jointly** with the chemical branches of industry, have created excellent polymers as far as **durability** and **thermal stability** are concerned. In our everyday life we are using beautiful fabrics and other materials which can now be made "to order" out of polymers obtained from natural gas, coal, shale, wood or oil. They are much more durable, cheaper, and of considerably better quality. Polymer substances are used in making bolts, **screws,** bodies for motor cars and motor boats, skis, tanks, belts, **springs,** bearings, blood vessels and **joints**, and a lot of other quite **improbable** things. We also know that almost all **detergents**, **fertilizers**, **lubricants**, fuels, antifreezes, pesticides, cosmetics, solid-state devices, energy-converters (magnets, lasers) and thousands of other products are constructed wholly or in part of synthetics.

In the not too distant future, when the atom, the Sun, the heat of the Earth, and the tides become the main sources of energy, the great quantities of coal, oil, gas, **shales** and wood, which are extracted and burned up all over the world every year, will be used to make consumer goods.

Today we are witnessing the development of a new scientific and technical branch - biochemical technology. The chemists-researchers have already succeeded in determining the place and the role of each atom in a complex bioorganic compound. We are also reading quite frequently about the scientists who can retrace and organize the processes in a living organism and change **hereditary** properties by introducing artificially created carriers of hereditary characters. The combination of biological or microbiological processes with those of direct chemical synthesis helps obtain new substances or microorganisms.

This also will provide humanity with unlimited sources of food, medicines, **fodder**, many types of highly valuable raw materials, etc. We are sure that there will be many new discoveries in chemistry. They will create new opportunities in the future of mankind.

Task 2. Answer the questions:

1. What is the characteristic feature of an ancient chemistry?
2. What is the role of chemistry in the life of contemporary society?
3. Why is chemistry an extremely useful science?
4. What is the impact of modern chemistry on production?
5. In what branches of industry is chemistry useful?
6. What new scientific and technical branches of chemistry have appeared?
7. What are the tendencies of modern chemistry?
8. What is the outstanding feature of chemistry and chemical industry?

Task 3. Translate into Ukrainian:

1. The chemists noticed the differences between substances derived from living matter and substances derived from materials.

2. Natural rubber is of higher quality than rubber produced artificially.

3. Physical changes are the changes which affect the state or condition of matter without changing its composition.

4. Being a good conductor, copper is widely used in industry.

5. Living organisms have some inorganic constituents, such as sodium ions, phosphate ions, calcium ions, carbonate ions, etc., and solid compound composed of some of these constituents.

6. For concrete sand and stone must be proportioned and mixed.

7. Cement should be ground extremely fine.

8. If you pour water into sulphuric acid heat will be given off, an explosion will take place.

9. If we heat the solution, the reaction will take place at a higher rate.

10. If we cool the solution, the reaction will slow down.

Task 4. Fill in the blanks with the necessary words:

tasks	consumers	metal	substance	economy	compounds	substances	material

1. Ancient scientists could not explain many things in the …………… world.

2. A chemical element is a ………….. that cannot by any ordinary means be separated into two or more different substances.

3. Water, salt, sugar are chemical …………. which are produced by a chemical combination of two or more atoms.

4. Zinc whose strong tendency is to loose electrons, is the cheapest …………. .

5. At higher temperatures most …………….melt and evaporate.

6. The chemical industry and the petrochemical industry are the biggest ……... of power, mineral raw materials, machines instruments and other products.

The development of every sector of the national ………… depends on chemical industry.

7. The chemical industry helps to accomplish many key .... facing the economy.

Task 5. Make up a dialogue about the place of chemical industry in modern life and dramatize it with a partner.

Part 2. Text. Chemistry and food industry

Task 6. Read the text and try to guess the meaning of the following words in bold**:**

Cooking

Before food can be eaten it has to be prepared. For cooking **heat** is usually applied. Heat causes chemical and physical changes in food. It makes the **flavour**, **palatability** and **digestibility** of the raw product more acceptable and may improve its keeping quality. But cooking more usually results in the loss of nutrients, this being the greatest at high temperatures, with long cooking times, or if an **excessive amount** of liquid is used.

Freezing

Food is spoiled because of the growth of microorganisms in it. That is why the food preservation is a very important problem. The most popular method of food preservation is freezing. But it may result in some loss of **thiamin** and vitamin C when vitamins are blanched in water before freezing. This **loss** is not so great as during **storage.** If the temperature of the freezer is kept below -18' C, there is practically no further loss of nutrients. Though in general, differences between the nutrient content in cooked fresh foods and cooked frozen foods as served on the plate are small.

Industrial Processing

The aim of **processing** in a factory is to preserve food so that the choice is greater and independent of geographical area or the season of the year, and to reduce time spent on preparing food in the home. The main commercial process which cause some loss of **nutrients** are blanching, heat processing, and **drying** or dehydration.

Blanching (or scalding) in water or steam is mainly to minimize enzyme activity, and the first step in the preservation of the most vegetables for canning, freezing of dehydration. The process is carefully controlled, but small amounts of some minerals and water soluble vitamins **dissolve** in the water and steam and are lost.

Heat processing in metal cans or **boiling** in glass jars reduces the amounts of heat-sensitive vitamins, especially thiamin, folic acid and vitamin C. The losses depend on the length of time needed to destroy any **harmful** organisms and to cook the food.

Dehydration (air drying) in carefully controlled conditions has little effect on most nutrients, but about half the vitamin C is lost. Prolonged sun drying allows great changes to occur. Suitable packaging of **dried foods** is essential to prevent nutrient losses during their prolonged **storage life.**

The freezing process itself has little effect on nutritional value. And since the delay after harvesting is minimal, the nutrients in the high quality fresh foods are generally well retained.

Preservation of Food by Ionizing Radiation

Some research programmes have produced useful results relating to the application of ionizing radiation for the preservation of food and disinfestations of **stored grain**.

Low dose gamma radiation has been successfully used to arrest spoiling due to sprouting in potatoes and onions. Thus, the storage life of potatoes and onions can be increased from 14 to 28 weeks. Radiation can also be used **to delay** ripening in fruits such as mangoes, resulting in an **extention** of storage life from 2 to 4 weeks.

Researchers have found the technique useful for the of Bombay Duck – a fish of considerable commercial importance in many tropical areas of the world which do not keep for more than a few hours at room temperatures or 2 to 3 days when packed in ice. Mild irradiation **extends** its shelf life to 6 weeks at 4' C.

These researches will soon be scaled up to commercial processes. One large irradiator will be used for research and development work for of fish, vegetables, fruit, dairy products and grain.

Task 7.Translate the following word combinations and make up sentences with them:

nutritive value	ideal conditions	cold storage
to result in the loss of nutrients	unhygienic preparation	
freezing preservation	canning industry	heat processing

Task 8. Put questions to the words in bold:

1. **Vitamin C** is partly destroyed during the cooking process.
2. Heating solutions of **sugars and amino acids** results in the formation of flavours.
3. **Calcium** is the most wide-spread mineral in the body.
4. Chemically, mixtures of triglycerides form **fats**.
5. **Vitamin D** is concerned in the laying down of calcium, essential for the growth and development of the body.

Task 9. Translate the following sentences:

1. Понад 170 років люди використовують для харчування консервовані продукти.
2. Швидке заморожування є одним із нових методів консервування.
3. Для зберігання заморожених продуктів потрібна температура -18' С і нижче.
4. Солі кальцію і фосфору є складовою частиною кісткової системи.
5. Наша консервна промисловість випускає понад 250 видів овочевих консерв.

Task 10. Read the text and decide which answer A, B, C or D best fits each space.

Food, Glorious Food

Much of the pre-prepared food we eat today contains additives of one 1) .... or another. 2) .... of these additives are harmless: some are not so harmless and some are even 3) .... In Europe, permitted additives are given a number which is prefixed by an ‘E’. Additives are used by food processing manufacturers to improve taste, thicken or preserve the food. 4) .... are also used to make the food look more inviting. Even 5) .... food from the greengrocer may contain residues of pesticides and other chemicals.

It is often argued that adding chemicals to food somehow makes our diet less wholesome than it was in the past, before the effect of such additives was discovered. Is this really 6) .... ? In 1872 a pioneer in investigating adulterated food, Dr Hassal, 7) .... that a variety of 8) .... chemicals and contaminates were to be found in 9) .... foodstuffs. He found, among other things, alum and chalk added to bread, and copper and lead added to other foods, to give colour. Even poisons such as strychnine were used. Foods consumed by the well-off, such as ice cream, were 10) .... as bad and were often contaminated with foreign material.

E-numbered chemicals 11) .... as food additives have to be listed on the labels of processed food, so at 12) .... the consumer has a choice nowadays whether to 13) .... the product or not. The Victorians had no such choice and the poor, especially, suffered. Many of the poisons 14) .... up in their bodies, causing chronic gastric irritation, food poisoning or death. In 1862 it was estimated that one fifth of all meat in England and Wales came from animals that had died of disease. E-numbered chemicals have received 15) .... of publicity, most of it bad. The fact is, though, without them the freshness, colour and flavour of our food would suffer.

1. A class	B sort	C thing	D division
2. A Few	B Little	C Various	D Some
3. A unsafe	B threatening	C dangerous	D risky
4. A Colourings	B Tints	C Shades	D Paints
5. A fresh	B new	C natural	D pure
6. A truthful	B true	C exact	D proper
7. A explored	B invented	C discovered	D tested
8. A toxic	B deathly	C poisoned	D venomous
9. A frequent	B general	C usual	D common
10. A only	B just	C about	D quite
11. A made	B used	C put	D applied
12. A first	B once	C most	D least
13. A have	B buy	C obtain	D take
14. A made	B built	C set	D put
15. A a lot	B much	C more	D a few

Part 3. Environmental and green chemistry

Task 11. a) Read the following article about environmental chemistry and fill the gaps with appropriate forms of the words in brackets. Use prefixes and suffixes.

Environmental chemistry is the .... (science) study of the .... (chemistry) and .... biochemistry) phenomena that occur in .... (nature) places. It can be defined as the study of the **sources**, reactions, transport, effects, and fates of .... (chemistry) **species** in the air, soil, and water environments; and the effect of human activity on these. Environmental chemistry is an .... (discipline) science that includes .... (atmosphere), ... (aqua) and soil chemistry, as well as .... (heavy) **relying on** .... (analysis) chemistry and being related to .... (environment) and other areas of science.

Environmental chemistry involves first .... (understand) how the **uncontaminated** environment works, which chemicals in what **concentrations** are present, and with what effects. Without this it would be .... (possible) to ....

(accurate) study the effects humans have on the environment through the **release** of chemicals.

b) Read the following paragraph and fill the gaps with the terms "environmental chemistry" and "green chemistry", as appropriate.

...., also called sustainable chemistry, is a chemical philosophy encouraging the design of products and processes that reduce or eliminate the use and generation of hazardous substances. Whereas .... is the chemistry of the natural environment, and of pollutant chemicals in nature, ... seeks to reduce and prevent pollution at its source.

c) Read about 12 principles of green chemistry and choose the best alternative for each of the underlined expressions. Define the meaning of the words in bold.

1. Prevent waste: Design chemical synthesies/syntheses to prevent **waste**, leaving no waste to treat or clean up/clean down.

2. Design safer/more safe chemicals and products: Design chemical products to be full/fully effective/efficient, yet have little or no toxicity.

3. Design less hazardous chemical syntheses/synthesies: Design syntheses/synthesies to use and generate matters/substances with little or no toxicity to humans and the environment.

4. Use renewable/renewible feedstocks: Use **raw materi**als and **feedstocks** that are renewable/renewible rather than **depleting**.

5. Use catalysts, not stoichiometric reagents: Minimize waste by using **catalytic** equations/reactions. **Catalysts** use/are used in small amounts and can carry out/carry a single reaction many times.

6. Avoid chemical derivates/derivatives: Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives/derivates use additional **reagents** and generate waste.

7. Maximize atom economy/economics: Design synthesies/syntheses so that the final reactant/ product contains/includes the maximum proportion of the starting materials.

8. Use safer solvents/soluents and reaction conditions: Avoid using soluents/solvents, **separation agents**, or other auxiliary chemicals. If these chemicals are necessary, use **innocuous** chemicals.

9. Increase/decrease energy efficiency: Run chemical reactions at **ambient** temperature and pressure whenever possible.

10. Design chemicals and products to degrade after use: Design chemical products to break down/break up to innocuous substances after use so that they do not accumulate in the environment.

11. Analyze in real time to prevent pollution: Include in-process real-time monitoring and control during syntheses/synthesies to minimize or eliminate the formation of **byproducts**.

12. Minimize the potential for accidents: Design chemicals and their formulas/forms (solid, liquid, or gas) to minimize the potential for chemical accidents consisting of/including explosions, fires, and **releases** to the environment.

Task 12. Answer the following questions on the paragraphs in Task 11:

1. What is the meaning of the word 'interdisciplinary'?
2. What branches of chemistry are essential for environmental chemistry?
3. What is the difference between 'environmental chemistry' and 'green chemistry? Can these 2 terms be used as synonyms?
4. Do you agree with 12 principles of green chemistry?
5. Do you think these principles should be observed and that it is possible to observe them?

Task 13. What is the meaning of the following terms? Match them with their definitions.

pollutant	**CFCs**
contaminant	**pH**
biochemical-oxygen demand (BOD)	**dissolved oxygen (DO)**

.... a class of volatile compounds consisting of carbon, chlorine, and fluorine. Commonly called **freons**, which have been in refrigeration mechanisms, and, until banned from use several years ago, as propellants in spray cans.

.... a substance that has a **detrimental impact** on the environment it is in

.... a substance present in the environment as a result of human activity, but without **harmful** effects. However, it is sometimes the case that toxic or harmful effects from contamination only become apparent at a later date.

.... one of the most important **indicators** of the condition of a water body, necessary for the life of fish and most other aquatic organisms.

.... the amount of oxygen, expressed in **milligrams per liter**, that is removed from aquatic environments by the life processes of micro-organisms. It is used in water quality management and **assessment**, ecology and environmental science. .... the measure of the **acidity** or **alkalinity** of a solution.

Task 14. Match the phrases (irritant, harmful, highly, flammable, dangerous for the environment, explosive, toxic, corrosive, oxidizing, extremely flammable, very toxic) with the symbols below. Then match the symbols with the phrases explaining their meaning:

...... Living tissues as well as equipment are destroyed on contact with thesechemicals.

...... Substances that are very hazardous to health when breathed, swallowed or in contact with the skin and may even lead to death.

...... Substances which are harmful to the aquatic, as well as the non-aquatic environment or which have a detrimental effect at longer term.

...... Substances which may explode under certain conditions.

...... Substances that can ignite combustible material or worsen existing fires and thus make fire-fighting more difficult.

...... Substances which may have an irritant effect on skin, eyes and respiratory organs.

...... 1. Liquids with flash points below 0°C and a boiling point of max. 35°C.

2. Gaseous substances which are flammable in contact with air at ambient temperature and pressure.

...... 1. Spontaneously flammable substances.

2. Substances sensitive to moisture.

3. Liquids with flash point bellow 21°C.

Task 15. Be ready to speak on the topic "Environmental and green chemistry".

Part 4. GRAMMAR: Relative Clauses

Rule	Example
1.Relative clauses can be **defining** or **non-defining.**	
2. To introduce relative clauses use **who** for people, **which** for things, **where** for places. Remember that **where** is an object pronoun and must be followed by a subject. Do not use **that** to introduce a non-defining relative clause.	Van Houten, **who** was Dutch, was the first person to extract chocolate from cocoa. Chocolate, which people enjoy all over the world, first came from Central America. Coffee first came from Central America **where** the Aztecs lived. That's the chocolate **that** I bought.
3. Use a **defining** relative clause to identify which member of a group the sentence talks about.	I've got three phones. The phone **which is in the kitchen** is broken. (The relative clause is necessary to identify which phone is meant).
4. Use a **non-defining** relative clause to give additional information about the noun it refers to. The information is not necessary to identify the noun. A **non-defining** relative clause is separated from the main clause by **commas**.	I've got only one phones. The phone, **which is in the kitchen,** is broken. (The relative clause gives additional information, but it isn't needed to identify the phone).
5. We put a **non-defining** relative clause immediately after the person or thing it refers to. The relative pronoun replaces the second noun or pronoun.	Courtes was the first person to bring chocolate to Europe. **He** was an explorer. = Courtes, **who** was an explorer, was the first person to bring chocolate to Europe.

Exercise 1. Look at the underlined relative pronouns in the sentences of Task 14. When do we use them?

Exercise 2. Complete these sentences with *who, which* or *where*.

1. The word chocolate, ... comes from the Aztec language, is the only Aztec word in English.

2. The Aztecs made a drink from cocoa beans .... was called Xocoatl.

3. Henri Nestle, ... was Swiss, developed the process of making milk chocolate.

4. Chocolate, ... contains a special chemical, makes us feel as if we are in love.

5. In 1847 Joseph Fry, ... lived in England, mixed the cocoa butter with other ingredients to make a solid chocolate bar.

6. Chocolate contains small amounts of the chemical phenylethylamine, ... is also naturally present in brain, and ..... which gives us the same feeling as when we fall in love.

7. People in Britain spend 98p a week on chocolate except in Scotland, ... they spend more.

Exercise 3. Choose the correct alternative to complete these statements. Underline the relative clauses.

1. A substance that dissolves in liquid is ....

a) dissolute b) dissolvable c) soluble

2. A liquid that dissolves substances is a ....

a) solvent b) soluent c) solutent

3. A material that is hard but breaks easily is ....

a) battle b) brittle c) bristle

4. A material that does not bend easily is ....

a) rancid b) rigorous c) rigid

5. A metal that can easily be beaten into new shapes is ....

a) beatable b) malleable c) mullible

6. A material that conducts electricity is ....

a) conducive b) conductive c) conductor

7. A material that catches fire easily is ....

a) flameable b) flammable c) inflammable

Exercise 4. Rewrite these sentences with *who, which* or *where*. There are two possible answers for each sentence, depending on which sentence you think contain an extra information.

1. Champagne is one of the most expensive drinks in the world. It comes from France.

2. Brazil exports the most coffee in the world. It produces a million tonnes a year.

3. The avocado contains the most calories of any fruit. It has more protein than milk.

4. Tea grows in India and China. It is the national drink in Britain.

5. The Mexicans serve roast chicken with *mole*. It is a kind of chocolate sauce.

6. The world's largest chocolate model was a 10 m by 5 m represantation of the Olympic Centre in Barcelona. In this city they held the Olympic Games in 1992.

7. The durian fruit has a disgusting taste and smell. It is considered by some people to be a delicacy.

Exercise 5. Take Everyday Chemistry Quiz and fill in the missing relative pronouns.

1. Two household chemicals .... you should never mix include:

a) Vinegar and baking soda. Those bubbles could be toxic!
b) Bleach and water. Diluting bleach only makes it more dangerous.
c) Oil and water. They don't mix and aren't meant to!
d) Bleach and ammonia. Chloramine vapors can be deadly!

2. The sweat-blocking ingredient .... is often in antiperspirant is:

a) An aluminum compound.
b) A calcium compound.
c) A magnesium compound.
d) A tin or stannous compound.

3. The acid in most car batteries .... is sometimes known as 'Oil of Vitriol' is:

a) Acetic acid.
b) Hydrochloric acid.
c) Nitric acid.
d) Sulfuric acid

4. Citrus fruit is one important source of Vitamin C ...... is:

a) Ascorbic acid.
b) Citric acid.
c) Salicylic acid.
d) Tricarboxylic acid.

5. Soft drinks may contain different acids. The acid .... produces fizz or bubbles is:

a) Ascorbic acid.
b) Carbonic acid.
c) Citric acid.
d) Phosphoric acid.

6. The starting ingredients ...... is used in making soaps and detergents from scratch is:

a) Potassium hydroxide.
b) Sodium hydroxide.
c) Sodium chloride.
d) Calcium carbonate.

7. Two metals …… are naturally contained in chocolate and cocoa are:

a) Cadmium and lead.
b) Aluminum and iron.
c) Cadmium and mercury.
d) Lead and cobalt.

TEXTS FOR INDEPENDENT WORK

Module 1. What is Chemistry?

Text 1. Mendeleev's Biography

Dmitri Mendeleev was born in Tobolsk, Siberia, Russia on February 8, 1834. he came of a family of heroic pioneers. His grandfather was Pavel Maximovich Sokolov, a Russian priest, was knowwn as the publisher of the first newspaper in Siberia, the Irtish. His father was a director of the local high school. Mendeleev was the youngest child of 17 siblings. At the age of 13, after the passing of his father and the destruction of his mother's factory by fire, Mendeleev attended the Gymnasium in Tobolsk.

Dmitri's mother made up her mind that he must get a good higher education and in 1849 the now poor Mendeleev family first relocated to Moscow, then to St. Petersburg, where he entered the Main Pedagogical Institute in 1850. He worked hard and graduated as a head of the class. After he graduated, an illness that was diagnosed as tuberculosis caused him to move to the Crimean Peninsula on the northern coast of the Black Sea in 1855. While there he became chief science master of the Simferopol gymnasium №21. He returned with fully restored health to St. Petersburg in 1857.

Between 1859 and 1861, he worked on the capillarity of liquids and the workings of the spectroscope in Heidelberg. In late August of 1861 he wrote his first book on the spectroscope in which it received high acclaim. In 1862, he married Feozva Nikitichna Leshcheva. Mendeleev became Professor of Chemistry at the Saint Petersburg Technological Institute and the University of St. Petersburg before he was 32. He wrote "We need a double number of Newtons to discover the secrets of nature and bring life into harmony with laws".

In 1863 he achieved tenure in 1867, and by 1871 had transformed St. Petersburg into an internationally recognized center for chemistry research. In 1865 he became Doctor of Science for his dissertation "On the Combinations of Water with Alcohol". In 1876, he became obsessed with Anna Ivanova Popova and began courting her; in 1881 he proposed to her and threatened suicide if she refused. His divorce from Leshcheva was finalized one month after he had married Popova in early 1882. Even after the divorce, Mendeleev was technically a bigamist; the Russian Orthodox Church required at least 7 years before lawful remarriage. His divorce and the surrounding controversy contributed to his failure to be admitted to the Russian Academy of Sciences (despite his international fame by that time). His daughter from his second marriage, Lyubov, became the wife of the famous Russian poet Alexander Blok. His other children were son Vladimir and daughter Olga, from his first marriage, and son Ivan and a pair of twins from Anna.

Though Mendeleev was widely honored by scientific organizations all over Europe, including the Copley Medal from the Royal Society of London, he resigned from St. Petersburg University on August 17, 1890.

In 1893, he was appointed Director of the Bureau of Weights and Measures. It was in this role that he was directed to formulate new state standards for the production of vodka. His fascination with molecular weights led him to conclude that to be in perfect molecular balance, vodka should be produced in the ratio of one molecule of ethyl alcohol diluted with five molecules of water, giving a dilution by volume of approximately 38% alcohol to

62% water. As a result of his work, in 1894 new standards for vodka were introduced into Russian law and all vodka had to be produced at 40% alcohol by volume.

Mendeleev also investigated the composition of oil fields, and helped to found the first oil refinery in Russia.

Mendeleev made other important contributions to chemistry. The Russian chemist and science historian L. A. Tchugayev has characterized him as "a chemist of genius, first-class physicist, a fruitful researcher in the fields of hydrodynamics, meteorology, geology, certain branches of chemical technology (explosives, petroleum, and fuels, for example) and other disciplines adjacent to chemistry and physics, a thorough expert of chemical industry and industry, in general, and an original thinker in the field of economy." Mendeleev was one of the founders, in 1869, of the Russian Chemical Society.
Mendeleev died in 1907 in St. Petersburg, Russia from inf1uenza. The Mendeleev crater on the Moon, as well as element number 101, the radioactive mendelevium, are named after him.

Text 2. Faraday's Contribution to Chemistry

We know electrochemistry to deal with the relations between the transformations of chemical and electrical energy. We know it to owe its birth to the discoveries of Volta. It culminated in the invention of the voltaic pile towards the end of the eighteenth century. This important tool was almost immediately employed by Sir Humphry Davy to study the chemical action of electric currents and to isolate potassium and sodium from the molten hydroxides of these elements. Everybody knows this memorable pioneer work to have paved the way towards the development of modern electrochemical industry of large proportions. But Davy's most significant service to science was his finding and training Michael Faraday to whom more than anyone else electrochemistry is indebted. To his experimental genius are due not only the discovery and enunciation of the two laws upon which so much of electrochemistry is practically based, but also the principle of electromagnetic induction which led ultimately to an economical means of generating energy, essential for the industrial application of electrochemistry.

Faraday (September 22, 1791 – August 25, 1867) was born in London in 1791 of a poor family and was one of the ten children of a blacksmith. There was no question of an education for young Faraday and he was apprenticed to a bookbinder. He lived among books and began to read some of them.He soon realized that his main interet was in science and especially in electricity. It was a stroke of luck that his employer knew him to have desire for learning and allowed him to read and to attend scientific lectures. Faraday wanted to make experiments, but he had too little money.

In 1812 a customer gave Faraday tickets to attend the lectures of Humphry Davy at the Royal Institution. Soon Faraday sent Davy his notes and an application for a job as his assistant. Davy was enormously impressed by clear ability of the youngster and offered the young man the job. His work at first was only to wash and prepare all the things which Davy and his fellow-scientists were to use in their experiments. Almost at once Davy left for his grand tour of Europe and took Faraday with him as secretary. Faraday, of course, was thrilled and accepted the invitation with great pleasure. He had never been more than a few miles from London in his life. Faraday enjoyed greatly his time in Europe, but he was not really sorry at the end of the journey because he was now able to continue his own work and experiments in England.

Faraday became director of the laboratory in 1825, and soon the one-time bookbinder's apprentice became professor of chemistry at the Royal Institution. In chemistry Faraday made his first mark in 1823, when he devised methods for liquefying gases under pressure. In 1825 he discovered benzene.

In addition Faraday carried on Davy's great work in electrochemistry. Davy had liberated a number of new metals by passing an electric current through molten compounds of those metals. Faraday named this process electrolysis. He named a compound or solution that carry an electric current an electrolyte. Everybody knows all these names to exist unchanged and to be used constantly in science.

In 1832 Faraday further reduced the matter of electrolysis to quantitative terms by announcing what are now called Faraday's laws of electrolysis. Faraday's laws put electrochemistry on its modern basis.

Module 2. Fundemental Concepts of Chemistry

Text 1. Definitions in Chemistry

Part I

An atom is the basic unit of an element consisting of a positively charged core (the atomic nucleus) which contains protons and neutrons, and which maintains a number of electrons to balance the positive charge in the nucleus. The atom is also the smallest entity that can be envisaged to retain some of the chemical properties of the element, such as electronegativity, ionization potential, preferred oxidation state(s), coordination number, and preferred types of bonds to form (e.g., metallic, ionic, covalent).

A chemical element is characteized by a particular number of protons in the nuclei of its atoms. This number is known as the atomic number of the element. For example, all atoms with 6 protons in their nuclei are atoms of the chemical element carbon, and all atoms with 92 protons in their nuclei are atoms of the element uranium. However, several isotopes of an element, that differ from one another in the number of neutrons present in the nucleus, may exist.

A compound is a substance with a particular ratio of atoms of particular chemical elements which determines its composition, and a particular organization which determines chemical properties. For example, water is a compound containing hydrogen and oxygen in the ratio of two to one, with the oxygen between the hydrogens, and an angle of 104.5^0 between them. Compounds are formed and interconverted by chemical reactions.

A chemical substance is a kind of matter with a definite composition and set of properties. Strictly speaking, a mixfure of compounds and elements is not a chemical substance, but it may be called a chemical. Most of the substances we encounter in our daily life are some kind of mixture, e.g. air, alloys biomass etc. A substance can often be classified as **an acid** or **a base.** This is often done on the basis of a particular kind of reaction, namely the exchange of protons between chemical compounds.

A molecule is the smallest indivisible portion, beside an atom, of a pure chemical substance that has its unique set of chemical properties, that is, its potential to undergo a certain set of chemical reactions with other substances. Molecules can exist as electrically neutral units unlike ions.

Molecules are typically a set of atoms bound together by covalent bonds, such that the structure is electrically neutral and all valence electrons are paired with other electrons either in bonds or in ione pairs.

A mole is the amount of a substance that contains as many elementary entities (atoms, molecules or ions) as there are atoms in 0.012 kilogram (or 12 grams) of carbon-l2, where the carbon-l2 atoms are unbound, at rest and in their ground state. The number of moles of a substance in one liter of a solution is known as its molarity. Molarity is the common unit used to express the concentration of a solution in physical chemistry.

An ion is a charged species, an atom or a molecule, that has lost or gained one or more electrons. Positively charged cations (e.g. sodium cation Na+) and negatively charged anions (e.g. chloride Cl-) can form a crystalline laffice of neutral salts (e.g. sodium chloride NaCl). Ions in the gaseous phase is often known as plasma.

Part II

A phase is a set of states of a chemical system that have similar bulk structural properties over a range of conditions, such as pressure or temperature. Physical properties, such as density and refractive index tend to fall within values characteristic of the phase. The phase of matter is defined by the phase transition, which is when energy put into or taken out of the system goes into rearranging the structure of the system, instead of changing the bulk conditions.

The most familiar examples of phases are solids, liquids, and gases. Many substances exhibit multiple solid phases. For example, there are three phases of solid iron (alpha, gamma, and delta) that vary based on temperature and pressure. A principal difference between solid phases is the crystal structure, or arrangement, of the atoms.

Redox is related to the ability of atoms or various substances to lose or gain electrons. Substances that have the ability to oxidize other substances are said to be **oxidative** and are known as oxidizing agents, oxidants or oxidizers. **An oxidant** removes electrons from another substance.

Similarly, substances that have the ability to reduce other substances are said to be **reductive** and are known as reducing agents, reductants, or reducers. **A reductant** transfers electrons to another substance, and is thus oxidized itself. And because it "donates" electrons it is also called an electron donor.

Oxidation and reduction properly refer to a change in oxidation number-the actual transfer of electrons may never occur. Thus, o**xidation** is better defined as an increase in oxidation number, and **reduction** as a decrease in oxidation number.

A chemical bond is a concept for understanding how atoms stick together in molecules. It may be visualized as the multipole balance between the positive charges in the nuclei and the negative charges oscillating about them.

Chemical reaction is a concept related to the transformation of a chemical substance through its interaction with another or as a result of its interaction with some form of energy. A chemical reaction may occur natural1y or carried out in a labotatory by chemists in specially designed vessels which are often laboratory glassware. It can result in the formation or dissociation of molecules, that is, molecules breaking apart to form two or more smaller molecules, or rearrangement or atoms within or across molecules. Chemical reactions usually involve the making or breaking of chemical bonds. oxidation, reduction, dissociation, acid-base nelfira|ization and molecular rearrangement are some of the commonly used kinds of chemical reactions.

The term **chemical energy** is often used to indicate the potencial of a chemical substance to undergo a transformation through a chemical reaction or transform other chemical substances.

Text 2. Mixture

Mixture in chemistry is a physical combination of two or more pure substances (i.e., elements or compounds). A mixture is distinguished from a compound, which is formed by the chemical combination of two or more pure substances in a fixed, definite proportion. The components of a mixture retain their own chemical properties and may be present in any proportions. For example, iron filings may be mixed with powered sulphur in any proportions, and even if very fine iron powder is carefully mixed with powered sulphur, the two components are easily separated by means of a magnet; the magnet will draw out the iron from the mixture. However, if seven parts by weight of iron filings or powder are mixed with four parts by weight of powdered sulphur and the mixture is heated to a red glow, the iron and sulphur react to form the compound iron sulfide; they are chemically combined and are not readily separated. The iron sulfide is not attracted by a magnet. Mixtures are often classified as homogeneous or heterogeneous. Solutions and colloids are homogeneous mixtures. The components of homogeneous mixture are too intimately combined to be distinguished from one another by visual observation. A suspension is a heterogeneous mixture. The particles in a heterogeneous mixture are coarse enough to be distinguished by visual observation. Alloys are mixtures of metals and may be either homogeneous or heterogeneous. The components of a mixture usually can be separated by physical means such as distillation, evaporation, precipitation, filtration, solvent extraction, or chromatography.

Module 3. Periodic Table of Elements

Text 1. The Element Gold.

Gold is element 79 and its symbol is Au. Though the name is Anglo Saxon, gold originated from Latin “Aurum“ or “shining dawn” and previously from the Greek. It's abundance in the earth's crust is 0.004 ppm. 100% of Gold found naturally is isotope Au197. 28 other isotopes can be produced artificially and are all radioactive.

Gold along with Silver and Copper, form a column in the periodic table. They are found naturally and were the first three elements known to man. They were all used as primitive money well before the first gold coins which appeared in Egypt around 3400 BC. Most gold is ancient or comes from Central American Aztecs and South American Incas. They brought to Europe by the Spanish and Portuguese in the 16th century, and which has since been recycled over and over again. In 1830 world output was no more than 12 tonnes pa. But around that time new gold discoveries were being made. Finds were discovered in Siberia, in California, New South Wales and Victoria, Australia, Transvaal, South Africa, the Klondike and Alaska, and they all produced gold rushes. The world production was then around 150 tonnes per year. It is now around 2300 tonnes pa.

Usually it is found in its natural state and does not naturally alloy with anything else and because it is the heaviest of all metals, sifting rock in water, the gold always falls to the bottom and all less dense impurities are washed away.

The largest nugget was the Welcome Stranger nugget found in Victoria, Australia in 1869. It weighed over 71 kg. This type of nugget occurrs naturally but it is very, very rare. Pure gold is 24 karat. 18 karat must be 75% gold and 12 karat gold is 50% gold and so on. Gold is the most malleable of all metals and soft enough to be cut with a knife. Stone age peoples hammered gold into plates for ornamental purposes. Really quite large amounts were gathered together. Though Tutankhamun was a minor Pharaoh and died aged 18, his coffin alone contained 112 kg of gold. Egyptians also made thin gold sheets, utensils, vast variety of jewellery and even gold threads. King Tut, when he was buried, had over 150 gold ornaments on his body.

Today 1 gram of gold can be beaten into a square meter sheet just 230 atoms thick. 1 cu centimetre would make a sheet of 18 square metres. Concord's windscreen had a layer of gold to screen pilots from UV light and today it is often used in skyscraper windows to cut down both heat and UV from sunlight. 1 gram can be drawn out to make 165 metres of wire just 1/200th of a millimetre thick.

The gold colour in the Buckingham Palace fence is actually gold. Gold covered, because it lasts 30 years, whereas gold paint, which actually contains no gold at all, lasts in tip-top conditions, only about a year or so.

Sea Water contains around 3 parts in a billion of gold, but there's never been found an economic means of recovering it. The Germans tried very hard during the 2nd WW but failed miserably.

The largest modern hoard is the 30,000 tons in the US Federal Reserve Bank in New York, which belongs to 18 different nations. It is estimated that all the world's gold gathered together would only make a cube around 18 metres per side - about 6000 cubic metres. And that's Gold.

Text 2. Aluminum and Its Characteristics

Aluminium is a chemical element in the boron group with symbol Al and atomic number 13. It is a silvery white, soft, ductile metal. Aluminium is the third most abundant element (after oxygen and silicon), and the most abundant metal, in the Earth's crust. It makes up about 8% by weight of the Earth's solid surface. Aluminium metal is so chemically reactive that native specimens are rare and limited to extreme reducing environments. Instead, it is found combined in over 270 different minerals. The chief ore of aluminium is bauxite.

Aluminium is remarkable for the metal's low density and for its ability to resist corrosion due to the phenomenon of passivation. Structural components made from aluminium and its alloys are vital to the aerospace industry and are important in other areas of transportation and structural materials. The most useful compounds of aluminium, at least on a weight basis, are the oxides and sulfates.

Despite its prevalence in the environment, no known form of life uses aluminium salts metabolically. In keeping with its pervasiveness, aluminium is well tolerated by plants and animals. Owing to their prevalence, potential beneficial (or otherwise) biological roles of aluminium compounds are of continuing interest.

Corrosion resistance can be excellent due to a thin surface layer of aluminium oxide that forms when the metal is exposed to air, effectively preventing further oxidation. The strongest aluminium alloys are less corrosion resistant due to galvanic reactions with alloyed copper. This corrosion resistance is also often greatly reduced by aqueous salts, particularly in the presence of dissimilar metals.

Owing to its resistance to corrosion, aluminium is one of the few metals that retain silvery reflectance in finely powdered form, making it an important component of silver-colored paints. Aluminium is oxidized by water to produce hydrogen and heat:

$$2\ Al + 3\ H_2O \rightarrow Al_2O_3 + 3\ H_2$$

This conversion is of interest for the production of hydrogen. Challenges include circumventing the formed oxide layer, which inhibits the reaction and the expenses associated with the storage of energy by regeneration of the Al metal.

Module 4. States of Matter

Text 1. Liquefaction of Cases

Now suppose you put enough pressure on a gas to halve its volume to make a pint of it into half a pint. The half-pint has as many molecules in it as the pint had. There are twice as many molecules in the gas, so it hits twice as many blows on a given area as it did when it was a pint. Accordingly, it is thrusting on its container twice as hard and it has twice the pressure.

If pressure is put upon any gas the molecules are crowded by the pressure towards each other, and when they get very near to each other they get within the range of each other's attraction. If the gas is one like carbon dioxide or sulphur dioxide, the crowded molecules may pull on each other so strongly that they hang together and the gas becomes a liquid. It is thus possible to turn many gases into liquids simply by compressing them. Ammonia, carbon dioxide, sulphur dioxide, chlorine and some other gases can easily be turned into liquid in this way. Any gas in fact can be turned into a liquid by compressing it - as long as it is not too hot. The jostling of the molecules, which we call heat, prevents the molecules clinging together and making a liquid; the attraction of the molecules pulls them together and causes them to make a liquid.

If there is a strong attraction, as with ammonia or carbon dioxide, pressure will liquefy the gas even if fairly warm; but gases like oxygen or hydrogen can only be liquefied by pressure if their molecules are calmed down by a great deal of cooling. 80, if we try to see what happens if we compress a gas to the greatest extent possible, we find that it starts by halving its volume each time we double the pressure. Then we begin to find it more than halves its volume when we double the pressure on account of the molecules attracting each other. Then either the gas collapses into a liquid, or, if it is too hot to do this, increase of pressure drives the molecules still nearer and makes the volume smaller. Now the molecules get so close that they repel each other, and as their outer rings of electrons get nearer the repulsion between them gets huge and the gas becomes more and more difficult to compress and finally is incompressible as a liquid or a solid. The liquefying of gases is an important industry. A gas takes up several hundred times as much room as it does in the form of a liquid and so if we want to send it by train or ship it, it is best to send it as a liquid. Chlorine gas - the green-poison-gas - is used for many quite beneficent purposes such as bleaching, making dyes, medicines, etc. A ton of chlorine as gas would have a volume of 422 cubic yards. It would take about forty railway trucks to hold it.

If chlorine is compressed, it collapses to a greenish liquid, which is run into closed steel boilers mounted on railway wheels. A ton of chlorine as liquid occupies only one cubic yard. The chlorine under the pressure of some seven atmospheres (105 lbs. per 1 square inch) in the boiler remains liquid permanently. If the boiler were to be smashed up in a railway accident the effects would not be quite as disastrous as might be expected, for the evaporation of the liquid would cool it intensely and the gas would be but slowly evolved.

Gases like oxygen and hydrogen will remain liquid only at very low temperatures (-1500to -2500C) and so it is almost as difficult to keep them liquid at ordinary temperatures as it would be to keep water liquid if the world were red-hot! Accordingly, we transport oxygen and hydrogen compressed in cylinders to 120 times the pressure of the air. If the cylinder holds 1 cubic foot, we can accordingly pack 120 cubic feet of gas into it. Higher pressures would be too dangerous.

Text 2. Expansion of Gases

Just as we can cool a gas by making it do work, so we can heat it by doing work upon it. Suppose, instead of letting the gas push the piston we apply power to the piston and make it push the gas. This speeds up its molecules and makes it hot. It follows, then, that if we compress a gas it becomes hotter. The best example of this is seen in a bicycle pump, which becomes very warm when a tyre is inflated. You might think this was due to the friction of the piston, but if you try working the pump without a tyre, you will find it does not heat up noticeably. The expansion of a compressed gas is used in driving steam-engines, petrol-engines, hot-air-engines, etc.

Gases expand very largely when they are heated. We saw that a cubic foot of steel expanded by 5 cubic inches when heated from OO C to 780 C, while a cubic foot of alcohol expanded 150 cubic inches over the same range. A cubic foot of air when heated from 0'C to 780 C expands by no less than 493 cubic inches. An interesting thing is that all gases expand to exactly the same extent when heated under the same conditions, which is by no means true for liquid or solids. When a liquid or solid is heated and expands there are two forces at work. The molecules are speeded up and so tend to swing in bigger orbits or to get further from each other. This effect is the same for all solids or liquids. But the attraction of the molecules opposes this effect; consequently substances whose molecules attract each other strongly will expand little and vice versa. But the molecules of gases are too far from each other to attract each other appreciably, so the effect of heating them is simply to increase the speed and energy of the molecules and make them bounce off each other harder and so fly farther apart. As the same rise of temperature means the same increase of energy, all gases expand equally.

The expansion of gases is very large, but it is not very useful for measuring temperatures because they expand and contract not only when the temperature alters but also when the air pressure alters. The expansion of a gas is sometimes used to measure rather high or very low temperatures and also for very accurate work. An air thermometer is rather a difficult affair to handle, and it is used only in the laboratory.

Module 5. Inorganic Chemistry

Text 1. The History and the Basics of English Chemistry Nomenclature

The history of chemical nomenclature is unclear. However, it is supposed that it originates from early alchemy and their needs to classify and name substances and compounds they were using.

The nomenclature of alchemy is rich in description, but does not effectively meet the aims outlined above. Opinions differ whether this was deliberate on the part of the early practitioners of alchemy or whether it was a consequence of the particular (and often esoteric) theoretical framework in which they worked.

While both explanations are probably valid to some extent, it is remarkable that the first "modern" system of chemical nomenclature appeared at the same time as the distinction (by Lavoisier) between elements and compounds, in the late eighteenth century.The French chemist Louis-Bernard Guyton de Morveau published his recommendations in 1782, hoping that his "constant method of denomination" would "help the intelligence and relieve the memory".

The system was refined in collaboration with Berthollet, de Fourcroy and Lavoisier, and promoted by the latter in a textbook which would survive long after his death at the guillotine in 1794. The project was also espoused by Jöns Jakob Berzelius who adapted the ideas for the German-speaking world.

The recommendations of Guyton covered only what would be today known as inorganic compounds. With the massive expansion of organic chemistry in the mid-nineteenth century and the greater understanding of the structure of organic compounds, the need for a less *ad hoc* system of nomenclature was felt just as the theoretical tools became available to make this possible. An international conference was convened in Geneva in 1892 by the national chemical societies, from which the first widely accepted proposals for standardization arose.

A commission was set up in 1913 by the Council of the International Association of Chemical Societies, but its work was interrupted by World War I. After the war, the task passed to the newly formed International Union of Pure and Applied Chemistry, which first appointed commissions for organic, inorganic and biochemical nomenclature in 1921 and continues to do so to this day.

The IUPAC nomenclature of inorganic chemistry is a systematic method of naming inorganic chemical compounds as recommended by the International Union of Pure and Applied Chemistry (IUPAC). Ideally, every inorganic compound should have a name from which an unambiguous formula can be determined. There is also an IUPAC nomenclature of organic chemistry.

The International Union of Pure and Applied Chemistry (IUPAC) is an international non-governmental organization established in 1919 devoted to the advancement of chemistry. It has as its members national chemistry societies. It is most well known as the recognized authority in developing standards for the naming of the chemical elements and their compounds, through its Interdivisional Committee on Nomenclature and Symbols (IUPAC nomenclature). It is a member of the International Council for Science (ICSU).

In addition to nomenclature guidelines, the IUPAC sets standards for international spelling in the event of a dispute; for example, it ruled that international aluminium is preferable to the American *aluminium* and American sulfur is preferable to the British *sulphur*.

Many IUPAC publications are available over the Internet. For example, Quantities, Units and Symbols in Physical Chemistry (the "Green Book") can be downloaded in its entirety, while Compendium of Chemical Terminology is fully searchable online.

Text 2. Carbon Monoxide

Carbon monoxide is a chemical compound, CO, a colorless, odorless, tasteless, extremely poisonous gas that is less dense than air under ordinary conditions. It is very slightly soluble in water and burns in air with a characteristic blue flame, producing **carbon dioxide**; it is a component of producer gas and water gas, which are widely used artificial fuels. It is a reducing agent, removing oxygen from many compounds and is used in the reduction of metals, e.g., iron, from their ores.

Carbon monoxide is formed by **combustion** of carbon in oxygen at high temperatures when there is an excess of carbon. It is also formed (with oxygen) by decomposition of carbon dioxide at very high temperatures (above 2000° C). It is present in the exhaust of internal combustion engines (e.g., in automobiles) and is generated in coal stoves, furnaces, and gas appliances that do not get enough air (because of a faulty draft or other reasons).

Carbon monoxide is an extremely **poisonous gas.** Breathing air that contains as little as 0.1 % carbon monoxide by volume can be fatal; a concentration of about 1 % can cause death within a few minutes. The gas is especially dangerous because it is not easily detected. Early symptoms of carbon monoxide poisoning include drowsiness and headache, followed by unconsciousness, respiratory failure, and death. First aid for a victim of carbon monoxide poisoning requires getting him to fresh air; administering artificial respiration and, if available, oxygen; and, as soon as possible, summoning a doctor. When carbon monoxide is inhaled it reacts with hemoglobin, the red blood pigment that normally carries oxygen to all parts of the body. Because carbon monoxide is attracted to the hemoglobin about 210 times as strongly as is oxygen, it takes the place of oxygen in the blood, causing oxygen starvation throughout the body.

Module 6. Organic Chemistry

Text 1. Sodium Chloride

Sodium chloride is NaCI, common salt. It is readily soluble in water and insoluble or only slightly soluble in most other liquids. It forms small, transparent, colorless to white cubic crystals. It is odorless but has a characteristic taste. It is an ionic compound, being made up of equal numbers of positively charged sodium, and negatively charged chloride ·ions. When it is melted or dissolved in water the ions can move about freely, so that dissolved, or molten sodium chloride is a conductor of electricity; it can be decomposed into sodium and chlorine by passing an electrical current through it.

Salt is important in many ways. It is an essential part of the diet of both men and animals, and is a part of most animal fluids, such as blood, sweat and tears. It aids digestion by providing chlorine for hydrochloric acid, a small but essential part of human digestive fluid. Persons with hypertensive heart disease often must restrict the amount of salt in their diet. Salt is widely used as a seasoning for foods, and is used in curing meats and preserving fish and other foods. As a chemical it is used in making glass, pottery, textile dyes, and soap, and in large amounts to melt ice and snow on streets and highways. It is also used for the production of chlorine, sodium metal and sodium hydroxide.

Nearly all chemical compounds that contain either sodium or chlorine are ultimately derived from salt. Salt is widely and abundantly distributed in nature. It makes up nearly 80% of the dissolved material in sea water, and is the greater part of dissolved matter in the Dead Sea, the Great Salt Lake, and in salt wells in various parts of the world. It is also widely distributed in solid form. Rock, or mineral, salt is usually less pure; it is found in large deposits in the USA, and also in Great Britain, France, Germany, China and India.

Salt is mined from deposits or is obtained as a brine by introducing water into the deposits to dissolve the salt and then pumping the solution to the surface. Salt is also obtained by evaporation of sea water, usually in shallow basins warmed by sunlight; salt so obtained was formerly called bay salt, and is now often called solar salt. Most salt for table use is obtained from sea water; it is usually not pure sodium chloride, small amounts of other substances being added to it to prevent lumping. Manufacture and use of salt is one of the oldest chemical industries. Salt has been used as money.

Text 2. Water-Soluble Vitamins

Vitamins B and C are considered to be water-soluble. The vitamin B is complex and includes thiamin (vitamin B1, riboflavin (vitamin B2), niacin (nicotinic acid), folic acid, vitamin B6. (pyridoxine), vitamin B12, biotin, pantothenic acid. The chemical structure of each of the B-vitamins is different, but they have some common features. As a rule they act as "co-factors" in different enzyme systems in the body; they are found in the same foods; and being water-soluble, they are not stored for long in the body. These characteristics mean that diets containing too little of the B-vitamins can lead to multiple deficiency within a few months.

Thiamin (B1) and pantothenic acid are necessary for the release of energy from carbohydrate (thiamin) and fat (pantothenic acid). They are wide-spread in both animal and vegetable foods. Rich sources of thiamin are those containing more than 0.04 mg per 100 kcal, such as milk, offal, pork, eggs, vegetables and fruit. It should be noted that cooking may result in considerable losses from these foods.

Riboflavin (B21) and niacin are necessary for the utilization of energy from food. Riboflavin is a bright yellow substance, which is widely distributed in foods. The main sources of this vitamin are milk, meat and eggs. The main sources of niacin in the average diet are meat and meat products, potatoes, bread and cereals. Milk and eggs are not rich in this vitamin.

Folic acid (folate) has several functions, including its action with vitamin B12 in rapidly dividing cells. Deficiency of this vitamin leads to anaemia and the degeneration of nerve cells. Vitamin B12 does not occur in vegetable foods, but only in animal products and in microorganisms including yeast. Liver is the richest source of vitamin B12, but useful amounts of it also occur in eggs, cheese, milk, meal and fish. As for folic acid, raw green leafy vegetables are rich in it, but most fruits, meat and dairy products contain little. Folic acid is easily destroyed in cooking, much being lost in the water used for cooking vegetables.

Vitamin B6 is necessary for the formation of haemoglobin. Its deficiency is rare in man, but high intakes are dangerous. In the diet vitamin B6 can be found in milk, meat, potatoes and other vegetables.

Biotin is essential for the metabolism of fat. Very small amounts of it are needed. Egg yolk is rich source of biotin. Smaller amounts are obtained from milk and dairy products, cereals, fish, fruit and vegetables.

Module 7. Chemical Laboratory

Text 1. Evaporation.

Evaporation is a change of a liquid into vapor at any temperature below its boiling points. For example, water, when placed in a shallow open container exposed to air, gradually disappears, evaporating at a rate that depends on the amounts of surface exposed, the humidity of the air, and the temperature. Evaporation occurs because among the molecules near the surface of the liquid there are always some with enough heat energy to overcome the cohesion of their neighbors and escape. At higher temperatures the number of energetic molecules is greater, and evaporation is more rapid. Evaporation is also increased by increasing the air circulation, thus carrying away the energetic molecules leaving the liquid before they can be slowed enough by collisions with air molecules to be reabsorbed into the liquid. If the air is humid some water molecules from the air will pass back into the liquid, thus reducing the rate of evaporation. An increase in atmospheric pressure also reduces evaporation. The process of evaporation is always accompanied by a cooling effect. For example, when a liquid evaporates from the skin, a cooling sensation results. The reason for this is that only the most energetic molecules of liquid is lost by evaporation, so that the average energy of the remaining molecules decreases; the surface temperature, which is the measure of this average energy, decreases also. Many refrigeration processes are based on this principle.

Text 2. Evaporimeter.

Evaporimeter is an instrument that measures the rate of evaporation of water into the atmosphere, sometimes called an atmometer. Evaporimeters are of two types, those that measure the evaporation rate from a free water surface and those that measure it from a continuously, wet porous surface. In the first type, the level of water in a tank or pan, often sunk into the ground level, is measured by a micrometer gauge. After accounting for increases, due to rain and decreases due to deliberate draining, the day-to-day decrease in the water level can be attributed to evaporation. In the evaporimeter of the second type, the evaporation rate is computed according to the rate of weight loss of a wet pack of absorbent material. The Piche evaporimeter uses an inverted graduated cylinder of water with a filter-paper seal at the mouth. Evaporation takes place from the wet filter paper and thus depletes the water in the cylinder, so that the rate of evaporation can be read directly from the graduations marking the water level. The Livingston sphere, another evaporimeter of the second type, uses a wet ceramic sphere as the evaporating surface to stimulate evaporation rates from vegetation. Because evaporation rates are so sensitive to the water supply, to the nature of the evaporating surface, and to the surface's exposure to the atmosphere, the data collected by such instruments, are often not representative of the natural evapotranspiration, from the soil, vegetation, and the oceans; evaporimeters are therefore not in wide-spread use by environmental scientists.

Module 8. Everyday Chemistry

Text 1. Radiation Sickness

Radiation sickness is a harmful effect produced on body tissues by exposure to radioactive substances. The biological action of radiation is not fully understood, but it is believed that a disturbance in cellular activity results from the chemical changes caused by ionization. Some body tissues are more sensitive to radiation than others and are more easily affected; the cells in the blood-forming tissues are extremely sensitive.

Radiation sickness may occur from exposure to a single massive emanation such as a nuclear explosion, or it may occur after repeated exposure to even very small doses in a plant or laboratory, since radiation effects are cumulative. Moreover, solar radiation in sufficient quantity is enough to cause tissue destruction; persons unduly exposed to sunlight, such as farmers and sailors, have a far greater incidence of skin cancer than has the general population.

Radiation sickness may be fairly mild and transitory, consisting of weakness, loss of appetite, vomiting, and diarrhea. A mild dose of radiation increases the tendency to bleed and reduces the body's defense against infection. After a massive dose of radiation the reaction may be so severe that death quickly ensues. This is usually due to severe anemia or hemorrhage, to infection, or to dehydration. Extremely high doses damage the tissues of the brain, and death usually follows within 48 hr. There is no treatment for radiation sickness, although it is sometimes possible for persons to survive otherwise lethal doses of radiation if bone marrow transplants are performed.

Exposure to radiation can cause genetic mutation; the progeny of those subjected to excessive radiation tend to show deleterious genetic changes. Persons working with radioactive materials or X-rays protect themselves from excessive exposure to radiation by shields and special clothing usually containing lead. Processes involving radioactive substances are observed through thick plates of specially prepared glass that exclude the harmful rays. A dosimeter, a device measuring the amount of radiation to which an individual has been exposed, is always worn by persons working in radioactive areas.

Text 2. Poison

Poison is any agent that may produce chemically an injurious or deadly effect when introduced into the body in sufficient quantity. Some poisons can be deadly in minute quantities; others only if relatively large amounts are involved. Factors of importance in determining the severity of a poison include the nature of the poison itself, the concentration and amount, the route of administration, the length of exposure, and the age, size, and physical health of the individual. If poisoning is suspected a physician or poison control center should be called immediately. The remainder of the poison and its container should be saved; the label may list ingredients; first aid measures or antidotes. For most ingested poisons emptying the stomach is the most important treatment; vomiting is best accomplished in the conscious individual by administering syrup of ipecac with large quantities of water. The major exceptions to this treatment are in cases of ingestion of corrosives such as lye and certain hydrocarbons such as kerosine. In corrosive ingestions a milk may be given, but vomiting should not be induced since the damage that may have already been sustained by the mucous membranes of the esophagus and stomach may advance to perforation; the patient should be seen by a physician as soon as possible.

Hydrocarbons are extremely volatile, and the dangers of their being aspirated into the lungs when vomiting is induced are greater than their toxicity if absorbed into the body. In gas or vapor poisoning the patient should be carried to a nonpolluted atmosphere; artificial respiration should be employed if necessary. If any poison has been absorbed through skin, all contaminated garments should be removed immediately and the skin washed with soap.

RENDERING THE ARTICLE

Rendering the article is the way in which the article is translated and explained.

Instruction for rendering the article

1. Read the article carefully.
2. Make up the plan of the article using narrative sentences. Leave blanks after each point for working out the plan in detail.
3. Find the meaning of the key words from the article in the bilingual dictionary.
4. Formulate the main idea of the article in a one sentence.
5. Work out the plan in detail.
6. Read the article again and compare it with your plan. Check up if you haven't missed the essential material.
7. Make up a clean copy according to the plan for rendering the article.

Plan for rendering the article

1. **The title of the article:**
   The article is headlined .... / The headline of the article I've read is ....

2. **The autor of the article, when and where it was published:**
   a) The autor of the article is .... / The article is written by ....
   b) It was published (printed) in the issue ....

3. **The main idea of the article:**
   a) The main idea of the article is ....
   b) The article is devoted to (dedicated to / deals with) ....
   c) The article draws the reader's attention to ....
   d) The purpose of the article is to give the reader some information about ....

4. **The content of the article:**
   a) The author starts by telling us about ....
   b) The author writes (stresses / thinks / points out / describes) ....
   c) The autor consides (tackles) the problem of ....
   d) The author gives a quotation from ....
   e) The article draws the reader's attention to ....
   f) The article goes on to say that ....
   g) In conclusion .... / The author comes to the conclusion that ....

5. **Your opinion of the article:**
   a) I found the article interesting (of no value / dull / too hard to understand / easy to read / important / exciting / actual / useful ....
   b) I recommend my fellow-students to read it because it enriches our knowledge in the field of / it tries to solve the problem of / it raises the question of ....

Sample rendering

Провідний український лабораторний портал / 28 вересня 2012 р.

Вплив магнітного поля на властивості води

У 1936 році бельгійський інженер Т.И.С. Вермейрен виявив, що при нагріванні води, яка перетнула силові лінії магнітного поля, на теплообмінній поверхні не утворюється накип. З тих самих пір магнітною обробкою води почали займатися майже всі. Так був запущений шалений ажіотаж навколо впливу магнітного поля на властивості води.

Ставлення до магнітної обробки води має полюсний характер. Одні відчайдушно вірять у магічні властивості омагніченої води, інші – скептики – готові знайти найменші недоліки й зовсім не сприймають науково обґрунтованих фактів і навіть називають їх шарлатанством. Але як казав Жан Луї Агасис: «Будь-яке велике відкриття в науці проходить три неминучі стадії. Спершу люди заявляють, що воно суперечить Біблії (О.М. – в нашому випадку в ролі Біблії виступає традиційна наука). Потім вони стверджують, що це давним-давно було відомо. Нарешті, вони кажуть, що ніколи не сумнівалися в його правильності».

Як відомо, вода – одна з найзагадковіших речовин, відомих на сьогодні науці. Існує безліч теорій і гіпотез аномальних властивостей води. На сьогодні немає чіткого науково підтвердженого уявлення про структуру та властивості води. А у випадку магнітного впливу на воду взагалі відбуваються процеси, які традиційна наука пояснити не може.

Теорії щодо магнітного впливу можна поділити на колоїдні, йонні, водяні та динамічні.

Прихильники колоїдної теорії стверджують, що магнітне поле, діючи на воду, може руйнувати колоїдні частинки, які в ній присутні. Таким чином, центром кристалізації замість поверхонь труб стають ці частинки, що легко видаляються з потоку у вигляді шламу. Накип на поверхні труб не утворюється. Наявність йонів заліза інтенсифікує появу зародків кристалізації.

Прихильники йонної теорії пов'язують дію магнітного поля з гідратацією йонів. Вплив магнітного поля на воду та її домішки пояснюється поляризаційними явищами та деформацією йонів солей. Гідратація йонів при обробці зменшується, вони зближуються й утворюють кристалічну форму солі. Таким чином, замість твердого накипу у воді з'являється мігруючий тонкодисперсний шлам, який легко видаляється з поверхні трубопроводів.

Прихильники гіпотез водяної теорії припускають, що магнітне поле впливає безпосередньо на структуру асоціатів води. Це може привести до деформації водневих зв'язків або перерозподілу молекул води у тимчасових асоціативних утвореннях, що також тягне за собою зміну фізико-хімічних характеристик процесів, які перебігають у ній.

На сьогодні найбільш популярною є динамічна теорія. Потік в'язкої рідини зводиться, з молекулярно-кінетичної точки зору, до трансляційного руху йонів і молекул рідини в напрямку руху прикладеної сили. Вважають рідину механічною системою, яка складається з незалежних частинок (йонів) та молекул води, що знаходяться в тепловому русі. На заряджені домішки, що рухаються в потоці води під дією магнітного поля, діє сила Лоренца, яка намагається змінити траєкторію руху цих частинок - закручує навколо магнітних ліній. Виникає макроскопічний потік води: усю масу нейтральних молекул води «тягне» одночасно множина низькомолекулярних катіонів та аніонів, причому джерелом енергії слугує енергія електричного поля, а магнітне поле виконує керуючі функції. Таким чином, під дією магнітного поля за рахунок ефекту Холла суттєву роль відіграють електричні поля, викликані електричним зарядом поверхні розділу фаз і сумарним об'ємним зарядом йонів.

Підтвердити або спростувати одну з цих теорій сьогодні неможливо. Але говорити, що це чисте шарлатанство - це не розуміти процесів наукового пізнання.

Олена Можаровська

The headline of the article I have read is “The magnetic field effect on water properties”.

The author of the article is Olena Mozharovska. It was published on the webside ”Leading Ukrainian laboratory portal” in the section “Chemistry” on the 28th of September, 2012.

The article deals with the water - one of the most mysterious substances known to science today. He also expresses that there is no clear scientific evidence of the structure and properties of water.

The author starts by telling that in 1936 a Belgian engineer T.Y.S. Vermeyren found that by heating water that crossed force lines of the magnetic field there was no boiler scale on the heat - exchange surface. It has been a frantic rush around the magnetic field on the properties of water since that time. Some believe in the magical properties of magnetic water others - skeptics - are ready to find the smallest flaws and do not accept scientifically grounded facts and even called them a fraud.

The author gives a quotation from Jean-Louis Ahasys who says that a great science discovery consists of three stages: first, people say it contradicts the Bible (in this case, Bible serves as traditional science), second, they claim it has been known since early time, finally, they say they have never doubted its correctness. There are a lot of theories and hypotheses of water anomalous properties. They can be divided into colloidal, ionic, water and dynamic. Colloidal theory supporters argue that the magnetic field acting on the water can destroy the colloidal particles. Ionic theory supporters link up the magnetic action with the ions hydration. Hypotheses water theories supporters suggest that the magnetic field acts directly on the structure of water associates. At present, the dynamic theory is the most popular. Supporters of these theory try to give a detailed explanation of the magnetic field effect on water properties.

In conclusion, the author states that it is impossible to refute one of these theories. But to say that it is fraud means not to understand the processes of scientific knowledge.

I found the article interesting and useful. The facts gives there may be of value for students and teachers of Chemistry. So I recommend my fellow students to read it because it enriches our knowledge in the field of chemistry and may be used in some scientific research.

Texts for rendering in English

Текст 1. Азот, азотна кислота

15 травня 2013 / Хімія

Чиста азотна кислота HNO-безколірна рідина з густиною 1,51 г/см. що при – 42° С загусає в прозору кристалічну масу. На повітрі вона, як і концентрована соляна кислота, "димить", так як пари її утворюють з вологой дрібні крапельки туману.

Азотна кислота не є стійкою. Уже під впливом світла вона поступово розкладається. Чим вище температура і чим концентрованіше кислота, тим швидше вона розкладається. При цьому виділяється диоксид азоту, який розчиняється у кислоті і надає їй буроо забарвлення. Азотна кислота належить до ряду найбільш сильних кислот; в розведених розчинах вона повністю дисоціює на іони H и–NO.

Окислювальні властивості азотної кислоти. Характерною властивістю азотної кислоти є її яскраво виражена окислювальна здатність. Азотна кислота – один з найбільш енергійних окисників. Більшість неметалів легко окислюются нею, перетворюючись у відповідні кислоти. Так, сірка при кип'ятінні з азотною кислотою поступово окислюється в сірчану кислоту, фосфор – в фосфорну. Жаринка, поміщена в концентровану HNO, яскраво розгоряється.

Азотная кислота діє майже на всі метали (за винятком золота, платини, танталу, родію, іридію), перетворюючи їх у нітрати, а деякі металии – в оксиди. Концентрована HNO пасивує деякі метали. Ще Ломоносов відкрив, що залізо, яке легко розчиняється у розбавленій азотній кислоті, не розчиняється в холодній концентрованій HNO. Пізніше было встановлено, що азотна кислота аналогічно діє на хром і алюміній. Ці метали переходять під дією концентрованої азотної кислоти у пасивний стан.

Ступінь окислення азоту в азотній кислоті дорівнює 4–5. Виступаючи як окисника, HNO може відновлюватись до різних продуктів. Яка з цих речовин утвориться, тобто як глибоко відновиться азотна кислота в тому чи іншому випадку, залежить від природи відновлення і від умов реакції , і перш за все від концентрації кислоти. Чим вище концентрація HNO, тим менш глибоко вона відновлюється. При взаємодії разбавленної азотної кислоти з малоактивними металами, наприклад, з міддю, виділяється NO. Сильно разбавлена азотна кислота взаємодіє з активними металами- цинком, магнієм, алюмінієм – з утворенням іона амонія, який дає з кислотою нітрат амонія. Звичайно одночасно утворюються декілька продуктів.

Для іллюсторації наведемо схеми реакцій окиснення деяких металів азотною кислотою. При дії азотної кислоти на метали, водень, як правило, не виділяється, а більш розбавлена кислота відновлюється до NO. В загальному, окислювально-відновлювальні реакції, які проходять за участі HNO3, протікают важко.

Суміш, що складається з 1 об'єма азотної і 3–4 об'ємів концентрованої соляної кислоти, називається царською водкою. Царська водка розчиняє деякі метали, що не взаємодіють з азотною кислотою, в тому числі і "царя металів" – золото. Дія її пояснюється тим, що азотна кислота окислює соляну з виділенням вільного хлору і утворенням хлороксида азоту(III), або хлорида нітрозилу. Хлорид нітрозилу є проміжним продуктом реакції і розкладається.

Хлор в момент виділення складається з атомів, що і зумовлює високу окислювальну здатність царської водки. Реакції окислення золота і платини протікают в основному згідно певниим рівнянням. З надлишком соляної кислоти хлорид золота (III) і хлорид платини (IV) утворюють комплексні сполуки.

На ряд органічних речовин азотна кислота діє так, що один чи декілька атомів водню в молекулі органічної сполуки заміщуються нітрогрупами. Цей процес називається нітруванням і має велике значення в органічній хімії.

Валентин Дворак

Text 2. Хімічні елементи, які входять до складу живих організмів

18 вересня 2013 / Хімія

Науку, яка вивчає хімічні речовини, що входять до складу живих організмів, їх структуру, розподіл, перетворення і функції називають біологічною хімією, або біохімією (від грецьк. bios – життя, хімія). Ця наука почала формуватися наприкінці XIX ст. До середини XX ст. були відкриті основні класи речовин, що входять до складу живих організмів.

Клітини живих організмів містять майже всі відомі в природі хімічні елементи. За кількісним складом у клітині їх можна розділити на три основні групи: макроелементи, мікроелементи, ультрамікроелементи.

Макроелементи складають основну масу органічних і неорганічних речовин. Чотири хімічні елементи, зокрема оксиген (О), гідроген (Н), карбон (С), нітроген (N), становлять майже 98% і входять до складу органічних сполук. Тому їх ще називають органогенними. Із чим пов'язано кількісне переважання цієї "четвірки"? Організми – складні системи. Це означає, що хімічні сполуки, з яких вони утворені, мають бути дуже різноманітними. Щоб ці сполуки зберігали свої властивості, їм треба мати стійку структуру. Таким чином, зв'язки, за допомогою яких утворюються ці речовини, мають бути міцними. Хімічний зв'язок, який відповідає цим вимогам, ковалентний. Ковалентні зв'язки утворюються внаслідок усуспільнювання двох електронів зовнішнього рівня, по одному від кожного атома. Чим менше діаметр атомів, які утворюють ковалентний зв' язок, тим сильніше взаємодія між ядром та усуспільненими електронами, і тим міцніший цей зв'язок. Саме тому в живих організмах переважають О, С, Н, N1, які легко утворюють ковалентні зв'язки. До макроелементів також належать фосфор (Р), калій (К), кальцій (Са), магній (М§), натрій (ТЧа), хлор (СІ), сульфур (Б), ферум (Бе). Їхня сумарна частка становить 1,9%.

Мікроелементи є складовими компонентами ферментів. Це понад 50 елементів, вміст яких у клітині – 10 %: бор (В), кобальт (Со), купрум (Си), молібден (Мо), цинк (2п), ванадій (V), іод (I), бром (Бг), манган (Мп). Вміст ультрамікроелементів (аурум (Аи), аргентум (А§), платина (Рі), плюмбум (РЬ) ще менший у клітині.

Усі хімічні елементи, що містяться в клітині живих організмів, входять до складу органічних і неорганічних сполук або перебувають у вигляді йонів. Вони відіграють велику роль у живленні клітин, їхньому рості, побудові тканин та органів, підтримують кислотно-лужну рівновагу, беруть участь в обміні речовин та енергії, у процесах подразнення та збудження клітини.

Ганна Омела

Text 3. Неорганічні сполуки: вода і мінеральні солі

27 жовтня 2012 / Хімія

Елементи, що входять до складу організмів, можуть бути або складовими частинами різноманітних неорганічних (вода і мінеральні солі) і органічних сполук (білки, вуглеводи, жири, нуклеїнові кислоти, гормони, вітаміни), або знаходитись у формі йонів (К , № , Са , М§ , СІ–, Н2РО4– та ін.).

Найважливішою з неорганічних речовин, що входять до складу живих організмів, є вода – Н2О. Вода є основним середовищем, у якому відбуваються процеси обміну речовин та перетворення енергії.

Виняткове значення води для живих систем пов' язане з будовою її молекул. Молекула води (Н2О) складається з двох атомів гідрогену, які пов'язані міцним полярним ковалентним зв 'язком з атомом оксигену. О – сильніший від Н неметал, через що спільні пари електронів зміщені в молекулі води в його бік. Тому, хоча молекула води загалом незаряджена, біля атома О збирається негативний заряд, а біля атомів Н – позитивний. Молекула води поляризована і є диполем (має і позитивний, і негативний заряди). Протилежні полюси сусідніх молекул води притягуються, утворюючи водневі зв' язки. Це відносно слабкі зв' язки, в 15–20 разів слабші за ковалентні. Саме вони визначають особливе значення води для життя. Молекули води в рідині зв'язані одна з одною і з молекулами розчинених речовин водневими зв'язками. Енергія цих зв' язків невелика, і тому вони швидко руйнуються та легко відновлюються. Завдяки утворенню водневих зв'язків пояснюється сила поверхневого натягу і підняття води по щілинах ґрунту та судинах рослин.

Через те що молекули води є диполями, вони мають унікальну властивість – розчиняти полярні речовини, до яких відносяться іонні сполуки: солі, кислоти, основи (до відома: до неіонних сполук відносяться спирти, цукор). Молекули води ніби "розтягують" молекули полярних речовин. При цьому зростає реакційна здатність розчинених речовин, оскільки їхні молекули або іони набувають можливості вільно рухатись. Речовини, здатні розчинятися у воді, називаються гідрофільними (від грецьк. hydor – вода, phileo – люблю).

Вода як універсальний розчинник відіграє надзвичайно важливу роль у живих організмах, оскільки більшість біохімічних реакцій відбувається у водних розчинах. Надходять речовини у клітини та виводяться з них продукти життєдіяльності також переважно в розчиненому вигляді. Вода бере безпосередню участь у реакціях гідролізу (від грецьк. hydor – вода, lysis – розкладання) - розщеплення органічних сполук з приєднанням до місця розриву іонів молекули води (Н та ОН–).

Речовини, які не взаємодіють з водою, а тому в ній не розчиняються, називаються гідрофобними (від грецьк. hydor – вода, phobos – страх). До гідрофобних речовин належать майже всі жири, деякі білки.

З водою пов'язана також регуляція теплового режиму організмів. їй притаманна велика теплоємність, тобто здатність поглинати тепло за незначних змін власної температури. Завдяки цьому вода запобігає різким змінам температури в клітинах і в організмі в цілому за значних її коливань у навколишньому середовищі. Під час випаровування води організми витрачають багато тепла. Так вони захищають себе від перегрівання. Завдяки високій теплопровідності, вода забезпечує рівномірний розподіл теплоти між тканинами організму, циркулюючи по порожнинах органів і тіла.

Вода може бути в трьох агрегатних станах – твердому (лід), газоподібному (пара), рідкому (рідина). При випаровуванні води багато енергії витрачається на розрив водневих зв' язків між її молекулами. При замерзанні води тепло виділяється. Тому запаси води істотно пом' якшують клімат нашої планети.

Густина води найбільша при 4 С, а густина льоду менша за густину води. Тому водойми промерзають дуже повільно: зверху їх закриває лід, а біля дна довго зберігається шар води з температурою 4 С. Це рятує взимку життя багатьом водним організмам.

За матеріалами Інтерфакс Україна

Text 4. Теорія хімічної будови органічних сполук О. М. Бутлерова

Провідний український лабораторний портал / 3 жовтня 2013

Теорія хімічної будови. Поняття «хімічна будова» вперше ввів О. М. Бутлеров у 1861 р. Він зауважував, що властивості речовин визначаються не тільки їхнім складом (якісним і кількісним), як вважалося раніше, а й внутрішньою структурою молекул, тобто порядком з'єднання атомів один з одним, які входять до складу молекули. Цей порядок і є хімічною будовою молекули. У поняття «хімічна будова» О. М. Бутлеров включав також характер зв'язку атомів, їхній взаємний вплив один на одного. Наприклад, водень і кисень, утворивши воду, настільки змінилися від взаємного впливу, що вода вже не має властивостей ні водню, ні кисню, хоча й містить Гідроген і Оксиген, що входили до складу відповідно водню і кисню. У молекулі фенолу C6H5OH бензольне ядро впливає на властивості гідроксильної групи, посилюючи її кислотність (аналогія зі спиртами).

Олександр Михайлович Бутлеров (1828—1886). Російський хімік-органік, професор Казанського (1854—1868), а далі до кінця життя професор Петербурзького університетів, академік Петербурзької АН (з 1871). Почесний член Московського і Київського університетів. За-сновник великої школи російських хіміків-органіків. Створив і обгрунтував теорію хімічної будови. Добув ізобутилен і відкрив реакцію його полімеризації. Синтезував низку органічних сполук, серед яких перший в історії хімії синтез цукристої речовини (1861). Його праці з гідратації етилену покладено в основу одного з сучасних способів добування етилового спирту.

Структурні формули завжди записують для окремої молекули, позначаючи рисочкою кожну зв'язувальну електронну пару. Вони справедливі тільки для речовин молекулярної будови. До таких речовин належать більшість органічних сполук, оксигеновмісні кислоти (крім HP03 і H2Si03) та деякі оксиди неметалів (CO, C02, NO, N02, S02, H20 тощо). Так, структурні формули сульфатної та ацетатної кислот передають порядок розміщення атомів у молекулах кислот.

Структурні формули не слід плутати із застарілим графічним зображенням формул, де рисочкою позначається не спільна електронна, а ступінь окиснення елемента. Наприклад, графічне зображення формули хлориду натрію Na–CI не можна вважати структурною формулою, оскільки NaCl – йонна сполука. В узлах її кристалічних ґраток містяться не молекули; а йони Na+ і CI– . Між ними немає зв'язку, утвореного парою електронів, йони Na+ і Cl– утримуються разом завдяки електростатичному притяганню. Розглядаючи хімічну структуру як певну послідовність атомів у молекулі та їхній взаємний вплив один на одного, О. М. Бутлерову вдалося розкрити суть явища ізомерії, відомого ще з часів Й. Берцеліуса. Це пояснюється тим, що порядок сполучення атомів у молекулі впливає на властивості речовини.

Ізомерія — це явище існування речовин з однаковим якісним і кількісним складом, але різною хімічною будовою, а тому й різними властивостями.
Теорія хімічної будови, яка спочатку була сформульована як учення про будову органічних сполук, виявилася справедливою і для неорганічних речовин, які мають молекулярну будову. У результаті вона стала загальною теорією хімії.

Петро Даниленко

GLOSSARY

Module I

alchemy *n* [U] a type of science that people used to try to change ordinary metals into gold, especially in the Middle Ages

alchemist *n* [C] someone who tried to change ordinary metals into gold, especially in the Middle Ages

chemical *adj* involving chemistry or produced by a method used in chemistry *Collocations: chemical processes; the chemical composition of the atmosphere*

chemical *n* [C] a substance used in chemistry or produced by a process involving chemistry *Collocations: the chemical industry; the dumping of toxic chemicals*. *e. g.*: You must wear gloves when handling any of these chemicals

element *n* [C] an important basic part of something complicated, for example a system or plan. *Collocations: an important/essential element:* Our new management system includes two essential elements

chemical element *n* [C] a substance that consists of only one type of atom. *e. g.:* hydrogen, oxygen and other elements

chemist *n* [C] **1.** *British* a shop that sells medicines, beauty products, and toiletries; **2.** *British* someone who works in a chemist's shop preparing and selling medicines; **3.** scientist who studies chemistry. *Collocation:* a *brilliant young research chemist*

chemistry *n* [C] the scientific study of the structure of substances and the way they react with other substances: *Collocations: organic/inorganic chemistry; a professor of chemistry*

investigation *n* [C] the process of trying to find out all the details or facts about something in order to discover who or what caused it or how it happened. ***investigation of/into; under investigation***

procedure *n* [C, U] a way of doing something, especially the correct or usual way. *e. g.:* Companies use a variety of testing procedures to select appropriate candidates. ***procedure for:*** The procedure for doing this is explained fully in Appendix 3. ***follow a procedure:*** Those ticket holders who followed the proper procedure will receive a full refund. ***standard/proper procedure***

property *n* [C] *often Pl* a quality or feature of something. *e. g.:* The water is said to have healing properties.

science *n* [C, U] **1.** the study and knowledge of the physical world and its behaviour that is based on experiments and facts that can be proved, and is organized into a system. *e. g.:* There's a shortage of people competent in maths, science, and technology.Chris is studying science at school. **2.** an area of study that uses scientific methods. *Collocations: medical/ veterinary sciences*. **3.** scientific subject such as chemistry, physics, or biology. *Collocations:* earth sciences; ***science of***: the modern science of ecology

scientific *adj* relating to science, or based on its methods. *Collocations: scientific research/ evidence/procedures; a scientific truth/fact/claim; scientific instruments*

scientist *n* [C] someone who is trained in science, especially someone whose job is to do scientific research. *Collocation: research scientists*

substance *n* [C] a particular type of liquid, solid, or gas. *e. g.:* The wood is coated with a special substance that protects it from the sun; **a hazardous/harmful/radioactive***:* Some workers had developed cancer after exposure to radioactive substances

Module II

bond *v* [intransitive/transitive] to fix two things firmly together, usually with glue, or to become fixed in this way. *Collocation: a substance used for bonding plastics;* ***bond together:*** The fibres bond together and form a thin sheet; ***bond something to something:*** This product bonds fabric to any surface

chemical bonding *n* [U] the process by which atoms join together

compound *n* [C**] 1.** a chemical substance that consists of two or more elements that together form a molecule. Each different compound has a fixed ratio of elements. For example the water compound (H2O) consists of two hydrogen atoms and one oxygen atom. *e. g.:* Why do chemical compounds behave as they do? Water is a compound of hydrogen and oxygen. **1a.** something that consists of two or more substances mixed together. *Collocation: a herbal compound used for treating headaches*

compound *v* [transitive] to mix two or more substances together in order to make a new substance or product

chemical equation *n* [C] a method of describing the process involved in a chemical reaction, using chemical symbols to show the reactants and products

consist of *v* [transitive] to be made of particular parts or things

contain *v* [transitive] **1.** if a substance contains something, that thing is a part of it. *e. g.:* Brown rice contains a lot of vitamins and minerals. **1a.** to include something, or to have it as a part. *e. g.:* The information you need is contained in this report

divide *v* [transitive] **1.** to separate people or things into smaller groups or parts. *e. g.:* Divide the pastry and roll out one part. ***divide something into pairs/groups/parts etc:*** Divide the class into three groups. **1a.** to have separate parts, or to form into separate groups. ***divide into***: The film divides into two distinct halves

division *n* [C, U] the process of separating people or things into smaller groups or parts

include *v* [transitive] to contain someone or something as a part. *e. g.:* The price includes dinner, bed, and breakfast

mixture *n* [C] a substance consisting of different substances that combine without a chemical reaction

solute *n* [C, U] the part of the solution that is mixed into the solvent (NaCl in saline water)

solution *n* [C] a liquid with another substance dissolved in it, so that it has become part of the liquid. It is made up of solutes and solvents

solvent *n* [C] the part of the solution that dissolves the solute (H_2O in saline water)

theory *n* [U] the set of general principles that a particular subject is based on. *Collocations: the theory and practice of education; psychoanalytic/Marxist/literary theory*.

Module III

arrange *v* [transitive] to put things in a neat, attractive or useful order. *e. g.:* Here is the list arranged chronologically

atom *n* [C] the smallest unit of any substance. It consists of a nucleus made of protons and neutrons with electrons travelling around it. *Collocations: hydrogen/carbon/oxygen atoms*

atomic number *n* [C] the number of protons in the nucleus of an atom, the number representing an element which corresponds with the number of protons within the nucleus

atomic weight *n* [C, U] relative atomic mass

base *n* [C] a substance that accepts a proton and has a high pH; a common example is sodium hydroxide (NaOH)
chemical law *n* [C] certain rules that pertain to the laws of nature and chemistry
column *n* [C] a vertical row
invent *v* [transitive] to design or create something such as a machine or process that did not exist before. *e. g.:* Alfred Nobel invented dynamite
ion *n* [C] a molecule that has gained or lost one or more electrons
ionization *n* [U] the breaking up of a compound into separate ions.
molecule *n* [C] a chemically bonded number of atoms that are electrically neutral
nucleus *n* [C] the centre of an atom made up of neutrons and protons, with a net positive charge
periodic table *n* a list of chemical elements arranged according to the structure of their atoms
proton *n* [C] a positive unit or subatomic particle that has a positive charge
recurrence *n* [U] the process of happening again, either once or several times
row *n* [C] a number of persons or things arranged in a line, esp. a straight line
symbol *n* [C] **1.** a picture or shape used to represent something. *Collocation: pagan fertility symbols*. ***symbol of***: A crescent moon was the symbol of the old Ottoman Empire. **1a.** a mark, letter, number etc used to represent something, for example in chemistry or music. *e. g.:* Fe is the symbol for iron

Module IV

change *v* [intransitive/transitive] to become different, or to make someone or something different. *e. g.:* Some things never change
crystal *n* [C] a solid that is packed with ions, molecules or atoms in an orderly fashion
energy *n* [U] **1.** a form of power such as electricity, heat, or light that is used for making things work. *e. g.:* Insulating your home is a good way to save energy. Environmentally friendly energy sources include water and wind power. **2a**. the power that is present in all physical things and that can be changed into something such as heat, movement or light
gas *n* [C, U] a substance such as air that is neither a solid nor a liquid. *e. g.:* carbon dioxide. They detected high levels of radon gas in the building
liquid *n* [C, U] a substance that can flow, has no fixed shape, and is not a solid or a gas. *e. g.:* a glass of colourless liquid. The detergent is available as a powder or a liquid
matter *n* [U] **1.** a particular type of substance. *e. g.:* You can improve the soil by adding composted organic matter. **1a.** physical substance that everything in the world is made of
state *n* [C, U] the condition of something at a particular time. ***the state of:*** We're collecting data on the state of the environment
state of matter *n* [C, U] matter having a homogeneous, macroscopic phase
plasma *n* [U] state of matter similar to gas in which a certain portion of the particles are ionized
solid *n* [C, U] one of the states of matter, where the molecules are packed close together, there is a resistance of movement/deformation and volume change
water *n* [U] a chemical substance, a major part of cells and Earth, and covalently bonded. *Collocations:* a glass of water; sparkling/carbonated water (=water for drinking that has gas added to it)

Module V

acid *n* [C, U] a compound that, when dissolved in water, gives a pH of less than 7.0 or a compound that donates a hydrogen ion
alkali metals *n* [C] the metals of Group 1 on the periodic table
alkaline earth metals *n* [C] the metals of Group 2 on the periodic table
chemical formula *n* [C] an exact description of the chemical elements that make up a particular substance or compound, written with chemical symbols
chemical reaction *n* [C] a change that happens when chemicals combine and form different substances. *Collocation: chemical reaction between ozone and chlorine*
combination *n* [C] something that combines several thingsa striking colour combination
decompose *v* [intransitive] if a chemical COMPOUND decomposes, it separates into the smaller parts that it consists of
displacement *n* [U] the amount of water that an object pushes out of the way when it is placed in water
inorganic chemistry *n* [U] the part of chemistry that deals with substances in which there is no carbon an element that is present in all living things
metal *n* [C, U] **1.** a hard, usually shiny element that exists naturally in the ground or in rock, for example lead, gold, or iron. Metals are usually good conductors of heat and electricity and are used to make things such as tools, machines, weapons etc. *Collocations: a frame made of metal; precious metals such as silver.* **1a.** an alloy such as steel that is made from two or more metals combined together, or a metal combined with a non-metal. **1b.** used about something that is made of metal. *Collocation: a metal buckle/a metal basin*
nomenclature *n* [C, U] a system for naming things. *Collocation: chemical nomenclature*
oxidation *n* [U] the process by which a substance combines with oxygen or loses **hydrogen** *n* [U] a gas that has no colour or smell and is lighter than air
react with *v* [intransitive] if a chemical substance reacts with another substance, it changes as they are mixed together. ***react with***: Car emissions react with sunlight to form ozone.

Module VI

carbohydrate *n* [C, U] a substance found in foods such as sugar, bread, and potatoes. *e. g.:* Carbohydrates supply your body with heat and energy.
carbon *n* [U] **1.** a chemical element that is found in all living things, and can also exist as diamonds or coal. **2.** the gases carbon dioxide and carbon monoxide
derivative *n* [C] something that has developed or been obtained from something else
enzyme *n* [C] a protein that speeds up (catalyses) a reaction
fat *n* [C, U] **1.** oil found in food. *e. g.:* Reduce the amount of fat in your diet. **1a.** oil in solid or liquid form that is obtained from plants or animals and used in cooking. *e. g.:* Fry the meat in a small amount of fat.
hydrocarbon *n* [C] a chemical substance that contains only hydrogen and carbon, for example methane
mineral *n* [C] a natural substance in some foods that you need for good health, for example iron and calcium. *e. g.:* Some people need to take vitamin and mineral supplements.
nutrient *n* [C] a substance in food that plants, animals, and people need to live and grow
organic chemistry *n* [C] the scientific study of chemical compounds based on carbon
organic compound *n* [C] compounds that contain carbon

protein *n* [C, U] a substance in food such as meat, eggs, and milk that people need in order to grow and be healthy
trace element *n* [C] **1.** a chemical element that a living thing needs in only extremely small amounts in order to grow and develop normally, for example iron or zinc. **2.** a chemical element that is found in extremely small amounts in a mineral

Module VII

burette (also buret) *n* [C] glassware used to dispense specific amounts of liquid when precision is necessary (e.g. titration and resource dependent reactions)
combustion *n* [U] an exothermic reaction between an oxidant and fuel with heat and light
cuvette *n* [C] glassware used in spectroscopic experiments. It is usually made of plastic, glass or quartz and should be as clean and clear as possible
distillate *n* [C, U] a liquid that has been distilled
distilled water *n* [U] water that has been made very pure by removing various substances from it through a process in which it is heated until it becomes a gas and then it is made colder so that it becomes a liquid again
equipment *n* [U] the tools, machines, or other things that you need for a particular job or activity. *Collocations: camping/lifting/safety equipment*. ***piece of equipment***: A computer is the most important piece of equipment you will buy.
experiment *n* [C] a scientific test to find out what happens to someone or something in particular conditions. *e. g.:* Experiments show that many plants tolerate a wide range of light conditions.***laboratory experiments***; ***experiment on/with***: a series of experiments on animals. ***do/carry out/conduct/perform an experiment***: Researchers now need to conduct further experiments.
filtration *n* [U] the process of removing solid parts that are not wanted from a liquid or gas by passing it through a filter
instruction *n* [C] usually *Pl* **1.** a statement or explanation of something that must be done, often given by someone in authority. *e. g.:* A detailed list of instructions was issued on what to do in an emergency. ***instructions to do something*:** The players were given strict instructions not to leave the hotel. ***follow (someone's) instructions:*** I tried to follow her instructions, but I got confused. **1a.** printed information explaining how to use or do something. *e. g.:* The instructions are written in English, German, and Japanese. Step-by-step instructions for assembling the workbench are included. ***follow the instructions:*** Press Enter and follow the on-screen instructions.
laboratory *n* [C] **1.** a building or large room where people do scientific and medical experiments or research: ***our new research laboratory*. 1a.** [only before noun] working in, used in, or done in a laboratory: ***laboratory assistant; laboratory equipment; laboratory test/experiment/study:*** Laboratory tests were conducted on the blood samples
perfom *v* [transitive] to complete an action or activity, especially a complicated one. ***perform an experiment/check/test:*** Two experiments were performed to test this hypothesis.
rule *n* [C] a statement explaining what someone can or cannot do in a particular system, game or situation
tool *n* [C] a piece of equipment, usually one that you hold in your hand, that is designed to do a particular type of work. *Collocations: kitchen/gardening/dental tools; a set of tools*

vessel *n* [C] a tube in people, animals, or plants through which liquid flows. *Collocation: blood vessels*

Module VIII

ancient *adj* **1.**very old. *Collocations: an ancient city/book/tradition*. **2.** relating to people who lived thousands of years ago, and to their way of life. *Collocations:* the ancient Greeks/Britons/Egyptians

biochemical *adj* relating to the chemical substances and processes in living things

biochemistry *n* [U] the study of chemical processes that occur in living things

contemporary *adj* modern, or relating to the present time. *Collocations: contemporary art/music/literature/dance; contemporary urban society*

the environment *n* the natural world, including the land, water, air, plants, and animals, especially considered as something that is affected by human activity. *e. g.:* Industrial development is causing widespread damage to the environment.

essential *adj* **1.** completely necessary. ***essential for:*** Light is absolutely essential for the healthy development of plants. ***essential to***: He had acquired the skills essential to his later success in science. ***it is essential (that):*** It is essential that all equipment is properly maintained. **2**. used about the substances that your body needs in order to stay healthy. *Collocations: essential vitamins/minerals/nutrients*

pollutant *n* [C] a substance that is harmful to the environment. *Collocation: the dumping of chemical pollutants in the world's oceans*

pollute *v* [transitive] to make air, water, or land too dirty and dangerous for people to use in a safe way. *e. g.:* The oil spillage has polluted the harbour. The villagers drank from wells polluted with toxic chemicals.

pollution *n* [C] **1.** the process of damaging the air, water, or land with chemicals or other substances. *Collocation: the pollution of local rivers*. **2. chemicals and other substances that have a harmful effect on air, water or land.** *e. g.:* The new agency is responsible for controlling air pollution

preservation *n* [U] the addition of a chemical substance to food or wood in order to prevent it from decaying. *Collocation: improved methods of food preservation*

prevent *v* [transitive] to stop something from happening. *e. g.:* Regular cleaning may help prevent infection. If necessary, add a little water to prevent sticking. ***prevent something (from) happening:*** Rubber seals are fitted to prevent gas from escaping

process *v* [transitive] to add chemicals or other substances to food, for example to keep it fresh for a long time. *Collocation: processed cheese/meat.* <u>Derived word:</u> **processing:** the food processing industry

radiation *n* [U] **1.** *in chemistry* a form of energy produced during a nuclear reaction that is used for making electrical power but can also kill or harm humans who receive too much of it. *e. g.:* There is a clear link between exposure to radiation and some forms of cancer. Some workers at the power station were exposed to high levels of radiation. **2.** *in physics* a type of energy that is sent out in the form of electromagnetic waves, for example, heat, light, or radio waves. *Collocation: ultraviolet radiation from the sun*

spectroscopy *n* [U] study of radiation and matter, such as X-ray absorption and emission spectroscopy

useful *adj* helpful for doing or achieving something. *e. g.:* Here's some useful information. *Collocation: a useful tool/technique/gadget*

CONTENT

SOURCES:

1. Англо-українсько-російський словник з хімії. У 2 кн. / за ред. М. Ю. Корнілова. – К.: Либідь, 1994. – 283 с.
2. Bozena Velebna. English for chemists. 2009 – 77 p. [Електронний ресурс] – Режим доступу : http://www.upjs.sk/public/media/3499/English-for-Chemists.pdf
3. Буданов С. І., Борисова А. О. Англійська мова: Підручник. – К.: Вища школа, 1995. – 225с.
4. Bogobowicz A., Mrozowska H. Matura. Tests. Longman, 2004. – 207p.
5. Evans V., Dooley J. Upstream. Intermediate, SB, Express Publishing, 2004.–186p.
6. Evans V., O'Sullivan N. Click on 4. SB, Express Publishing, 2002. – 208p.
7. Гмирянська В. О., Левченко Г. Й. Підручник англійської мови. – К.: Вища школа, 1982. – 318с.
8. Гороть Є. І. Англо-український словник / Є. І. Гороть, Л. М. Коцюк, Л. К. Малімон, А. Б. Павлюк. – Вінниця : Нова кн., 2006. – 1698 с.
9. Harmer J. The Practice of English Language Teaching / J. Harmer. – [Third edition, completely revised and updated]. – Longman, 2004. – 370 p.
10. Longman Dictionary of Contemporary English. – [New edition]. – Pearson Education Limited, 2003. – 1950 p.
11. Macmillan English Dictionary for Advanced Learners. – Macmillan, 2007. – 1748p.
12. Medela A., Serafimowicz F. The New Matura Guide, Macmillan Polska, 2001. – 74p.
13. Murphy R. English Grammar in Use. – Cambridge: Cambridge University Press, 1994. – 350 p.
14. Oxford Wordpower Dictionary. – [New 3rd edition]. – Oxford University Press, 2006. – 823 p.
15. Phillips J. Oxford Wordpower Dictionary. Oxford University Press, 2001.- 1068p.
16. Сайфуллин Р. С., Сайфуллин А. Р. Универсальный лексикон: химия, физика и технология. – Universal concise dictionary: chemistry, physics and technology. Справочник. Текст на рус. и англ. языках. – М.: Лотос, 2002. – 448с.
17. Шевцова С. В., Брандукова М. А. Учебник английского языка. – М.: Высшая школа, 1982. – 295с.

Навчальне видання

Кирикилиця Валентина Василівна
Яциняк Ольга Петрівна

English with Dictionaries Use for the Students of Chemistry

Англійська мова з використанням словників для студентів хімічного факультету

Навчальний посібник

Редактор і коректор *Н. П. Шуляр*
Технічний редактор *Н. П. Шуляр*

Підп. до друку 25.06.2009. Формат 60×84 $^{1}/_{16}$. Папір офс. Гарн. Таймс. Друк цифровий. Обсяг 2,79 ум. друк. арк., 2,5 обл.-вид. арк. Наклад 200 пр. Зам. 2218. Волинський національний університет ім. Лесі Українки (43025, м. Луцьк, просп. Волі, 13). Друк – ВНУ ім. Лесі Українки (43025, м. Луцьк, просп. Волі, 13). Свідоцтво Держ. комітету телебачення та радіомовлення України ДК № 3156 від 04.04.2008 р.

English-Ukrainian Dictionary

Chemistry as a Branch of Science

property – властивість

substance – речовина

primary – основний

to define – визначати

molecule –молекула

to abandon – відмовлятися

voltaic – гальванічний

cell - елемент

to equilibrate - урівноважувати

constituent - складовий

alkali – луг

oxide – оксид (окис)

solution – розчин

hypothesis – припущення

hydrogen – водень

synthesis – синтез

simultaneously - одночасно

triumph - тріумф

collaboration - співробітництво

inert – інертний

Periodic Law

recurrence [rɪˈkʌrəns] — *повернення; повторення*

to identify [aɪˈdentɪfaɪ] — *ототожнювати(ся)*

octave [ˈɔktɪv] — *октава*

to devise [dɪˈvaɪz] — *винаходити*

to predict [prɪˈdɪkt] — *провіщати; передрікати*

discrepancy [dɪsˈkrepnsɪ] — *відповідність*

exception [ɪkˈsepʃn] — *виняток*

reliable [rɪˈlaɪəbl] — *надійний*

reliable [rɪˈlaɪəbl] — *надійний*

Water

compound [ˈkɔmpaund] — *суміш*
abundant [əˈbʌndənt] — *багатий (на)*
surface [ˈsə:fɪs] — *поверхня*
on the contrary [ˈkɔntrərɪ] — *навпаки*
hydraulic [haɪˈdrɔ:lɪk] — *гідравлічний*
accumulator [əˌkju:mjuˈleɪtə] — *акумулятор*
tremendous [trɪˈmendəs] — *величезний*
appreciably [əˈpri:ʃəblɪ] — *значно*
resistance [rɪˈzɪstəns] — *опір*
hence [ˈhens] — *отже, з цього часу*
application [ˌæplɪˈkeɪʃn] — *використання*
indispensable [ˌɪndɪsˈpensəbl] — *дуже необхідний*
to purify [ˈpjuərɪfaɪ] — *очищати*
solution [səˈlu:ʃn] — *розчин*
invisible [ɪnˈvɪzəbl] — *невидимий*
to absorb [əbˈsɔ:b] — *вбирати*
evaporation [ɪˌvæpəˈreɪʃn] — *випаровування*
indestructible [ˌɪndɪsˈtrʌktəbl] — *незламний, непорушний*

Chemistry in modern life

ancient [ˈeɪnʃnt] — *античний; стародавній*
Egypt [ˈi:dʒɪpt] — *Єгипет*
medicine [ˈmedsn] — *медицина; ліки*
contemporary [kənˈtemprərɪ] — *сучасний*
impact [ˈɪmpækt] — *вплив*
synthetic [sɪnˈθetɪk] — *синтетичний*
to promote [prəˈmout] — *сприяти*
equipment [ɪˈkwɪpmənt] — *обладнання*
to be aware [əˈwɛə] **of** — *знати*
jointly [ˈdʒɔɪntlɪ] — *спільно*
durability [ˌdjuərəˈbɪlɪtɪ] — *стійк*
thermal [ˈθə:məl] — *тепло*
stability [stəˈbɪlɪtɪ] — *стійк*
shale [ˈʃeɪl] — *глина*
cheap [tʃi:p] — *дешев*
screw [skru:] — *гвинт*
spring [sprɪŋ] — *ресорс*
joint [ˈdʒɔɪnt] — *шарні*
improbable [ɪmˈprɔbəbl] — *неймо*
detergent [dɪˈtə:dʒnt] — *засіб*
fertilizer [ˈfə:tɪlaɪzə] — *добри*
lubricant [ˈlu:brɪkənt] — *масті*
consumer goods [kənˈsju:mə] — *товар*
hereditary [hɪˈredɪtrɪ] — *спадк*
fodder [ˈfɔdə] — *фураж, корм*

Evaporation. Evaporemeter.

evaporation [ɪˌvæpəˈreɪʃn] — *випаровування*
to boil [ˈbɔɪl] — *кипіти*
shallow [ˈʃælou] — *мілкий; поверховий*
to expose [ɪksˈpouz] — *виставляти, виявляти*
humidity [hju:ˈmɪdɪtɪ] — *вогкість*
to overcome [ˌouvəˈkʌm] — *побороти*
cohesion [kouˈhi:ʒn] — *зчеплення, зв'язок*
to escape [ɪsˈkeɪp] — *утекти, врятуватися*
circulation [ˌsə:kjuˈleɪʃn] — *циркуляція, кругообіг*
collision [kəˈlɪʒn] — *зіткнення; колізія*
to accompany [əˈkʌmpənɪ] — *супроводити*
to decrease [di:ˈkri:s] — *зменшувати*
refrigeration [rɪˌfrɪdʒəˈreɪʃn] — *охолоджування, заморожування*

tank [ˈtæŋk] — *резервуар; цистерна, бак*
gauge [ˈgeɪdʒ] — *еталон; критерій*
deliberate [dɪˈlɪbərɪt] — *обдуманий; навмисний*
draining [ˈdreɪnɪŋ] — *дренаж; осушення*
absorbent [əbˈsɔ:bənt] — *поглинаючий*
to seal [si:l] — *герметизувати, щільно закривати*
mouth [ˈmauθ] — *вхід*
to deplete [dɪˈpli:t] — *вичерпувати*
ceramic [sɪˈræmɪk] — *керамічний*
vegetation [ˌvedʒɪˈteɪʃn] — *рослинність*
exposure [ɪksˈpouʒə] — *викриття*
widespread [ˈwaɪdspred] — *широко розповсюджений*

GLOSSARY

arrangement - the manner or way in which things are arranged, a particular way things are organized
bound - tied, connected or attached firmly
column - a vertical row
common - united, widespread, ordinary
to contribute (to) - to give (money, food, etc.) to a common supply, fund, etc.:
to determine - to conclude sth e.g. after observation
entire - whole
equal - as great as, the same as
essential - absolutely necessary
to focus (on) - to concentrate
to foil - to prevent the success of; frustrate
charge - a quantity of electricity (can be either positive or negative)
involve - to include as a necessary circumstance, condition, or consequence; imply; entail, engage, employ
laundry - articles of clothing, linens, etc., that have been or are to be washed
magnitude - size; extent; dimensions, greatness of size or amount
noble gas - name of a group member of gases such as Ne, Ar etc...
nucleus - a fundamental arrangement of atoms, as the benzene ring, that may occur in many compounds by substitution of atoms without a change in structure
plumber - a person who installs and repairs piping, fixtures, appliances etc
property - an essential or distinctive attribute or quality of a thing
question mark - a mark indicating a question
row - a number of persons or things arranged in a line, esp. a straight line
shorthand - a system of rapid handwriting employing symbols to represent words, phrases, and letters, a system, form, or instance of abbreviated or formulaic reference
sign - symbol, indication, any object, action, event, pattern, etc., that conveys a meaning
significance - importance, meaning

similarity - the state of being similar; likeness; resemblance
to skip - to pass over without reading, to jump lightly over
sublevel - a level under another one, a level dependent on another one
to puzzle - to put (someone) at a loss; mystify; confuse; baffle
to pursue - to continue, to follow in order to complete, catch or kill sth, to go on with