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АНГЛИЙСКИЙ ЯЗЫК

Лексико-грамматические тесты для студентов технических вузов химических специальностей

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Пособие предназначено для студентов химических специальностей БГТУ, может быть использовано в качестве учебного пособия для аудиторной и самостоятельной работы, для тренировки в процессе обучения, для само- и взаимоконтроля, а также может быть полезным для лиц, желающих самостоятельно совершенствовать и тестировать свои владения английского языка как на начальном этапе изучения материала, так и на стадии контроля приобретенных знаний.

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ВВЕДЕНИЕ

Данное методическое пособие по английскому языку предназначено для студентов 1 и 2 курсов химических специальностей.

В основу пособия положены оригинальные тексты, подобранные из учебников и монографий по общей и неорганической химии, изданных в Великобритании и США.

В пособие включены аутентичные тексты профессионально ориентированной направленности (The Atomic Theory; Brownian Movement; Diffusion; Stability of the Noble Gases; Covalent Bonding; Carbon; Alcohols; Isomerism; etc.) и задания тестового характера по контролю умений и навыков различных видов речевой деятельности: чтения, говорения, аудирования и письма.

Целью пособия является тестирование приобретённых знаний, навыков и умений в вышеуказанных видах речевой деятельности.

Материал пособия разделен на 11 частей. Предтекстовые упражнения призваны активизировать у студентов навыки узнавания интернациональных слов. Упражнения, следующие за текстом, нацелены на закрепление активной лексики и грамматических явлений, встречающихся в нем, тренировку и совершенствование основных речевых умений, а также их тестирование. В пособие включены также упражнения, позволяющие проверить понимание студентами содержания текста. Некоторые разделы содержат дополнительный текст, связанный по тематике с основным и представленный в виде лексико-грамматического задания. Каждая учебная тема завершается вопросами тестового характера, которые предполагают обстоятельный устный или письменный ответ.

Пособие может быть использовано как для аудиторной работы, так и для самостоятельной работы студентов, бакалавров, а также на факультативных занятиях со студентами старших курсов и может быть рекомендовано аспирантам, готовящимся к сдаче экзамена кандидатского минимума.

UNIT 1

Ex. 1. *Read and memorize the following words.*

Apply, v – применять, употреблять; charge, n – заряд; cluster, n – группа; compose, v – составлять; be concerned with, v – касаться, иметь отношение; liquid, adj – жидкий; mean, n – средство, способ; v – значить; particle, n – частица; primarily, adv – первоначально, сначала; solid, adj – твердый; in turn – по очереди; split up, v – раскалываться, расщепляться; vaporous, adj – парообразный; carry out, v – выполнять, осуществлять; cell, n – клетка; conclude, v – заключать, делать вывод; convection current – конвекционный ток; draught, n – тяга; erratic, adj – неустойчивый; pollen grains – частицы пыльцы; similar, adj – похожий, сходный.

Ex. 2. *Make sure you know the following international words.*

Chemistry, n; substance, n; nature, n; mass, n; the Universe, n; individuality, n; type, n; molecule, n; ion, n; botanist, n; experiment, n; microscope, n; bombardment, n; apparatus, n; illuminate, v; reflect, v; direction, n.

Ex. 3. *Read the text and prove that atoms do exist.*

Can we prove the existence of atoms?

Chemistry is primarily concerned with what things are made of and how various substances react with each other. One of the chemist's most important tasks is to find out as much as possible about the nature of matter. By matter is meant something which occupies space and has mass.

One of the main discoveries of the earlier scientists was that complex substances can be broken down into simpler ones. The substances which cannot be split up into anything simpler by chemical means are called elements. About ninety of these elements occur in nature and all the thousands of different substances in the world and throughout the Universe are made up from these «building bricks».

The tiny particles of which the elements themselves are composed are called atoms.

The idea that all matter is composed of tiny particles is not new. The word atom comes from the Greek word «atomos» which means indivisible.

An atom is the smallest particle, into which an element can be divided and still keep its individuality. There exists another type of a particle called a molecule. A molecule is a group or cluster of atoms. The smallest particles of the vapour are molecules, each consisting of atoms. Another small particle

is called an ion. An ion is an atom or group of atoms which possesses an electric charge.

Ice, liquid water, and steam are all made up of molecules and it is obvious that they are held most closely and tightly together in the ice and least tightly and furthest apart in the steam. Many substances can exist in turn in the solid, liquid, and vapour state and the same reasoning can be applied to these substances. So here is another point to think about: the tiny particles which make up all matter, whether they are atoms, molecules or ions, rarely exist as free particles but are held together in some way.

Ex. 4. *Match the word in column A with its meaning in column B.*

A	B
Matter	is the smallest amount of a chemical substance which can exist by itself without changing or breaking apart.
An element	is referred to any substance or to all substances in general way.
Atom	are electrically charged atoms.
Molecule	is a substance that consists of only one type of atom.
Ions	is the smallest amount of a substance that can take part in a chemical reaction.

Ex. 5. *Find the right continuation of the sentences.*

1. The chemist's most important task is
a) to find complex substances which can be broken into simpler ones.
b) to find «building bricks» which constitute different substances.
c) to find out as much as possible about nature of matter.
d) to find out as much as possible about constituents of matter.
2. The main discovery of the earlier scientists was
a) that substances can be broken down into elements.
b) that every complex substance can be decomposed into simpler ones.
c) that atoms are indivisible.
d) that many substances can exist in the solid, liquid and vapour states.
3. Atoms, molecules, ions
a) are free particles.
b) react with acids.
c) seldom exist as free particles.
d) are components of liquids.
4. Molecules are held most tightly in
a) steam;

b) a substance;
c) liquid water;
d) ice.

Ex. 6. *Put the words in the right order to make sentences.*

1. The, made, different, up, are, substances, bricks, from, building.
2. Atoms, are, the, particles, composed, of, tiny, which, elements, are, the.
3. Molecules, are, in, atoms, held, together, some, ions, and, way.
4. Concerned, various, chemistry, react, is, how, with, substances, each, primarily, other.
5. Vapour, the, particles, molecules, the, are, smallest, of.
6. Electric, possesses, an, is, an, charge, ion, atom, which, an.
7. Substances, exist, many, three, can, states, in.
8. Indivisible, the, atom, word, means.
9. Can, simpler, be, substances, ones, broken, complex, into, down.
10. Mass, something, has, is, matter, which.

Ex. 7. *Fill in the gaps with* ***up, into, with, out, of, to, down.***

1. Each substance is composed ... elements.
2. This theory is concerned ... nature of matter.
3. You can find ... the mass of the substance by weighing it.
4. Molecules can be split ... into atoms.
5. An element is divided ... molecules.
6. This knowledge is widely applied ... different substances.
7. The tiny particles can be broken ... into atoms, molecules or ions.

Ex. 8. *Fill in the blanks with the words given below.*

Liquid, manner, move, more, energy, sufficient, decreases, particles, weak, cooled, solid, liquid, explained, point.

Particles in solid, liquid and vaporous states

The molecules in a liquid are still able to ... about but much more slowly than in a gas. As the liquid is ... this movement becomes slower still until, when the ... solidifies, the molecules become fixed in a three-dimensional pattern. Each molecule still has sufficient ... to vibrate and rotate about a fixed ... but less and less vigorously as the temperature drops and the energy ... .

The reverse process can also be ... by the kinetic theory in a similar ... . As the temperature rises the ... of a solid vibrate more quickly until they have ... energy to break out of the regular three-dimensional arrangement and the ... melts. Heating the liquid makes the molecules more and ...

energetic until they are able to overcome the ... forces holding them together and the ... vaporizes.

Notes: arrangement, n – расположение; solidify, v – твердеть, застывать; sufficient, adj – достаточный; vaporize, v – испаряться; vigorously, adv – сильно, энергично.

Ex. 9. *Read the text and explain what Brownian movement is.*

Brownian movement

An interesting and historic experiment on the movement of particles was first carried out by the botanist Robert Brown in 1827. He made his discovery by accident when he was observing some pollen grains suspended in water under a microscope. He noticed that the pollen was moving about in an erratic manner. As he had not seen any similar movement when examining larger and heavier particles and as he was able to discount the effects of draughts and convection currents, Brown concluded that the movements «belonged to the particles themselves». Brown's observations were later explained by C. Wiener in 1863 as being due to bombardment of the pollen grains by the much smaller but rapidly moving water particles.

This movement of visible particles caused by smaller but invisible ones is known as Brownian movement.

An excellent method of showing Brownian movement is by the «Smoke Cell». A specially constructed piece of apparatus allows smoke particles, illuminated from the side, to be viewed under a microscope. The light is reflected from the smoke particles (very small fragments of carbon) and numerous bright pin points of light can be seen as the smoke particles are pushed in all directions.

Ex. 10. *Match each underlined word in column A with its probable meaning in column B.*

A	B
1. He made his discovery by <u>accident</u>	many
2. This movement of <u>visible</u> particles	are forced to move
3. The light <u>is reflected from</u>	by chance
4. ... <u>numerous</u> bright pin points of light	to be seen
5. ... and he was able <u>to discount</u> the effects of	produced, created
6. This movement <u>caused</u> by smaller	to reject, to ignore

7. A specially constructed piece of apparatus allows particles to be viewed under	seeable, noticeable, recognizable
8. As the smoke particles are pushed in all directions.	is sent back from

Ex. 11. *Replace the underlined word or phrase in the sentence with the words given below.*

To carry out, to notice, to examine, observations, movement, erratic manner, to show.

1. Particles are too small to be seen under even the most powerful light microscope. 2. Greeks performed numerous experiments to find a fundamental particle which could not be divided further. 3. Brown noticed that the pollen grains were moving about in an irregular way. 4. C. Wiener tried to study the behaviour of smoke cells. 5. Make notes of your findings of this experiment. 6. This activity of visible particles caused by invisible ones is known as Brownian motion. 7. It was necessary to demonstrate that particles were too small to be seen by the microscope and that they were moving.

Ex. 12. *Change the following sentences from active to passive.*

1. Robert Brown carried out an interesting experiment on the movement of particles. – An interesting experiment on the movement of particles ... .
2. He suspended some pollen grains in water and observed them under a microscope. – Some pollen grains ... .
3. At first he examined larger and heavier particles. – Larger and heavier particles ... .
4. Brown noticed the pollen grains move in an erratic manner. – The pollen grains ... .
5. Later C. Wiener explained Brown's observations. – Brown's observations ... .
6. The much smaller but rapidly moving water particles were bombarding the pollen grains. – The pollen grains ... .
7. The smoke particles reflect the light. – The light ... .
8. You can see numerous smoke particles under a microscope. – Numerous smoke particles ... .

Ex. 13. *Fill in the blanks with suitable words given below.*

Effect, about, these, change, movement, solids, to, applications, in, particles, gases, energy, direct, with, observed.

The kinetic theory

The energy possessed by particles of ..., liquids and gases is called kinetic ... (energy of motion). So far it isn't said much ... the movement of the ... of a solid. This is because this movement is not apparent, as the particles do not ... their relative positions, although they do rotate and vibrate. Particles in liquids and gases also rotate and vibrate and ... addition move from place ... place. The effects of these translational movements can be ... .

The theory which deals ... the energy due to particle ... is the kinetic theory. It is still called a theory as there is no ... evidence of the movement of ... submicroscopic particles. As the movement of molecules of ... has so much more ... on their properties than in the case of liquids and solids, the ... of the kinetic theory are, in the main, confined to gases.

Ex. 14. *Testing questions*.

1. What was the main discovery in the field of chemistry?
2. What were Brown's observations and how they were explained later?
3. What is the kinetic theory?
4. What happens to molecules when the temperature rises?

UNIT 2

Ex. 1. *Read and memorize the following words.*

Average, adj – средний; collision, n – столкновение; deal with, v – иметь дело; impede, v – препятствовать, мешать, задерживать, затруднять; rebound, v – отскакивать, рикошетить; unceasing, adj – непрерывный, непрекращающийся; application, n – применение; behave, v – вести себя; cause, v – быть причиной, вызывать; considerable, adj – значительный; exert, v – оказывать давление, влиять; predict, v – предсказывать; tyre, n – шина; velocity, n – скорость.

Ex. 2. *Make sure you know the following international words.*

Ammonia, n; concentration, n; diffusion, n; hydrogen, n; chloride, n; isolation, n; nitrogen, n; oxygen, n; produce, v; region, n; second, n; temperature, n; concentrate, v; container, n; bombardment, n; constant, adj; discovery, n.

Ex. 3. *Read the text and explain why it takes molecules much time to reach each other.*

Diffusion

It appears that particles in liquids and gases are continuously on the move. The unceasing movement of one set of particles within another produces uniform mixing of the liquids and gases. This movement of particles from a region of high concentration to one of lower concentrations is known as diffusion.

The molecules of ammonia actually move at an average speed of 550 metres per second and those of hydrogen chloride at 450 metres per second. How is it then, that a gas molecule, moving at a rate of 500 metres per second, takes twenty minutes to move one metre? The answer is, of course, that we are not dealing with one molecule in isolation but with countless millions, all moving in straight lines at enormous speeds and in all possible directions, continually bumping into each other and rebounding. Our ammonia molecule has to fight its way down the tube impeded by other ammonia molecules and also by the oxygen and nitrogen molecules from the air already there. This is rather like having to make your way down the subway of a tube station in the rush hour in the opposite direction to the majority of the crowd of people. No wonder the ammonia molecules and the hydrogen chloride molecules took so much time to reach each other.

This means that the molecules in air at room temperature are traveling on average a quarter of a mile per second. In each second one molecule makes about 10^9 collisions; more than the ticks of a second hand of a watch in thirty years.

Ex. 4. *Replace the underlined word in the sentence with the word given below.*

1. The unceasing movement of one set of particles within another produces uniform mixing of the liquids and gases.
2. The molecules of ammonia actually move at an average speed of 550 metres per second.
3. A gas molecule is moving at a rate of 500 metres per second.
4. We deal with countless millions of molecules.
5. Molecules are all moving in straight lines at enormous speeds.
6. They are bumping into each other and rebounding.
7. This is rather like having to make your way down the subway in the rush hour in the opposite direction.
8. The molecules at room temperature are traveling on average a quarter of a mile per second.
9. In each second one molecule makes more than the tickers of a second hand of a watch in thirty years.

10. No wonder that it takes the ammonia molecules and the hydrogen chloride molecules so much time to reach each other.

Preferably; hurry, haste; be surprised, consistent, in fact, in reality; speed, tempo; mean, standard; click, beat; innumerable, immeasurable; direct; hitting.

Ex. 5. *Put the words in the right order to make sentences.*

1. Diffusion, the, concentration, concentrations, of, from, of, to, of, is, high, particles, one, region, movement, lower, a.
2. Per, the, at, of, a, of, hydrogen, molecules, metres, move, chloride, second, speed, 450.
3. It, metre, twenty, one, take, why, minutes, a, move, gas, to, molecule, does?
4. Not, millions, with, do, isolation, in, countless, deal, but, one, with, we, molecule.
5. Fight, the, the, molecule, down, tube, to, ammonia, has, way, its.
6. Direction, way, like, rush, it, your, hour, in, is, make, the, in, to, opposite, the.
7. Rate, room, air, molecules, a, at, at, the, traveling, temperature, are, high, in.
8. In, collisions, molecule, each, great, one, makes, of, number, a, second.

Ex. 6. *Choose a suitable word or a phrase from the list given below for Russian fragments in brackets.*

1. The particles in liquids and gases are (постоянно) on the move.
2. All molecules are moving in all (возможных направлениях).
3. How is it then, that a gas molecule (необходимо) twenty minutes to move one metre?
4. Countless millions of molecules are (непрерывно сталкиваются и отскакивают друг от друга).
5. The movement of particles from (области) of high concentration to lower ones is known as diffusion.
6. A gas molecule is moving (со скоростью) of 500 metres per second.
7. It is like to make your way down the subway in the rush hour in the (противоположном направлении).
8. In each second one molecule (совершает) innumerable collisions.

Continually bumping into each other and rebounding, makes, continuously, at a rate, takes, opposite direction, possible, region.

Ex. 7. *There is one mistake in each of the following sentences. Correct it.*

1. The molecules of ammonia in reality move on an average speed of 550 metre per second.
2. The answer is that we are not deal with one molecule in isolation.
3. The particles in gases are continuous on the move.
4. The unceased movement of particles produces uniform mixing of liquids and gases.
5. A gas molecule takes it twenty minutes to move one metre.
6. Do the ammonia molecule has to fight its way down the tube?
7. One molecule does a lot of collisions in each second.
8. We shouldn't forget that we always deal to millions of molecules.

Ex. 8. *Use the following sentences in the Passive Voice.*

1. Ammonia molecules impede the tube. – The tube ... .
2. We make our way in the opposite direction. – Our way ... .
3. One molecule makes numerous collisions in a single second. – Numerous collisions ... .
4. The movement of particles produces homogeneous mixture of the liquids and gases. – The homogeneous mixture of the liquids and gases ... .
5. We deal with one molecule in isolation. – One molecule in isolation ... .
6. Some molecules are continually bumping into other molecules and rebounding. – The other molecules ... .

Ex. 9. *Read the text and tell what happens when the speed of molecules increases.*

Ex. 10. *Match the word with its definition.*

1. Container	a) is to fill it with air.
2. Pressure	b) means that you recognize them or know them well because you have seen, heard or experienced them before.
3. Discovery	c) means to hit repeatedly.
4. Familiar	d) is a box or bottle that is used to hold or store things in.
5. To increase	e) is power that is obtained from sources such as electricity, coal or water and that makes machines work or provides heat.
6. To pound	f) is the finding of an object or fact that nobody knew about.
7. To bear out	g) is the force that a quantity of gas or liquid has on a surface that it touches.
8. To blow up	h) is warmth or the quality of being hot.

9. Heat	i) means to become larger in amount.
10. Energy	j) is to support something, e.g. idea, result.

Ex. 11. *Match a line in column A with a line in column B and put a new word combination into each gap in the sentence.*

A	B
blown-up	conditions
early	speed
kinetic	results
certain	tyres
average	difference
concentrated	energy
considerable	gas
experimental	days

1. Change of temperature makes a ... to the velocity of the molecules.
2. Since ... gases are known to exert pressure.
3. Under ... gases behave in a predicted way.
4. Fully ... may burst.
5. There is the ... inside the balloon.
6. These predictions can be borne out by ... .
7. With the rise in temperature increases the ... of the molecules.
8. The ... is widely used in predictions of gas behaviour.

Ex. 12. *Use the following sentences in the Passive Voice.*

1. In 1782 J.A. Charles discovered the law telling how much the pressure increases with rise in temperature. – The law telling how much the pressure increases with rise in temperature ... .
2. Change of temperature makes a considerable difference to the velocity of the molecules. – A considerable difference to the velocity of the molecules ... .
3. Air molecules pounds the balloon on the outside. – The balloon ... .
4. The gas molecules are constantly bombarding the tyre on the inside. – The tyre ... .
5. It is possible to predict the behaviour of gases under certain conditions. – The behaviour of gases ... .
6. Experimental results bear out the predictions. – The predictions ... .
7. The molecules hit the balloon greater on the inside. – The balloon ... .
8. We can easily understand this discovery. – This discovery ... .

Ex. 13. *Put all possible questions to the sentences.*

1. Now heat is a form of energy.
2. The number of collisions with the walls of the container increases with rise in speed of the molecules.
3. The law bears the name of J.A. Charles.
4. It is the constant bombardment of the gas molecules that causes the pressure.
5. The first balloon made the fact familiar to everybody.
6. In fact this theory can easily be understood from the discovery of what could happen to a balloon which was too near the fire.

Ex. 14. *Fill in the blanks with the suitable words given below.*

Move, increases, of, quickly, doubled, gas, as, will, down, first, movable, between, be, more, fixed, to, increases, by.

Imagine a cylindrical vessel with a ... piston in the top containing a ... mass of gas. If the piston is pushed ... so that the volume ... the gas is halved the molecules of gas will ... more tightly packed and ... make twice as many collisions ... before, i.e. the pressure will be ... . Thus as the volume decreases, the pressure ... and the converse is also true; as the volume ... the pressure decreases. This fact was ... determined experimentally in 1662 ... Robert Boyle.

According to the kinetic theory, ... molecules move more ... as the temperature is increased. If the temperature of a gas is gradually lowered the molecules will ... more and more slowly, until eventually the weak attractive forces which exist ... all molecules become effective and the molecules are pulled much ... closely together. The gas condenses ... a liquid.

Notes: converse, n – обратное положение, утверждение; gradually, adv – постепенно; determine, v – определять, устанавливать; halve, v – уменьшать, сокращать наполовину; piston, n – поршень; push down, v – двигать(ся) вниз; tightly, adv – плотно; vessel, n – сосуд.

Ex. 15. *Testing questions.*

1. What is the movement of particles from a region of high concentration to one of the lower concentrations?
2. Why do molecules move so slowly at a high average speed?
3. What is translational movement?
4. When can the change in velocity of the molecules be observed?

UNIT 3

Ex. 1. *Read and memorize the following words:*

Approximately, adv – приблизительно; revive, v – возвращать к жизни, восстанавливать; outcome, n – результат; determine, v – устанавливать, определять; indestructible, adj – неразрушаемый; bulk, n – громада, огромное количество; ratio, n – отношение, пропорция; concise, adj – сжатый, краткий; shorthand, n – сокращение; supersede, v – сменять; weigh, v – взвешивать; relative, adj – относительный; measure, v – измерять; available, adj – имеющийся в наличии, доступный; nucleus, n – ядро; speed, n – скорость.

Ex. 2. *Guess the meaning of the following international words. Do not use the dictionary.*

Identical, adj; combination, n; structure, v; proton, n; neutron, n; electron, n; educate, v; constant, adj; multiple, adj; proportion, n; stimulate, v; sulphur, n; iron sulphide, n; represent, v; realize, v; analyze, v; accelerate, v.

Ex. 3. *Look through all the parts of the text and pick up the names of the chemical elements. Write down the name and its symbol.*

Ex. 4. *Using the subtitles of the parts of the text and your background knowledge try to predict the contents of the text.*

Ex. 5. *Read the text attentively. Be ready to express the main idea of each part of the text.*

The atomic theory. John Dalton

John Dalton was born in the small village of Eaglesfield in Cumbria in 1766. His parents were poor and he was educated at the village school, but he showed early promise of brilliance in science and mathematics and in his early twenties he obtained a teaching post at Manchester College, where he spent the rest of his life doing scientific research.

In 1808 he published his Atomic Theory which was the outcome of many years of determined work and brilliant thinking. The main points of his theory were:

1. The elements are made up of tiny particles of matter called atoms.
2. Atoms are indivisible and indestructible.
3. Atoms of any element are identical and have the same mass.
4. Atoms of different elements have different masses.
5. When elements combine to form compounds, combination takes place between small whole numbers of atoms to form what Dalton called «compound atoms».

The two important new ideas in Dalton's theory of atoms were that each atom had its own individual mass and that chemical combination took place

between atoms. This theory explained the laws of Constant and Multiple Proportions which had already been formulated from experimental work on chemical compounds, and stimulated research on the masses of atoms and how they combine, for the next fifty years.

From his statement that when compounds were formed, small whole numbers of atoms combined, Dalton worked out that a reaction between a small number of atoms could be taken as representing the whole bulk of the reacting substances.

Dalton's next step was to write symbols for the atoms so that a reaction could be represented by a concise kind of chemical shorthand. Dalton invented a set of symbols. They were never generally used but were superseded by the system suggested by J.J. Berzelius in which an atom of an element is represented by the initial letter of the element, e.g. H stands for one atom of hydrogen etc. Where several elements have the same initial letter, a second letter is added, Co is the symbol for cobalt. As it was usual in the time of Berzelius (1811) to use Latin names for the elements, copper (cuprum) is represented by Cu, and iron (ferrum) by Fe.

Dalton's Atomic Theory proved to be a tremendous stimulus to the scientists of his time and produced a new interest in chemistry. Dalton realized that atoms were far too small to be weighed or measured by any means then known, but he was able to work out the relative masses of some of the atoms, taking the mass of hydrogen as the standard. Other scientists continued this work and gradually tables of atomic masses were built up. In 1865 a method was discovered for measuring, with some degree of accuracy, the true masses of individual atoms, and by the end of the century, the size and mass of the atoms of many of the elements were known.

An atom is now thought to consist of a very small and extremely dense region, the nucleus, surrounded by a cloud of negative electric charge. The main subatomic particles are the following. The proton is found in the nucleus of every atom and carries a unit positive charge. It has a mass approximately the same as that of the hydrogen atom, i.e. one atomic mass unit. The neutron is uncharged and has about the same mass as the proton. It forms part of the nucleus of all atoms except hydrogen. The electron carries unit negative charge and has a mass only about 1/1800 of the proton. Electrons can be considered to orbit the nucleus at great speeds. The number of protons present in the nucleus of an atom is a fundamental characteristic of the element and is known as the atomic number. As the atom is electrically neutral the number of electrons is always the same as the number of protons.

Ex. 6. *Look through the texts once again and choose the right continuation of the following sentences.*

John Dalton was born	to consist of a very small and extremely dense region, the nucleus, surrounded by a cloud of negative electric charge.
The two important new ideas in Dalton's theory of atoms were	and gradually tables of atomic masses were built up.
Dalton invented	a set of symbols.
Dalton's atomic theory proved to be a tremendous stimulus to the scientists of his time	in the small village of Eaglesfield in Cumbria in 1766.
Other scientists continued this work	that each atom had its own individual mass and that chemical combination took place between atoms.
An atom is now thought	and produced a new interest in chemistry.

Ex. 7. *Read the texts about Dalton's atomic theory and its influence on chemistry. Put all the sentences in the chronological order. Write the numbers in the correct boxes.*

Dalton's next step was to write symbols for the atoms so that reaction could be represented by a concise kind of chemical shorthand.

Dalton realized that atoms were far too small to be weighed or measured by any means then known, but he was able to work out the relative masses of some of the atoms, taking the mass of hydrogen as the standard.

In 1865 a method was discovered for measuring, with some degree of accuracy, the true masses of individual atoms, and by the end of the century, the size and mass of many of the elements were known.

The two important new ideas in Dalton's theory of atoms were that each atom has its own individual mass and that chemical combination took place between atoms.

In 1808 John Dalton published his atomic theory which was the outcome of many years of determined work and brilliant thinking.

Ex. 8. *Express your agreement or disagreement orally or write down True (T) or False (F) for each of the sentence below according to the information given. If the information is not given put a question mark (?).*

1. Dalton's theory explained the Laws of Constant and Multiple Proportions.
2. Dalton invented a set of symbols, which differed from the system suggested by J.J. Berzelius.
3. According to Dalton's atomic theory, atoms of any element are different and have different mass.
4. The main elements of any atom are: nucleus, proton, neutron, electron.
5. The electron carries unit positive charge.
6. As the atom is electrically neutral the number of electrons is different from that of protons.
7. The number of protons present in the nucleus of an atom is known as atomic number.

Ex. 9. *Read the following definitions. Fill in the blanks with the words:*

Atom, proton, neutron, electron, nucleus, neutral, element, atomic number.

… are the building bricks with which everything is made. … are small particles; 100 million placed end-to-end would measure 1 cm. They are made up of even smaller – sub-atomic particles: … , … , … . These particles are found in the centre of the … – the … . The particles move round the … .

… as a whole is electrically … although … and … carry electrical charges. … which lose or gain … are called ions. All … of the same … contain the same number of … and have the same … … , but atoms of the same … can contain different number of … . An … can be thought as the smallest part of an element that can take part in a chemical reaction.

Ex. 10. *Make a summary of every short text. Retell them. Choose the sentences which convey the main ideas of the text. While speaking use the following expressions:*

The data are given about … .
It is shown that … .
… is dealt with … .
… is formulated … .
Attention is drawn to … .
… is described in short … .
It is known that … .

Attempts are made to analyze … .

Ex. 11. *Testing questions.*

1. What are the main points of Dalton's Atomic theory?
2. What phenomena does Dalton's Atomic theory explain?
3. What practical consequences follow the Atomic theory?
4. What is Dalton's influence on chemistry in the nineteenth century?
5. What is the present day knowledge of atomic structure?

UNIT 4

Ex. 1. *Read and memorize the following words:*

Quantity, n – количество; level (shell), n – уровень (оболочка); reduce, v – уменьшать; interrepulsive, adj – взаимоотталкивающий; decay, n – разложение; occur, v – встречаться, происходить; negligible, adj – незначительный; cobalt, n – кобальт; fluorine, n – фтор; iodine, n – йод; manganese, n – марганец; artificially, adv – искусственно; obviously, adv – очевидно; weigh, v – взвешивать; arbitrarily, adv – произвольно, условно; unsuitable, adj – неподходящий, непригодный; lead (led, led), v – приводить, вести; clarify, v – делать(ся) ясным, прозрачным; assign, v – назначать, определять; sample, n – образец.

Ex. 2. *Guess the meaning of the following international words without any help of the dictionary:*

Hydrogen, n; helium, n; lithium, n; beryllium, n; neon, n; stability, n; disintegrate, v; isotope, n; molecular mass; formula mass.

Ex. 3. *Look through the text and pick up the chemical elements mentioned in the text. Could you write a scheme of the arrangement of electrons on their shells? Find these elements in the Periodic Table and characterize them. What are: the atomic number, the atomic mass, the number of electrons, protons neutrons in the nucleus?*

Ex. 4. *Pick up the definitions of the following concepts: isotopes, atomic mass, an average atom, molecular mass, formula mass. Do they convey the same meaning as in your chemistry textbooks?*

Ex. 5. *Read the texts. Be ready to express the main idea of each part of the text.*

The arrangement of the electrons

The varying quantities of energy the electrons possess are known and can be arranged in sets of energy levels. Thus the energy level (or shell) nearest to the nucleus can contain a maximum of two electrons, the next shell up to

eight, and in the next energy level there can be as many as eighteen electrons. The hydrogen atom, which has the lowest atomic number, has one electron in the lowest energy level; helium has two. The lithium atom has three electrons, two (the maximum number) in the first energy level and one in the second. Beryllium, atomic number four, has two electrons in the first shell and two in the second. This pattern continues until with neon, atomic number ten, the second energy level has the full complement of eight electrons. With the sodium atom, atomic number eleven, a new shell is started and this atom has two electrons in the first energy level, eight in the second and one in the third.

As atoms are electrically neutral the number of protons and the number of electrons in any given atom must be the same. The neutrons play an important part in the stability of the nucleus as they reduce the inter-repulsive effects of the protons. The difference between atoms of one element and those of another is due to the differing numbers of electrons, protons, and neutrons they contain. An atom is therefore characterized by the number electrons, protons and neutrons it contains.

Atoms of the same element which contain different numbers of neutrons are called isotopes. Isotopes always have the same chemical properties. This is because they have the same number of electrons and it is the number of electrons present in the outer shell of an atom that determines its chemical properties. The only effect of the extra neutrons is to increase the mass of the atom, and this has a negligible effect on the chemical properties. Most elements occur as isotopic mixtures and some elements have a large number of isotopes .

Atomic mass. Dalton introduced the idea that atoms of the same element all had the same mass and differed in mass from atoms of other elements. It was decided to fix a scale for comparing the mass of atoms. Hydrogen was the lightest element and the mass of its atom was arbitrarily fixed as one unit (i.e. H = 1). The masses of other atoms were then found by comparing their masses with that of a hydrogen atom.

The mass of any atom compared with that of a hydrogen atom was called the atomic mass. Thus the atomic mass of an oxygen atom is sixteen, the atomic mass of nitrogen is fourteen.

As work on determining atomic masses progressed it was found that hydrogen was an unsuitable standard as it did not combine with many elements. Physicists then redefined their standard. The standard for comparison was again changed.

The atomic mass of an element is now defined as, the mass of an «average atom» of the element is 12. An «average atom» of an element is

the weighted mean of the masses of all the atoms present in the normal isotopic mixture of the element.

Molecular mass is found by adding together the atomic masses of all the atoms present in a molecule. For example, a water molecule (H_2O) would have a molecular mass of 1 + 1 + 16 = 18, using the approximate atomic masses of hydrogen and oxygen. Molecular mass is defined as the mass of an «average molecule» of an element or compound relative to that of the mass of an atom which is 12. If the compound is made up of ions we should not really talk about its «molecular mass», and another term has been introduced to overcome this difficulty. This is the formula mass which is defined as the combined mass of all the atoms making up the formula of a compound compared with the mass of an atom.

Ex. 6. *Complete the following sentences using the ideas from the text:*

1. As atoms are electrically neutral … .
2. The difference between atoms of one element and those of another is … .
3. Isotopes are … .
4. The atomic mass is … .
5. An average atom of an element is … .
6. Molecular mass is found … .
7. The formula mass is defined as … .

Ex. 7. *Express your agreement or disagreement with the information given in the following sentences. Use the suggested parentheses:*

I think it is true … .	I think it is false … .
I am sure it is correct … .	It is partially true … .
I absolutely agree with that … .	I disagree with that … .
It is right … .	It is wrong … .

1. The energy level (or shell) nearest to the nucleus can contain a maximum of two electrons, in the next energy level there can be as many as eighteen electrons.
2. The neutrons play an important part in the stability of the nucleus as they reduce the inter-repulsive effects of the protons.
3. An atom is characterized by the number of nuclei it contains.
4. Atom of the same element which contain the same number of neutrons are called isotopes.
5. Isotopes always have different chemical properties.
6. Most elements occur as isotopic mixtures and some elements have a large number of isotopes.
7. At first the mass of any atom compared with that of a hydrogen atom was called the atomic mass.

8. The standard for comparison to determine atomic masses as – 12.

Ex. 8. *Put the words in the right order to make a statement or a question.*

1. The energy level, can, a maximum, contain, of two electrons, nearest to the nucleus.
2. In the lowest energy level, has, the hydrogen atom, one electron.
3. Of the nucleus, in the stability, the neutrons, an important part, play.
4. Atoms, isotopes, are called, of the same element, different numbers, which contain, of neutrons.
5. Chemical, have, properties, the same, isotopes, always.
6. Molecular mass, the atomic masses, present in a molecule, is found, of all the atoms, by adding together.

Ex. 9. *Read the following definitions of «Atomic Mass» and «Atomic Number». Fill in the blanks with the following words:*

atom(s), protons, electrons, nucleus.

Atomic Mass: … have different masses if they contain different number of … , … and … . Because these particles are so small the mass of an … is tiny. It is not usual to refer to the mass of an … in grams or kilograms but we normally compare the mass of one atom with a standard mass. This is called the relative atomic mass (A_r).

Atomic number: This is the number of … in the … of an atom. All … of the same element have the same atomic number, e.g. sodium … contain 11 … . In a neutral atom the number of … equals the atomic number.

Ex. 10. *Reproduce the main idea of the text, make use of a plan if necessary.*

Ex. 11. *Testing questions.*

1. What are the peculiarities of electrons' arrangement?
2. What are isotopes?
3. What is atomic mass of an element?
4. What is molecular mass?
5. What is formula mass?

UNIT 5

Ex. 1. *Read and memorize the following words:*

Stability, n – устойчивость, стабильность, прочность; be linked, v – быть связанным; quota, n – доля, часть, квота; achieve, v – достигать; join, v – присоединять(ся), соединять(ся); bonding, n –

связь, соединение; lose, v – терять; in order to – для того чтобы; attain, v – достигать; unaltered – неизменный; derivative, n – производное (соединение); equal, adj – равный; gain, v – получать, приобретать; overall, adj – полный, общий; surplus, adj – избыточный, добавочный; superscript, n – верхний индекс, надстрочный знак; possess, v – обладать; whereas – тогда как; poisonous, adj – ядовитый; molten – расплавленный; aqueous solution – водный раствор; conduct, v – проводить; electric current – электрический ток; share, v – делить, совместно использовать; outer shell – внешняя оболочка; entirely, adv – полностью, целиком; solvent, n – растворитель; remain, v – оставаться; intact, adj – нетронутый, целый; exhibit, v – показывать, проявлять, обнаруживать.

Ex. 2. *Read and translate the following international words without a dictionary, pay attention to the part of speech.*

Configuration, n; tendency, n; chlorine, n; ionic, adj; mixture, n; giant, adj; electrostatic, adj; attraction, n; crystalline, adj; separate, v; benzene, n; discrete, adj; intramolecular, adj; intermolecular, adj; directional, adj; silicon, n.

Ex. 3. *Read the text and put in the English words and phrases instead of the Russian ones. The English equivalents are given under the text.*

Stability of the Noble gases

The noble gases are very stable (элементы), showing very little chemical (активность). This (стабильность) must obviously be linked with their electronic (структурами) and the fact that each (оболочка) has its full quota of electrons.

In the case of atoms, the most stable states are those in which the (атом) has the electronic configuration of a (инертного газа). Thus atoms of all the other elements could become more stable if they could (достигнуть) this configuration. How can the less stable atoms attain these stable electronic structures? Free atoms are (редко) found in nature because of their (тенденции) to become more stable.

All other atoms join together in an (попытке) to become more stable, even if in some cases (это означает) that they have to join to another atom of the same kind. For example chlorine (существует) as chlorine molecules (Cl_2) and not just as single chlorine atoms (Cl).

Noble gas, elements, structures, exists, atom, achieve, rarely, shell, tendency, it means, activity, effort, stability.

Ex. 4. *Let us consider an atom of sodium and an atom of chlorine. Draw their electronic structures in your notebook, and answer the following questions:*

a) Which is the nearest noble gas to sodium? Draw its electronic structure in your notebook.

b) How does its electronic configuration differ from that of a sodium atom?

c) What then must an atom of sodium do to attain this structure?

Answer these same three questions with respect to the chlorine atom instead of the sodium atom.

Ex. 5. *Read and translate the text, be ready to explain the meaning of the term «Ionic Bonding».*

Ionic Bonding

It is known that the sodium atom must lose one electron in order to attain the electronic configuration of a neon atom. And when a sodium atom loses an electron, the resultant structure is a «mixture». The electronic structure is that of a neon atom, but the nucleus is that of a sodium atom. As the number of protons is unaltered, the atomic number of the resultant structure is still eleven so it is a derivative of sodium. (The atomic number = the number of protons and is only equal to the number of electrons when we consider a «neutral atom».) The resulting structure is called a sodium ion.

An ion is formed when an atom or radical has either lost or gained one or more electrons. In this case the sodium atom has lost one electron and formed a sodium ion. Is there an equal number of electrons and protons in the ion? Is the structure still neutral? As the number of electrons has decreased by one, the ion produced has eleven protons (each carrying a unit positive charge) and ten electrons (each carrying a unit negative charge), so there is an overall surplus charge of one positive unit. This is usually written as a superscript after the symbol for the element, i.e. Na^+.

The number of electrons possessed by any atom or ion determines its chemical properties. Thus the sodium ion, which has ten electrons arranged in the neon configuration, will be unreactive and will therefore show different chemical properties from an atom of sodium which has eleven electrons. For example, people eat sodium ions (Na^+) which are present in common salt (Na^+ Q~), but it is possible to imagine what would happen if someone tries to eat the very reactive sodium metal (Na).

Now consider the chlorine atom. It must gain one electron in order to attain the electronic configuration of an argon atom.

By reasoning similar to that used in the case of sodium the chloride ion (Cl^-) has been formed. Again the difference in electronic structure between a chlorine atom and a chloride ion results in the two having completely different chemical properties. The chloride ions (Cl^-) present, for example, in common salt ($Na^+ Cl^-$) are unreactive and quite harmless, whereas chlorine gas (Cl_2) is reactive and poisonous.

Ex. 6. *Read the text «Ionic Bonding» right through and match each word in column A with its probable meaning in column B. Be careful, there are some extra meanings in column B.*

A	B
configuration	unchanged, without modification
resultant structure	the smallest particle of the matter
mixture	the charge beyond the needed one
nucleus	to reach the goal
unaltered	harmful, may cause the death
surplus charge	an arrangement of elements
superscript	without meaning, senseless
to attain	the part of an atom where the mass is concentrated
harmless	a combination of two or more substances
poisonous	the structure attained as a result of some changes in it
	something written after the symbol
	not harmful

Ex. 7. *Read the statements given below and if you think the statement is true, agree to it saying «That's right». If you think it is not true, disagree saying «I'm afraid», «That's wrong» and make the necessary corrections.*

1. The sodium atom must lose two electrons in order to attain the electronic configuration of a neon atom. 2. When a sodium atom loses an electron, the resultant structure is a «mixture». 3. The atomic number is the number of electrons. 4. An ion is formed when an atom or radical has either lost or gained one or more electrons. 5. The number of electrons possessed by any atom or ion is determined by its chemical properties. 6. The sodium ion has nine electrons arranged in the neon configuration. 7. The chlorine atom must gain one electron in order to attain the electronic configuration of an argon atom. 8. There is some difference in electronic

structure between a chlorine atom and a chloride ion but they have the same chemical properties.

Ex. 8. *Read a short text about the properties of ionic compounds. There is one grammar mistake in each sentence. Find and correct it.*

Properties of ionic compounds

1. Ionic compounds composes of two or more different kinds of oppositely charged ions.
2. These oppositely charged ions attract one another and are formed with a large three-dimensional lattice, called a giant structure, which is held together by the inter-ionic electrostatic attraction. Thus ionic compounds are usually crystallinely solids.
3. Because of the great attraction between the ions, a large amount of energy has to be using to separate them. It is not until the "particles" are separately that a solid can melt and eventually boil. Thus ionic compounds usually has high melting and boiling points.
4. Ionic compounds when molten, or in aqueous solution, are conducted an electric current.
5. Ionic compounds are usually solubles in water, but do not dissolve in organic solvents such as ethanol or benzene.

Ex. 9. *Read and translate the text. Explain the difference between ionic and covalent bonding.*

Covalent Bonding

There are a great many substances which do not have the properties of ionic compounds. They are non-crystalline and have low boiling points; many are actually gases at room temperature. How are the atoms of these substances joined together?

There are groups of atoms, and it is known that gases such as chlorine, oxygen, and nitrogen consist not of single atoms but of pairs of atoms joined together. How can two chlorine atoms, each of which needs to gain an electron to achieve the stable configuration of electrons, become bonded together to form a molecule? The answer is that the two chlorine atoms share electrons. Only the electrons in the outer shell of an atom are used to form bonds by sharing electrons.

Each chlorine atom shares one of its electrons with the other one, so that a pair of electrons is shared between the two atoms. Each chlorine atom now has eight electrons in its outer shell, six of which belong entirely to that

atom, the other two being shared. This shared pair of electrons bonds the two atoms together and the bond is called a covalent bond.

When two or more atoms are joined together by means of covalent bonds a molecule is formed. In this case the covalent bond is specifically formed between two chlorine atoms, thus chlorine will exist as discrete molecules (Cl_2). These molecules have only a very weak attraction for each other and so do not form a lattice structure as in compounds where the bonding is ionic. Thus in covalent substances the intermolecular forces (i.e. the bonds between the molecules) are weak, but the intramolecular forces (i.e. the bonds in the molecule itself) are strong.

Ex. 10. *Read the text «Covalent Bonding» and choose the correct question to the following statements.*

1. There are a great many substances which do not have the properties of ionic compounds.
A. Where can be found the properties of ionic compounds?
B. How many substances are there which do not have the properties of ionic compounds?
C. When do many substances have the properties of ionic compounds?
2. Such gases as chlorine consist of pairs of atoms joined together.
A. Why do such gases as chlorine form pairs of atoms?
B. How do such gases as chlorine form pairs of atoms?
C. Do such gases as chlorine consist of pairs of atoms joined together?
3. Two chlorine atoms need to gain an electron to achieve the stable configuration of electrons.
A. How many chlorine atoms are needed?
B. How is the stable configuration of electrons gained?
C. What do two chlorine atoms need to achieve the stable configuration of electrons?
4. Only the electrons in the outer shell of an atom are used to form bonds by sharing electrons.
A. What kind of electrons are used to form bonds by sharing electrons?
B. What electrons are found in the outer shell of an atom?
C. What can be done by sharing electrons?
5. A pair of electrons is shared between the two atoms.
A. Why is a pair of electrons shared between the two atoms?
B. Is a pair of or three electrons shared between the two atoms?
C. Where can you find a pair of electrons shared between the two atoms?
6. This shared pair of electrons bonds the two atoms together.
A. Why does this shared pair of electrons bond the two atoms together?

B. This shared pair of electrons bonds the two atoms together, doesn't it?
C. In what way does this shared pair of electrons bond the two atoms together?
7. When two or more atoms are joined together by means of covalent bonds a molecule is formed.
A. When is a molecule formed?
B. What molecules are formed by means of covalent bonds?
C. What is the purpose of forming a molecule?
8. These molecules have only a very weak attraction for each other.
A. When do these molecules have only a very weak attraction for each other?
B. How many molecules have only a very weak attraction for each other?
C. What kind of attraction for each other do these molecules have?

Ex. 11. *Complete the following sentences using the ideas from the text.*

1. Non-crystalline substances have … .
2. Chlorine, oxygen, and nitrogen are not single atoms but consist of ... .
3. Each chlorine atom needs to gain … .
4. Two chlorine atoms … .
5. Each chlorine atom has eight … .
6. Two or more atoms may be joined together by … .
7. These molecules do not form a lattice structure as in … .
8. Thus in covalent substances … .

Ex. 12. *Complete the sentences using a suitable derivative of the word given in brackets.*

Properties of Covalent Compounds

1. Covalent compounds consist of two or more (to differ) atoms linked together by covalent bonds to form individual molecules.
2. The molecules formed have only a very weak (to attract) for each other and so can (easy) be separated, thus (covalence) compounds are usually gases or liquids with low (to melt) and boiling points.
3. Covalent compounds are often (insolubility) in water, but dissolve more readily in organic solvents.
4. Covalent compounds do not conduct (electric).
5. The (bonding) are directional.

Ex. 13. *Read and translate the following text.*

Predicting if elements will form ionic or covalent bonds

In general, covalent compounds are formed when both atoms need to gain electrons. You should compare this with ionic compounds which are formed when one atom needs to gain electrons and the other to lose electrons. Thus atoms of elements which need to lose electrons form ionic bonds, whereas those which need to gain electrons either completely or by sharing can form both ionic and covalent bonds.

As it is well known, an atom achieves a greater stability by losing or gaining electrons in order to attain the electronic structure of the nearest noble gas. Atoms with one, two or three electrons in their outer shell will tend to lose electrons when they form compounds, whereas atoms with five, six or seven electrons in their outer shell will tend to gain electrons. An atom can lose or gain one electron fairly readily, but it is more difficult to lose or gain two electrons and quite difficult to lose or gain three electrons.

Atoms which have four electrons in their outer shells would be expected to either gain or lose four electrons. However, it is virtually impossible for any atom to completely gain or lose four electrons, and the only way in which such atoms can achieve the noble gas configuration is by sharing four more electrons, i.e. by forming four covalent bonds. Thus the compounds of carbon and silicon are always covalent.

Ex. 14. *Find the right continuation of the given sentences.*

1. Covalent compounds are formed when	a) electron fairly readily.
2. Thus atoms of elements which need to	b) and silicon are always covalent.
3. An atom achieves a greater stability by losing or gaining electrons	c) their outer shell will tend to gain electrons.
4. Atoms with 1, 2 or 3 electrons in	d) their outer shells would be expected to either gain or lose four electrons.
5. Atoms with 5, 6 or 7 electrons in	e) in order to attain the electronic structure of the nearest noble gas.
6. An atom can lose or gain one	f) lose electrons form ionic bonds.
7. Atoms which have 4 electrons in	g) their outer shell will tend to lose electrons.
8. Thus the compounds of carbon	h) both atoms need to gain electrons.

Ex. 15. *Which of the following elements will gain, and which will lose, electrons on compound formation: oxygen, aluminium, magnesium, phosphorus, sulphur, chlorine, lithium? Consequently, which of these elements can form both ionic and covalent compounds and which can form ionic compounds only?*

Ex. 16. *Read the text «Valency», try to understand it and insert the necessary prepositions and particles. Choose among of (5), in (1), by (1), to (3).*

Valency

The valency … an element may be defined as the number … electrons an atom … that element must lose or gain, either completely or … sharing, … order … attain a noble gas configuration. Many elements have more than one valency.

Thus as a sodium atom must lose one electron … attain a noble gas configuration it has a valency … one. Similarly a chlorine atom must gain one electron … attain a noble gas configuration, therefore it also has a valency … one.

Ex. 17. *Read the text «Valency» and answer the following question: what would the valencies of atoms of the following elements be: phosphorus, sulphur, calcium, magnesium, nitrogen, oxygen?*

Ex. 18. *Read the following sentences and put them in the correct order so as to make the text «Radicals».*

1. The important exception is the ammonium radical NH_4, which behaves as though it were the metallic part of a compound and forms a positive ion NH_4^+.
2. For example, the compounds sodium carbonate, Na_2CO_3, calcium carbonate, $CaCO_3$, and magnesium carbonate, $MgCO_3$, all contain the carbonate radical, CO_3. The valency of this radical is always two.
3. A radical is a group of atoms which usually forms the non-metallic part of a compound and which can remain intact through many different chemical reactions, behaving in many ways like a single atom and always exhibiting a constant valency.
4. Radicals have no independent existence. You will never find a bottle of 'carbonate' or 'sulphate' on the shelves of a chemistry laboratory, but they can exist as free ions in aqueous solution.
5. Most radicals form the non-metallic part of a compound so their ions are negatively charged.

Ex. 19. *Testing questions.*

1. What are the most stable states of atoms?
2. What determines the chemical properties of any atom or ion?

3. What can you say about melting and boiling points of ionic compounds? Are they high or low?
4. What are the properties of ionic compounds?
5. What is the difference between the ionic and covalent bonding?
6. What are the properties of covalent compounds?
7. Why do the atoms tend to attain the electronic structure of the nearest noble gas?
8. How is it possible to define valency?
9. How can you define a radical?

UNIT 6

Ex. 1. *Read and memorize the following words:*

Conjure up, v – вызывать в воображении; vague, adj – неясный, смутный; fuming, adj – дымящий; unless, prep – за исключением; stomach, n – желудок; digestion, n – переваривание пищи; vinegar, n – уксус; handle, v – обращаться с; dilute, adj – разбавленный; respectively, adv – соответственно; frequently, adv – часто; rhubarb, n – ревень; sorrel, n – щавель; spray out, v – разбрызгивать, брызгать во все стороны; unfamiliar, adj – неизвестный; litmus, n – лакмус; lichen, n – ягель, лишайник; base, n – основание; alkali, n – щелочь; destroy, v – разрушать, нейтрализовать; relationship, n – отношение, взаимосвязь, зависимость; guide, n – ориентир, подсказка; vehicle, n – транспортное средство; strength, n – концентрация, сила, прочность; correspond, v – соответствовать; degree, n – степень; excess, adj – избыточный; formula, n – формула, формулировка.

Ex. 2. *Read and translate the following words without a dictionary.*

Corrosive, adj; hydrochloric acid; be secreted, v; sulphuric, adj; nitric acid, be referred to, v; citric acid, tartaric acid, oxalic acid, be classified, v; opposite, n; automatically, adv; alkalinity, n; acidity, n; neutralization, n; inorganic, adj; chemicals, n; replacing.

Ex. 3. *Read and translate the text «Common Laboratory Acids». Find in the text and write down the words which may be used with the word «acid» (for example the names of the acids or adjectives describing them).*

Common laboratory acids

Most people have heard of acids, and to a beginner the term may conjure up vague impressions of highly dangerous, corrosive, and fuming liquids. In actual fact most of the acids are not particularly dangerous if

used carefully unless concentrated (one of them, hydrochloric acid, is secreted by the stomach as an aid to digestion, and ordinary vinegar contains ethanoic (acetic) acid) although they must always be handled with care. It is rather easy to name some of the common acids used in the laboratory, and some of their formulae are well known. Acids can be obtained as pure substances, although they are normally used as concentrated or dilute solutions, according to whether they have been dissolved in a small or large volume of water respectively.

The sulphuric, hydrochloric and nitric acids are often referred to as the mineral acids because they were first obtained from minerals. Acids used rather less frequently in the laboratory include citric acid, tartaric acid, and oxalic acid, all of which are white solids when pure. Citric acid occurs in many fruits, especially those of the citrus variety, and lemon juice may contain up to 10 per cent of the acid. Tartaric acid is found in grapes, and small quantities of the very poisonous oxalic acid occur in rhubarb leaves and sorrel. All three solids are soluble in water.

Before investigating the properties of acids it is necessary to remember an important laboratory rule. Never dilute a concentrated acid by adding water to it. The heat produced may cause the water to turn to steam and the acid to spray out into the air.

Ex. 4. *Read the statements given below and if you think the statement is true, agree to it saying «That's right». If you think it is not true, disagree saying «I'm afraid», «That's wrong» and make the necessary corrections.*

1. The term «acid» means highly dangerous, corrosive, and fuming liquid. 2. Most of the acids are not particularly dangerous if used carefully unless concentrated. 3. It is not necessary to handle the acids with care. 4. Acetic acid is secreted by the stomach as an aid to digestion. 5. Acids can be obtained as pure substances, although they are never used as concentrated or dilute solutions. 6. Dilute it means dissolved in a large volume of water. 7. The sulphuric, hydrochloric and nitric acids are often referred to as the mineral acids although nobody knows the reason. 8. Citric, tartaric and oxalic acids are white solids when pure. 9. Citric acid occurs in grapes, and tartaric acid is found in citrus fruits. 10. Citric, tartaric and oxalic acids are insoluble in water.

Ex. 5. *Match the antonyms in line A and B.*

A. Dangerous, corrosive, concentrated, careful, vague, pure, large, white, soluble.

B. Dilute, black, clear, harmless, noncorrosive, small, insoluble, dirty, careless.

Ex. 6. *Read the text below and decide which answer A, B or C best fits each space. Circle your answer. Be ready to speak about the properties of acids.*

Properties of Acids

Many compounds [1] … as acids and it is [2] … to learn and understand why they are grouped together in this way. Acids have certain characteristic [3] … properties which become familiar while examining [4] … of the more common ones. Once the ideas [5] … understood it is possible to decide whether an unfamiliar material is an acid or not [6] … conducting some simple tests on it.

There are many commercial [7] … such as litmus (an extract from lichen), phenolphthalein, and methyl orange.

All acids will neutralize bases.

Acids [8] … solution are always electrolytes.

The most reliable tests for an acid in solution [9] … its action on indicators and on carbonates or hydrogen carbonates. The reaction [10] … metals is not always conclusive but [11] … often be used as a confirmatory test with the other two.

	A	B	C
1	classified	are classified	classifies
2	substantial	considerable	important
3	chemical	chemically	chemistry
4	any	something	some
5	will be	are	were
6	by	in	of
7	indicators	indicator's	indicator
8	by	in	of
9	am	is	are
10	on	at	with
11	may	must	has to

Ex. 7. *Remember that vinegar contains ethanoic (acetic) acid. Which two of the following terms best describe the characteristic taste of vinegar?*

Sweet, sharp, sour, bitter, mild.

Can the same adjectives be applied to the taste of lemon juice, which contains citric acid?

Ex. 8. *Read and translate the following text, be ready to speak about the differences of the bases and alkalis.*

Bases and alkalis

You may already be familiar with the terms base and alkali. The «parent» term is in fact base, for an alkali is a special kind of base. Acids and bases may be regarded as «chemical opposites» and when they react together each destroys the other's characteristic properties, forming a neutral substance.

The relationship between bases and alkalis.

A compound which consists of only an element and oxygen is called an oxide, e.g. copper (II) oxide, CuO. Many elements form compounds containing hydrogen and oxygen in which the hydrogen and oxygen atoms are joined together to form OH groups, and such compounds are called hydroxides, e.g. sodium hydroxide, NaOH.

As a general guide most oxides and hydroxides of metals are bases, but whereas many are soluble in water, many bases are insoluble. Bases which do dissolve in or react with water form solutions which are given the special name alkali. All alkalis are thus automatically bases and have the same properties as bases except that they also dissolve in water. All alkalis are bases but not all bases are alkalis (e.g. all buses are vehicles but not all vehicles are buses).

Even when equal concentrations of acids are considered, some appear to be stronger (more acidic) than others. This is also true of alkalis. Ordinary indicators such as methyl orange and litmus can only be used to show if a substance is an alkali or an acid but they cannot show how strong or weak they are.

Universal indicators and the pH scale.

If an indicator is to determine the strength of an acid or alkali it must be capable of showing a variety of colours, each of which corresponds to a certain degree of alkalinity or acidity. Indicators such as methyl orange can only show one colour in acidic solution and one in alkaline solution; finer subdivisions cannot be detected. Special indicators have been produced to show a range of colours corresponding to different degrees of acidity or alkalinity. Such an indicator is called a «universal indicator».

In order to compare acid and alkali strengths in a scientific way a scale of numbers is used, called the pH scale, which ranges approximately from 0 to 14. If a solution has a pH of less than 7 it is an acid. Neutral liquids have a pH of 7 and alkaline solutions have a pH of more than 7. An acid with a pH of 0 or 1 is a very strong acid, and strong alkalis have a pH of 13 or 14. There is a complete range of possibilities, with strong acids and strong alkalis the two extremes.

Ex. 9. *Put the words in the right order to make a statement or a question.*

1. Is, an alkali, of base, a, special kind.
2. As, bases, acids, and, «chemical opposites», regarded, may be.
3. Oxide, what, an, is called, compound?
4. Compounds, many, form, and, containing, hydrogen, elements, oxygen.
5. Buses, buses, all, all, not, are, are, vehicles, vehicles, but.
6. Of alkalinity, to a certain, each, or acidity, colour, corresponds, degree.
7. Can, how, colours, methyl orange, show, in acidic, many, solution?
8. From, the pH scale, 0 to 14, approximately, ranges.
9. A pH, have, alkaline, of more, solutions, than 7.

Ex. 10. *Read the text «Bases and Alkalis» once more and choose the right continuation of the following statements.*

1. Acids and bases react together and
a) form hydroxides.
b) each destroys the other's characteristic properties.
c) each destroys a neutral substance.
2. All alkalis have the same properties as bases
a) except that they also dissolve in water.
b) except that they also dissolve in inorganic solvents.
c) except that they also dissolve in organic solvents.
3. All alkalis are bases but
a) they have some properties of acids.
b) their properties are better expressed.
c) not all bases are alkalis.
4. When equal concentrations of acids are considered,
a) the acids are equally strong.
b) some appear to be stronger than others.
c) it is difficult to measure the strength of acids.
5. Ordinary indicators are used to show
a) if a substance is an alkali or an acid.
b) how strong or weak alkalis or acids are.

c) the beginning of the reaction.
6. Special indicators have been produced to show
a) a table corresponding to different degrees of acidity or alkalinity.
b) a scale corresponding to different degrees of acidity or alkalinity.
c) a range of colours corresponding to different degrees of acidity or alkalinity.
7. If a solution has a pH of less than 7
a) it is a neutral liquid.
b) it is an acid.
c) it is an alkaline solution.

Ex. 11. *Read and translate the following text. Complete the sentences using a suitable derivative of the word given in brackets.*

The Use of Indicators to Illustrate neutralization

The (to neutralize) of an acid drop shows how a base such as a stomach powder can overcome problems due to excess acidity. No attempt was made to (measurement) the amount of base used as an excess of such a mild base is un-important and will result in no major discomfort.

When a base is (gradual) added to an acid the pH of the (solve) rises, i.e. the acidity falls, and when the solution has a pH of 7 it is said to be (neutrally). At this point there is neither (to exceed) of acid nor excess of dissolved base. If more of a soluble base is added, the pH continues to rise and the solution becomes (alkali), i.e. contains the excess alkali. If the added base is (insolubility) the solution will first become neutral, because acids can (reaction) with bases even if they are insoluble in water, and then stay neutral even if excess base is (addition), as only dissolved substances can effect the pH of a solution.

Ex. 12. *Read and translate the following text, be ready to explain the meaning of the term «salt» and to speak about the characteristic features of salts.*

What are Salts?

It is quite easy to decide whether an unfamiliar substance is a salt or not if its name or formula is known. It so happens that most of the inorganic chemicals used, which are not acids or bases, will in fact be salts.

The parent compound of any salt is an acid. All acids form salts. Sodium chloride is a salt formed by the reaction between hydrochloric acid and sodium hydroxide. Hydrochloric acid always forms salts called chlorides. All metallic chlorides are salts.

If the formulae of hydrochloric acid (HC1, the parent acid) and of sodium chloride (NaCl, the salt formed from the acid) is considered, it is clear that the salt is formed by replacing the hydrogen in the acid by a metal.

The replacement by the metal was not performed directly for the base sodium hydroxide was used to provide the metal part. Sometimes the reaction can be performed directly by using a metal, but the essential point in preparing a salt is to use some substance to provide a metal which can substitute for the hydrogen of an acid.

This idea leads to a definition of a salt, for all common acids contain hydrogen which can be replaced (directly or indirectly) by a metal.

A salt is a substance formed when the hydrogen of an acid is partly or completely replaced by a metal or an ammonium ion.

Hydrochloric acid has only one atom of hydrogen in each molecule and so it can form only one series of salts, the chlorides. Sulphuric acid has two atoms of hydrogen in each molecule and can form two different types of salt. If one of the two hydrogen atoms in a molecule of sulphuric acid is replaced by a metal, the salt formed still contains hydrogen. Such salts are called acid salts as some of the hydrogen of the original acid is still present. If all of the hydrogen in the «molecules» of sulphuric acid is replaced by a metal a normal salt is produced.

Ex. 13. *Read the text «What Are Salts? » once more and match each word in column A with its probable meaning in column B. Be careful, there are some extra meanings in column B.*

A	B
unfamiliar	to put a person or a thing in the place of another
formula	a white crystalline solid
inorganic	something unknown, strange
compound	matter or material of which anything consists
chloride	symbolic representation of a chemical compound composition
to replace	a combination of elements or substances
essential	to substitute
substance	the simplest and the lightest of the elements
to substitute	not involving living organisms
atom	a compound of chlorine
	necessary, very important
	the smallest unit of an element

Ex. 14. *Look through the following word combinations and say which of them you didn't encounter in the text «What Are Salts? » Think of situations in which you can use each word combination.*

Normal salt, different degrees of acidity, unfamiliar substance, dissolved base, sulphuric acid, hydrochloric acid, sodium hydroxide, alkaline solution, inorganic chemicals, neutral substance, partly or completely replaced, acid salt, citric acid.

Ex. 15. *In the following pairs of sentences only one is correct. Read them and say which one is correct.*

1. All inorganic chemicals which are not acids or bases will be salts. Most of the inorganic chemicals which are not acids or bases will be salts.
2. The parent compound of any salt is an acid. The derivative compound of any salt is an acid.
3. Hydrochloric acid always forms salts called chlorides. Hydrochloric acid never forms salts called chlorides.
4. All salts are metallic chlorides. All metallic chlorides are salts.
5. The salt is formed by replacing the hydrogen in the acid by a metal. The acid is formed by replacing the hydrogen in the salt by a metal.
6. All common acids contain oxygen which can be replaced by a metal. All common acids contain hydrogen which can be replaced by a metal.
7. Hydrochloric acid has two atoms of hydrogen in each molecule. Hydrochloric acid has only one atom of hydrogen in each molecule.
8. Sulphuric acid can form two different types of salts. Sulphuric acid can form only one type of salt.
9. In acid salts one of the two hydrogen atoms in a molecule of sulphuric acid is replaced by a metal. In acid salts two of the three hydrogen atoms in a molecule of sulphuric acid is replaced by a metal.

Ex. 16. *Testing questions.*

1. How can you describe acids?
2. What are the less frequently used laboratory acids?
3. What are the properties of acids?
4. What substances may be regarded as chemical opposites: acids and bases or alkalis and bases? Why?
5. What is the difference between a «universal indicator» and methyl orange?
6. When can you say that the solution is neutral?
7. What is the pH level of an acid and alkali?
8. What is easy to decide when the substance formula is known?
9. What is salt?

10. What is a parent compound of any salt?

UNIT 7

Ex. 1. *Read and memorize the following words. Check up the proper pronunciation of the words in the dictionary.*

Conduct, v – проводить (напр., электричество); conductor, n – проводник; conductivity, n – электропроводность, удельная проводимость; either … or, conj – либо … либо; exception, n – исключение; notably, adv – исключительно, особенно; molten – расплавленный; dissolved – растворенный; discharge, v – разряжать; fuse, v – плавить(ся), сливать(ся); attain, v – достигнуть, добиться.

Ex. 2. *Translate the following international words:*

Graphite, n; electric current; electrolyte, n; electrolysis, n; electrode, n; anode, n; cathode, n; decompose, v; anion, n; cation, n; oxidation, n; reduction, n; redox reaction; oxidize, v.

Ex. 3. *Find and write down in your notebook all the definitions, connected with electroconductivity and electrolysis. Do they convey the same meaning as in your chemistry textbook?*

Ex. 4. *Read the text attentively and make up the new title of the text.*

Electricity and Chemical elements

1. Metals will conduct electricity when either solid or liquid. They are not chemically changed during the process and are simply called conductors.

2. Non-metallic elements, with few exceptions (notably graphite), do not conduct electricity. Covalent compounds do not themselves conduct but in some cases react with water to form conducting solutions.

3. Ionic compounds do not conduct when solid but become «conductors» when molten or dissolved in water. They are always decomposed during the process. Such substances are called electrolytes.

An electrolyte is a compound which, when fused or dissolved in water, conducts an electric current and is decomposed in the process.

Electrolysis is the chemical change which takes place when an electric current passes through a fused or dissolved electrolyte.

An electrode is the metal or carbon rod by which the current enters or leaves the electrolyte.

The anode (+) is the electrode from which the electrons leave the electrolyte.

The cathode (-) is the electrode at which the electrons enter the electrolyte.

An anion is an ion carrying one or more negative charges. It is attracted to the anode during electrolysis.

A cation is a positively charged ion which is attracted to the cathode during electrolysis.

Hydrogen and the metals form positive ions.

Non-metals and radicals form negative ions.

The charge on the ion is the number of electrons the atom has to gain or lose to attain a stable noble gas electron configuration.

The decomposition of molten electrolytes simply produces one of the two components at each electrode. Solutions are more complicated as there are more ions present. When two different ions are attracted to the same electrode, the ion is discharged which gives up or takes electrons the more easily or is present in the greater numbers. Different experimental conditions such as temperature or the material of the electrode may influence the ease with which an ion is discharged, and at this stage it is necessary to remember which type of ion is selected in the electrolysis experiments that follow. It so happens that in all these cases the ion with the initial letter earlier in the alphabet is the one selected and discharged. This is not a scientific rule but just a convenient way to choose the correct ion for discharge and there are cases in which this «rule» does not apply.

Oxidation and reduction in electrolysis.

Oxidation can be defined as the removal of electrons from a substance.

Reduction can be defined as the addition of electrons to a substance.

Neither reaction can occur without the other and the complete process, i.e. oxidation of one substance with consequent reduction of the other, is known as a redox reaction.

The reactions which occur at the electrodes during electrolysis are reactions in which electrons are removed or added and so they are redox reactions. For example, in the electrolysis of fused lead bromide, the bromide ions give up electrons at the anode and are oxidized to bromine atoms, the lead ions gain electrons from the cathode and are reduced to lead atoms.

Ex. 5. *Fill in the gaps with a suitable derivative of the word given in the brackets.*

1. Non-metallic elements do not (conductivity) electricity.
2. Covalent compounds in same cases react with water to form (conductivity) solutions.
3. Electrolysis is the chemical change which takes place when an electric current passes through a (fusion) or dissolved electrolyte.
4. A cation is a positively (charge) ion which is (attraction) to the cathode during electrolysis.
5. Hydrogen and the metals form positive (to ionize).
6. The (decomposing) of molten electrolytes simply produces one of the two components at each electrode.
7. Reduction can be (definition) as the addition of electrons from a substance.
8. (To oxidize) can be defined as the removal of electrons from a substance.

Ex. 6. *There is a logical, lexical or grammar mistake in each of the following sentences. Find and correct it.*

1. Non-metallic elements does not conduct electricity.
2. Hydrogen and the metals decompose positive ions.
3. Different experimental conditions such as temperature or pressure of the electrode may influence the ease with which an ion is discharged.
4. Reduction can be defined as the removal of electrons to a substance.
5. The reacting substances which occur at the electrodes during electrolysis are reactions in which electrons are removed or added and so they are redox reactions.

Ex. 7. *Choose the correct question to the following statements.*

1. Covalent compounds do not themselves conduct but in some cases react with water to form conducting solutions.
A. Covalent compounds do not themselves conduct electricity, do they?
B. What exceptions are known about covalent compounds reactions?
C. Do covalent compounds themselves conduct electricity?
2. Electrolysis is the chemical change which takes place when an electric current passes through a fused or dissolved electrolyte.
A. What process is described in the following definition?
B. What is electrolysis?
C. When does the chemical change take place?
3. The charge on the ion is the number of electrons the atom has to gain or lose to attain a stable noble gas electron configuration.
A. How can the charge on the ion be characterized?
B. How many electrons has the atom to lose or to gain to attain a stable noble gas configuration?

C. What is the charge on the ion?
4. The decomposition of molten electrolytes simply produces one of the two components at each electrode.
A. What is the decomposition of molten electrolytes?
B. Does the decomposition of molten electrolytes produce one of the two components at each electrode?
C. What produces one of the two components at each electrode?
5. The reactions which occur at the electrodes during electrolysis are reactions in which electrons are removed or added and so they are redox reactions.
A. What are redox reactions?
B. The reactions which occur at the electrodes during electrolysis are reactions in which electrons are removed or added, are not they?
C. Where are electrons removed or added?

Ex. 8. *Pick up and write down the key sentences in your notebook, prepare and reproduce orally or in the written form the summary of the text.*

Ex. 9. *Testing questions.*
1. What substances are good electricity conductors?
2. What substances are bad electricity conductors?
3. What are the constituent elements of electrolysis?
4. What chemical changes take place during the process of electrolysis?
5. What is oxidation in electrolysis?
6. What is reduction in electrolysis?

UNIT 8

Ex. 1. *Read and memorize the following words. Check up the proper pronunciation of the words in the dictionary.*

Comparable, adj – сравнимый; displacement, n – перемещение, вытеснение; exposure, n – выставление (на солнце, воздух и т. п.); rust, v – ржаветь; reversible, adj – обратимый; trace, n – след, остаток; affect, v – воздействовать, влиять; prevent, v – предотвращать; layer, n – слой; surface, n – поверхность; whereas, conj – тогда как; crude form – грубая, необработанная форма; alloy, n – сплав; roast, v – обжигать, кальцинировать; smelt – расплавлять, плавить; draught, n – тяга воздуха, сквозняк; air current – воздушный поток; charcoal furnace – угольная печь; brass, n – латунь, желтая медь.

Ex. 2. *Guess the meaning of the following international words. Do not use the dictionary.*

Potential, n; mercury, n; hydrated aluminium oxide; reactivity, n; electrochemical series; concept, n; magnesium, n; chloride, n.

Ex. 3. *Read the text attentively and then divide it into the logical parts. Entitle each part.*

Reaction of the Metals with Air

The metals can react with other substances in the air in addition to oxygen. The order of reactivity is comparable to the order of electrode potential and of displacement, because once again it is the metals that most readily lose electrons that react most easily with oxygen. Thus sodium oxidizes instantly on exposure to air and for this reason has to be stored in hydrocarbon oil. Iron rusts rapidly in moist air but this is a reaction in which both oxygen and water take part. Copper only reacts with atmospheric oxygen on heating, as does mercury, and this latter reaction is reversible. Silver does not react with the oxygen in the air although traces of sulphur compounds in the atmosphere may cause it to blacken because of the formation of silver sulphide. Gold is not affected by the atmosphere under any conditions.

The electrochemical series. In the more common metals the order of electrode potentials is the same as the order of their chemical activity. (Calcium is a notable exception here.) This is true also for all the other lesser known metals. This arrangement of the metals, and hydrogen, with regard to both electrical character and chemical behaviour is known appropriately as the electrochemical series. It is usual to write the electrochemical series starting with sodium as the most active and least electronegative of the common metals, and ending with gold as the least active and most electronegative. If this list is reversed the metals are now in the order in which they have been discovered and used by mankind. The reason for this is that the more chemically active the metal, the stronger are the bonds that it forms with other elements in nature, and the more difficult it is to extract it from its compounds. Gold and silver are so unreactive that they are found "native", that is uncombined, and were known and used by the earliest civilizations. Men of the Bronze Age were able to prepare a crude form of the alloy by roasting ores that contained both copper and tin. The Iron Age came later because the iron could only be smelted when some type of draught or air current was used in the wood or charcoal furnace. By the time of the Roman occupation of Britain, gold, silver, mercury, bronze, iron, lead, and

brass (a copper-zinc alloy) were known and used, but it was not until many hundreds of years later, when new sources of energy became available, that the last group of metals, the active ones at the top of the electrochemical series, were discovered. Sodium, for example, had never been seen until 1807, when Humphrey Davy carried out his now famous experiment in which he electrolyzed fused sodium hydroxide.

Where gold and silver are found native, no chemical reaction is needed for their extraction; only crushing and washing are necessary to obtain the metals in a comparatively pure state. An impure form of copper is made by roasting the ore in a stream of oxygen. The metal is then purified by electrolysis.

Lead, iron, and zinc are obtained by reducing the heated oxides with carbon or carbon monoxide.

Aluminium, magnesium, and sodium compounds need so much energy for their decomposition that this can only be brought about by electrolysis. Aluminium is obtained by the electrolysis of the fused oxide and magnesium and sodium by electrolyzing their fused chlorides.

Thus the method of extracting a metal is related to its position in the electrochemical series, the energy needed becoming less and the ease of extraction becoming greater the lower the position of the metal in the series.

Ex. 4. *Look through the text once again and choose the right continuation, i.e. match properly the parts of sentences in these two columns.*

1. Sodium oxidizes instantly on exposure to air	a) they are found “native”, that is uncombined.
2. Iron rusts rapidly in moist air	b) as the electrochemical series.
3. Gold is not affected by	c) is related to its position in the electrochemical series.
4. In the more common metals the order of electrode potential is	d) and for this reason has to be stored in hydrocarbon oil.
5. The arrangement of the metals is known	e) but this is a reaction in which both oxygen and water take part.
6. Gold and silver are so unreactive that	f) reducing the heated oxides with carbon or carbon monoxide.
7. Lead, iron and zinc are obtained by	g) the atmosphere under any conditions.
8. The method of extracting a	h) the same as the order of their

metal	chemical activity.

Ex. 5. *Find the passage in the text dealing with the discoveries of metals by mankind. Compare the contents of the text with these sentences and put them in the chronological order. Write the numbers in the correct boxes.*

The Iron Age came later because the iron could only be smelted when some type of draught or air current was used in the wood or charcoal furnace.

By the time of the Roman occupation of Britain, gold, silver, mercury, bronze, iron, lead, and brass (a copper-zinc alloy) were known and used.

Men of the Bronze Age were able to prepare a crude form of the alloy by roasting ores that contained both copper and tin.

Gold and silver are so unreactive that they are found «native», that is uncombined, and were known and used by the earliest civilizations.

Ex. 6. *Express your agreement or disagreement orally or write down True (T) or False (F) for each of the sentence below according to the information given. If the information is not given put a question mark (?).*

1. The metals do not react with substances in the air.
2. The order of metal's reactivity is comparable to the order of electrode potential and of displacement.
3. Iron rusts rapidly indoors in a dry place.
4. Gold is not affected by the atmosphere under any conditions.
5. In the more common metals the order of electrode potentials is the same as the order of their chemical activity.
6. It is usual to write the electrochemical series starting with silver.
7. Gold and silver were known and used by the earliest civilizations.
8. The most active metals were discovered only in the 19^{th} century.
9. The method of extracting a metal does not depend on its position in the electrochemical series.

Ex. 7. *Put the words or word combinations in the right order to make a statement.*

1. Only, reacts, on heating, copper, with atmospheric oxygen.
2. Sodium, in hydrocarbon oil, has, to be stored.
3. In moist air, rapidly, rusts, iron.
4. On the metal surface, a very thin protective layer, forms, the oxide.
5. As the electrochemical series, is, known, of the metals, and hydrogen, the arrangement of the metals.
6. Starting with sodium, it, is, to write, usual, the electrochemical series.

7. Where gold and silver, native, no chemical reaction, are found, for their extraction, is, needed.

Ex. 8. *Imagine you are to deliver a short introductory lecture entitled «The Electrochemical Series» to the students. Make up a plan of your lecture. Use the information from the text and the following expressions:*

To begin with …
Here I try to describe …
Let us proceed to …
The next to be mentioned is …
Nowadays …
To sum it up …

Ex. 9. *Testing questions.*

1. How do metals react with air?
2. What is defined as the electrochemical series?
3. What is historical succession of metals discoveries?
4. What is the method of extracting a metal related to?

UNIT 9

Ex. 1. *Read and memorize the following words. Check up the proper pronunciation of the words in the dictionary.*

Confine, v – ограничивать; ring, n – кольцо; chain, n – цепь; permutation, n – перестановка, перемещение; maintain, v – сохранять, поддерживать; arrange, v – располагать, упорядочивать; constituent, adj – составляющий; three-dimensional shape – трехмерная форма; saturated hydrocarbon – насыщенный углеводород; occurrence, n – встречаемость, распространенность; space, n – пространство; steeply, adv – невероятно, чрезмерно; plane, n – плоскость; arise (arose, arisen), v – возникать, появляться; superimpose, v – накладывать (одно на другое); label, v – относить к какой-либо категории, перен. приклеивать ярлык.

Ex. 2. *Guess the meaning of the following international words. Do not use the dictionary.*

Isomerism, n; isomer, n; phenomenon, n; term, v; stereoisomerism, n; formula, n; asymmetric, adj.

Ex. 3. *Study the box «The Isomerism Tree». Using your background knowledge and this scheme explain how the phenomenon of isomerism is classified and subdivided.*

Ex. 4. *Read the text attentively and pick up the definitions of all kinds of isomers which exist.*

Isomerism Classification

The molecular formula of an organic compound tells you how many atoms of each element are present in a molecule. For simple molecules such as the alkanes methane CH_4, ethane C_2H_6 and propane C_3H_8, this provides enough information to work out the structure of the molecule. In each case, there is only one way of arranging the atoms that obeys the bonding rules for a saturated hydrocarbon: each carbon atom forms four covalent bonds and each hydrogen atom forms one covalent bond.

The different structures lead to different properties.

Two molecules that have the same molecular formula but differ in the way their atoms are arranged are called isomers.

Isomers are distinct compounds with different physical properties and often different chemical properties too. The occurrence of isomers (isomerism) is very common in carbon compounds because of the great variety of ways in which carbon can form chains and rings, but you will meet examples in inorganic chemistry too.

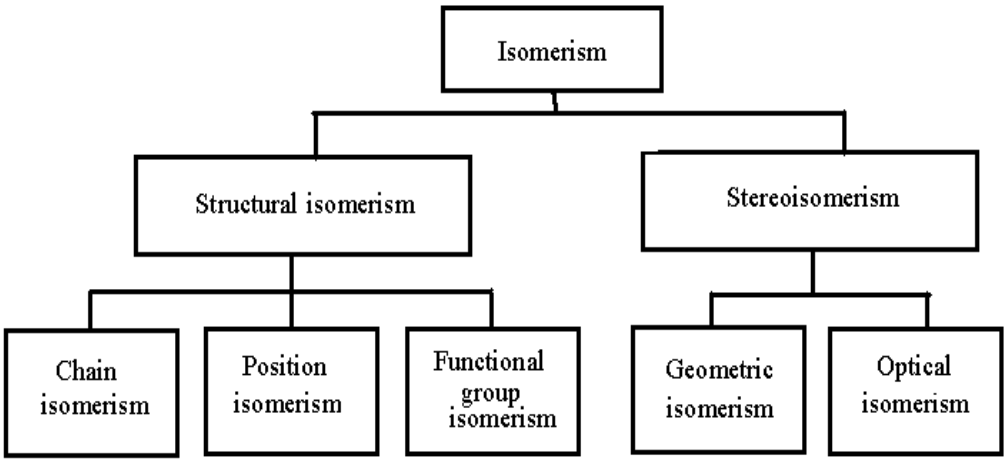
There are two ways in which atoms can be arranged differently in isomers.

● The atoms are bonded together in a <u>different order</u> in each isomer. These are called <u>structural isomers</u>.

● The order of bonding in the isomers is the same; but the <u>arrangement of atoms in space is different</u> in each isomer. These are called <u>stereoismers</u>.

The «isomerism tree» in Box 1 shows how these two main types of isomerism are further subdivided. Let us look first at structural isomerism – there are three different ways it can arise.

Box 1. The isomerism tree



Structural isomerism

Chain isomerism.

This arises because carbon chains can be straight or branched. Butane and methylpropane are examples of chain isomerism. As the number of carbon atoms in an alkane increases the number of possible isomers increases steeply.

Position isomerism.

This can occur when a molecule contains one (or more) functional groups substituted in the carbon framework and the functional groups are situated in different positions in the molecule. For example, there are two isomeric compounds with the molecular formula C_3H_7Cl. The –Cl functional group is situated at two different places on the hydrocarbon chain.

Functional group isomerism.

It is sometimes possible for compounds with the same molecular formula to have different functional groups. As well as showing different physical properties (such as boiling point), they have quite different chemical properties because they belong to different homologous series.

Stereoisomerism.

Stereoisomers have identical molecular formulae and the atoms are held together in the same order, but the arrangement of atoms in space is different in each isomer. There are two different ways this can happen: geometric isomerism and optical isomerism.

Geometric isomerism.

This can occur in compounds that contain a C=C double bond. For example, there are two isomers of 1,2-dichloroethene ($C_2H_2C_{12}$) depending

on whether the chlorine atoms are on the same, or opposite sides, of the double bond. They are called the cis- and trans- isomer respectively.

Optical isomerism.

This occurs when a molecule is asymmetric, i.e. it does not have a centre or plane of symmetry. This may seem a strange thing to say but it means that there will be two different forms of the molecule that are mirror images of each other – rather like your right and left hand. These appear to be identical in every respect – except that you cannot superimpose one on top of the other. Your right-hand glove will not fit on your left hand because your two hands are not the same.

Such compounds are called optical isomers or enantiomers. The isomers are often labelled D- or L-. Chemically their reactions are identical, except when reacting with other 'handed molecules'. Biologically, they are quite different. This is because many molecules in living things are asymmetric too. For example, all the 20 naturally-occurring amino acids in the body (with the exception of the simplest one, glycine) are L-isomers.

Most of the examples of isomerism are organic compounds. But stereo-isomers occur in inorganic compounds too, particularly in the complexes of transition-metal ions with ligands.

Ex. 5. *Look through the text once again and choose the right continuation, i.e. match properly the parts of sentences in these two columns.*

1. The molecular formula of an organic compound tells you	a) very common in carbon compounds.
2. Each carbon atom forms	b) are organic compounds.
3. Each hydrogen atom forms	c) the arrangement of atoms in space is different in each isomer.
4. The two molecules that have the same molecular formula but	d) how many atoms of each element are present in a molecule.
5. The occurrence of isomers (isomerism) is	e) four covalent bonds
6. Stereoisomers have identical molecular formulae and the atoms are held together in the same order, but	f) one covalent bond.
7. Most of the examples of isomerism	g) differ in the way their atoms are arranged are called isomers.

Ex. 6. *Study the box «The Isomerism Tree». Find in the text all the definitions of the terms, mentioned in the sub-boxes. Write them down in your notebook.*

Ex. 7. *Study the text «Phenomenon of Isomerism». Tick (v) the sentences which present the new information, and mark the sentences with a «+», which duplicate the information of the previous text.*

Phenomenon of Isomerism

Three words frequently confused by young students of chemistry are isotopes, allotropes, and isomers. The latter are usually, but not always, confined to the world of organic chemistry, or, in other words, to the compounds of carbon. Carbon atoms in compounds can be joined together in long chains, which can be «straight» or branched, and also in rings. Many organic molecules contain both rings and chains of carbon atoms. Some of these structures are composed of thousands of atoms, and indeed there seems no limit to the number of possible permutations. It automatically follows that there are millions of different organic compounds.

In each of the examples the normal valencies of carbon (4) and hydrogen (1) have been maintained, but it is often possible to arrange a given group of atoms in more than one way while still maintaining the normal valencies of the constituent atoms. Thus the group of atoms C_2H_6O can be arranged to form two independent molecules.

Note that in each case the normal valencies of carbon, oxygen, and hydrogen are preserved, but two different structures are possible; (a) is ethanol (the alcohol found in alcoholic drinks), and (b) is methoxy-methane (dimethyl ether). These two molecules are isomers. When two or more structures exist which have the same molecular formula (same type and number of atoms) but different structural formulae (different arrangements of the atoms) the phenomenon is termed isomerism and the individual forms are isomers.

Thousands of organic molecules have isomers. One of the simplest proteins has the molecular formula $C_{662}H_{1020}M_{193}O_{201}S_4$, and it would indeed be an involved homework to calculate the number of isomers possible.

The different structural arrangements of a given group of atoms each have their own three-dimensional shape.

Ex. 8. *Put all the possible questions to the following sentences.*

1. Two molecules that have the same molecular formula but differ in the way their atoms are arranged are called isomers.

2. There are two ways in which atoms can be arranged differently in isomers.
3. The occurrence of isomers (isomerism) is very common in carbon compounds because of the great variety of ways in which carbon can form chains and rings.
4. The –Cl functional group is situated at two different places on the hydrocarbon chain.
5. Optical isomerism occurs when a molecule is asymmetric.

Ex. 9. *Choose the right English word or word combination for the Russian fragments in brackets.*

1. (Атомы углерода) in compounds can be (соединены) together in long (цепи), which can be «straight» or branched, and also in (кольца).
2. Thousands of (органические молекулы) have isomers.
3. The different (структурное расположение) of a given group of atoms each have their own (трехмерную форму).
4. Isomers are distinct compounds with (различными физическими свойствами и часто различными химическими свойствами) too.
5. Chain isomerism (возникает) because carbon chains can be (прямые или разветвленные).
6. Optical isomerism (встречается) when a molecule is asymmetric, i.e. it does not have a centre or (плоскость симметрии).
7. The isomers are often (относятся к категории) D- or L-.

Ex. 10. *Pick up the most important information from the texts and the box, prepare an oral report «What Is Isomerism? Isomerism classification».*

Ex. 11. *Testing questions.*

1. What is isomerism?
2. What are isomers?
3. How are the isomers classified? (Describe the isomerism tree.)
4. What are the reasons of the isomerism phenomenon?
5. What chemistry (organic or inorganic) are the isomers widely spread in?

UNIT 10

Ex. 1. *Read and memorize the following words.*

Charcoal, n – древесный уголь; diamond, n – алмаз, бриллиант; in excess of – сверх, больше чем; extinct, adj – потухший; gemstone, n – поделочный камень; hull, n – корпус (корабля); impure, adj – с примесью, неоднородный; lampblack, n – ламповая копоть, сажа;

lubricant, n – смазка; moderator, n – замедлитель; soot, n – сажа, копоть; subject, v – подвергать.

Ex. 2. *Make sure you know the following international words.*

Allotrope, n; polyacrylonitrile, n; crater, n; electrode, n; graphite, n; process, n/v; structure, n; volcano, n.

Ex. 3. *Read the text and name the forms of carbon.*

Carbon

Free carbon in the form of graphite and diamond occurs only rarely in nature, and the element is found mainly in an impure form as coal and in a combined state in petroleum and various carbonate minerals such as calcium carbonate.

Over 90 per cent of the world's diamonds come from South Africa where they are found in the craters of extinct volcanoes, having been formed when carbon was subjected to enormous pressures and high temperatures. Attempts to synthesize diamonds have proved only partially successful despite the use of pressures in excess of 100 000 atmospheres and temperatures in the region of 2000°C. Very small synthetic diamonds have been prepared by this method and these are used as cutting tools in industry, but diamonds large enough to be cut into gemstones have not yet been synthesized. Diamond is the hardest known natural substance (although it is not as hard as the synthetically produced boron nitride) and is chemically unreactive. In addition to its use as a gemstone and in cutting tools, it is also used in rock drilling equipment.

The other allotrope of carbon, graphite, occurs to a small extent in many countries, particularly Ceylon. Nowadays, graphite is usually prepared synthetically by the Acheson process, which involves heating impure carbon with sand in an electric furnace. In contrast to diamond, graphite is one of the softest solids known and is used as a lubricant, in electrodes, as a «moderator» in atomic reactors and, when mixed with clay, as «lead» in pencils.

The very different properties of diamond and graphite can be explained by the structures of these compounds. Another form of carbon, in which the atoms did not appear to be arranged in any regular manner, was called «amorphous» (without shape) carbon and was used to describe forms of the element such as coke, charcoal, soot, lampblack and coal. These forms have many uses, e.g. activated charcoal has good adsorptive power and is used to purify materials. It is now believed that «amorphous» carbon consists of very small fragments of graphite crystals.

Another interesting form of carbon is carbon fibre, which is made by the controlled thermal degradation of a textile fibre such as viscose rayon or polyacrylonitrile. The orientation of the carbon atoms in the original fibre is retained in the product. Carbon fibre is particularly useful where a material of high durability, strength, and lightness is required. Its commercial potential has not yet been exploited but it is beginning to find applications in reinforcing plastics used in turbo-engines, racing car bodies, ships' hulls, etc.

Ex. 4. *Match the word in column A with its definition in column B.*

A	B
1. Extinct	a) means that something has the necessary amount of a quality.
2. To prepare	b) is the ability of an object to be treated roughly, or to support or carry heavy weights without being damaged or destroyed.
3. Enough	c) is to stir or shake two substances together.
4. Drill	d) means when things have equal amounts of time or space between them.
5. To mix	e) means that volcano does not erupt or is very unlikely to erupt.
6. Compound	f) to make it ready.
7. Regular	g) is not very great in amount, degree, or intensity.
8. Fibre	h) is a to tool or machine that you use for making holes.
9. Strength	i) is a thin thread of a natural or artificial substance, especially one that is used to make cloth or rope.
10. Lightness	j) is a substance that consists of two or more elements.

Ex. 5. *Put the words in the right order to make sentences.*

1. Is, known, graphite, the, one, solids, softest, of.
2. Unreactive, diamond, hardest, and, is, the, chemically, natural, substance, is.
3. Of, exploited, carbon, commercial, the, not, has, been, potential, yet.
4. As, found, impure, an, is, carbon, coal, mainly, in, form.
5. The, graphite, today, process, usually, Acheson, by, synthetically, prepared, carbon.

6. Purify, activated, is, charcoal, used, has, to, good, materials, adsorptive, and, power.
7. Of, crystals, carbon, graphite, «amorphous», fragments, very, small, consists, of.
8. Volcanoes, diamonds, extinct, are, of, found, craters, in, the.
9. Furnace, with, in, sand, electric, an, process, involves, this, carbon, heating, impure.

Ex. 6. *Match each underlined word in column A with its probable meaning in column B.*

A	B
1. Over 90 per cent of the world's diamonds were formed when carbon was subjected to enormous pressures and high temperatures.	a) take place
2. The atoms didn't appear to be arranged in a regular manner.	b) strengthen
3. Attempts to synthesize diamonds proved only partially successful.	c) expose to
4. Some other forms of carbon occur to a small extent in many countries.	d) surplus
5. ... a material of high quality is required.	e) seem
6. ... despite the use of pressure in excess of 100 000 atmospheres	f) preserve
7. Another form of carbon is made by the controlled thermal degradation of a textile fibre	g) turn out
8. Carbon has found wide applications in reinforcing plastics.	h) need
9. Carbon is particularly useful	i) debasement
10. The orientation of the carbon atoms in the original fibre is retained in the product.	j) especially

Ex. 7. *Fill in the gaps with the prepositions.*
1. «Amorphous» carbon consists [1] ... very small fragments of graphite crystals.
2. Another form of carbon is made [2] ... the thermal degradation of a textile fibre.
3. In addition [3] ... its use as a gemstone, it is also used [4] ... rock drilling equipment.
4. Carbon can be subjected [5] ... enormous pressures.

5. The different properties of diamond and graphite can be explained [6] ... the structures of the compounds.
6. In contrast [7] ... diamond, graphite is used as «lead» in pencils when mixed [8] ... clay.
7. Another form of carbon in which the atoms are not arranged [9] ... a regular manner is called «amorphous».
8. Very small synthetic diamonds were prepared [10] ... this method.
9. Diamonds large enough to be cut [11] ... gemstones were not synthesized.
10. Carbon fibre finds applications [12] ... reinforcing plastics.

	A	B	C	D
1	by	of	with	off
2	with	from	by	of
3	by	of	to	from
4	at	in	from	to
5	to	at	of	by
6	from	in	at	by
7	to	from	with	by
8	by	in	at	with
9	at	in	with	by
10	with	by	in	at
11	in	from	into	by
12	at	by	in	into

Ex. 8. *Fill in the blanks with the suitable words given below.*

Dioxide, in, limited, to, once, from, in, to, was, of, monoxide, dioxide, is, living, carbon.

The carbon cycle

In addition to being present ... carbon dioxide in the atmosphere, carbon ... an essential constituent of all ... organisms. There is a balance between the carbon ... liberated into the atmosphere and that used up ... the atmosphere. This is conveniently summarized in the ... cycle.

It is important ... realize that virtually all the carbon atoms on the earth have been present since the earth ... formed, and are constantly “circulating” in nature. For example, it is possible that some ... the carbon atoms in your body ... formed part of a tree in a primeval forest, then part of a dinosaur, then part of a Viking ship, part of Shakespeare’s body, etc.

All forms of carbon, if heated ... a sufficiently high temperature in a plentiful supply of air, give carbon ..., but carbon ... is formed if the supply of air is ... .

Carbon reduces many metallic oxides to the metal when the two are heated together.

Notes: constituent, n – составная часть; cycle, n – круговорот, цикл; circulate, v – циркулировать; supply, n – подача, приток; plentiful, adj – обильный, изобильный.

Ex. 9. *Testing questions.*

1. What are the commonest forms of carbon?
2. Where is the application of carbon particularly useful?
3. How is graphite usually prepared?
4. Where does carbon play an essential part as a constituent?
5. How can the difference in properties of diamond and graphite be explained?

UNIT 11

Ex. 1. *Read and memorize the following words and phrases.*

Miscible, adj – смешивающийся; monohydric, adj – одноатомный; trihydroxypropane, n – глицерин; barley, n – ячмень; beverage, n – напиток; elderberry, n – ягода бузины; ethanoic acid – этановая (уксусная) кислота; fizzy, adj – газированный, шипучий; hop, n – хмель; liquor, n – спиртной напиток; port, n – портвейн; proof, n – крепость; rhubarb, n – ревень; starch, n – крахмал; sugar cane – сахарный тростник; vinegar, n – уксус; yeast, adj – дрожжевой.

Ex. 2. *Make sure you know the following international words.*

Alcohol, n; alternative, adj; fermentation, n; bacteria, n; distillation, n; enzyme, n; lemonade, n; manufacture, v; molecule, n; natural, adj.

Ex. 3. *Read the text and say what parts an alcohol molecule is made up of.*

Alcohols

General characteristics

Alcohols are among the earliest compounds to have been prepared by man. Since ancient times they have been made by the fermentation of sugar solutions, and even now this method is still widely employed, despite the discovery of alternative methods of preparation. Beer (about 4 per cent), wines (about 10-20 per cent) and spirits (up to 40 per cent) contain «alcohol».

The alcohol referred to is mainly ethanol (ethyl alcohol), C_2H_5OH. This is an important member of the group of aliphatic alcohols which form an homologous series of general formula $C_nH_{(2n+1)}OH$ and are named by substituting the ending *-ol* for the final *-e* in the name of the corresponding alkane. Thus when n = 1, the alcohol is CH_3OH, methanol; when n = 2, C_2H_5OH, ethanol etc.

Alcohols containing one –OH group attached to an alkyl radical are said to be monohydric alcohols. Other alcohols exist which contain more than one hydroxyl group, e.g. 1,2-dihydroxyethane (ethylene glycol), $CH_2OH.CH_2OH$, contains two hydroxyl groups and is said to be a dihydric alcohol. Similarly 1,2,3-trihydroxypropane (glycerol), $CH_2OH.CHOH.CH_2OH$, is a trihydric alcohol. Many other *polyhydric* alcohols are known.

All members of the series having less than twelve carbon atoms are liquids at room temperature and show the usual trend of increasing boiling points with increasing numbers of carbon atoms.

An alcohol molecule is made up of two parts, the hydrocarbon portion which is hydrophobic (water hating) and the hydroxyl group which is strongly hydrophilic (water loving). The first three alcohols are very soluble in water (miscible in all proportions) due to the greater influence of the hydrophilic group. However, as the length of the hydrocarbon chain increases, the solubility of the alcohol decreases, and alcohols higher in the series than hexanol are practically insoluble. The chemical reactions of all members of the series are similar.

Ex. 4. *Match the word with its definition.*

A compound	means to join something to an object.
A solution	means to have an effect on somebody or something.
To employ	is a substance that consists of two or more elements.
General	is a part of something.
To correspond	is used when describing something that belongs or relates to the whole of something rather than to its details or parts.
To attach	is a liquid in which a solid substance has been dissolved.
A trend	means almost, but not completely or exactly.
A portion	means to be similar to something.
Practically	means to use something.
Influence	is a change towards doing or being something

	different.

Ex. 5. *Choose the right continuation of the sentences.*

1. Man prepared	a) the boiling points of all members of the series also grow.
2. Alcohols were made by	b) of the series are the same.
3. Ethanol is an important member of	c) alcohols long ago.
4. Aliphatic alcohols derive their names	d) is easily miscible with water in all proportions.
5. Monohydric alcohols are made up of	e) the group of aliphatic alcohols.
6. When a rise in the members of carbon atoms happen	f) one –OH group added to an alkyl radical.
7. An alcohol molecule consists of	g) the fermentation of sugar solutions.
8. The first trio of alcohols	h) we can observe the decrease in solubility of the alcohol.
9. When the length of the hydrocarbon chain increases	i) from the change of the ending *-ol* for the final *-e*.
10. The chemical reactions of all members	j) the hydrocarbon part and the hydroxyl group.

Ex. 6. *Fill in the gaps with the suitable derivatives of the word given on the right.*

1. We have alternative methods of ... of this compound.	prepare
2. Alcohols ... one –OH group are said to be monohydric alcohols.	contain
3. When carrying out this experiment we could observe the trend of ... boiling points.	increase
4. Some of these ... were successful.	substitute
5. Any increase in complexity brings with it a ... probability of error.	correspond
6. These compounds are ... insoluble.	practice
7. These ... reactions should be carried out with particular care.	chemistry
8. The ... points of this metal are extremely high.	melt

Ex. 7. *There is one mistake in each of the sentences. Correct it.*

1. All members of the series are liquids in room temperature.
2. Alcohols having one –OH group attaching to an alkyl radical are monohydric alcohols.
3. Ethylene glycol contains one hydroxyl group and is a dihydric alcohol.
4. This method is still wide employed.
5. An alcohol molecule is make up of two parts.
6. This is an important members of the group of aliphatic alcohols.
7. The first three alcohols are very soluble with water.
8. Beer, wines and spirituals contain «alcohol».

Ex. 8. *Fill in the blanks with* ***to, up, with, to, by, of, for, of, to, of.***

1. The compound was prepared ... our specialist.
2. A molecule is made ... of a group of atoms.
3. Due ... the influence of the hydrophilic group these alcohols are readily miscible ... water.
4. Here we can see the trend ... increasing boiling points with increasing numbers of carbon atoms.
5. This work is often referred ... in the scientific literature.
6. Some alcohols are composed ... several hydroxyl groups.
7. You should substitute this substance ... another one.
8. To get a trihydric alcohol three hydroxyl groups should be attached ... an alkyl radical.

Ex. 9. *Read the text and tell where the term «proof» was derived from.*

Alcoholic beverages

Starch is a natural polymer which can be broken down into sugar molecules and thence to ethanol. Various compounds containing forms of starch can thus be used to make alcoholic beverages. For example, beer is made from the starch in barley, and the resulting alcoholic solution is then boiled with hops to give it a bitter taste. Similarly, a wide variety of wines may be made from substances containing either starches or sugars. In addition to grapes, such substances as elderberries, beetroot, potatoes, rhubarb etc., can be used. It is estimated that over one million people in Britain make wine in their homes in this way.

When making wine it is necessary to be careful not to overexpose the wine to air in the early stages of fermentation, because oxidizing bacteria, whose spores are always present in air, may oxidize the wine to vinegar, i.e. the ethanol to ethanoic acid. This is how vinegar is made. Fortunately, when

the alcoholic content of the wine is greater than about 12 per cent, the bacteria become inactive and so wines and spirits do not turn sour on exposure to air. Beer, which has a lower alcoholic content, would turn sour in air fairly rapidly and so «stabilizers» are usually added. In contrast, when the alcoholic content of wine reaches about 17 per cent, the yeast enzymes then cease to function and further increase in the alcoholic content of the solution must be brought about by distillation, or even direct addition of alcohol, as in port.

Some spirits are said to be 40° proof or 70° proof, etc. This does *not* mean that such solutions contain 40 per cent or 70 per cent alcohol. The term is derived from an old method of determining the alcohol content of a solution, as such solutions were taxed according to the amount of alcohol they contained. The method consisted of pouring the alcoholic liquor over gunpowder and then applying a flame. If the gunpowder was left dry enough to ignite, it was 'proof that the liquor under test did not contain too much water. The liquor was then said to be proof. If the gunpowder was left too damp to ignite, the liquor was «underproof». Nowadays the Customs and Excise officer determines the amount of alcohol by the much less exciting method of measuring the density of the solution with a hydrometer.

Much of the world's supply of ethanol is still manufactured by fermenting natural starches or sugars, e.g. from starch in potatoes (Europe), from starch in rice (Asia) and from sugar in sugar cane (America). The carbon dioxide produced is usually collected and used on site in the making of lemonade and other «fizzy» drinks.

Ex. 10. *Match each underlined word in column A with its probable meaning in column B.*

A	B
1. Beer would turn sour in air fairly rapidly.	a) as well
2. Much of the supply of the ethanol is still manufactured by fermenting natural starches or sugars.	b) in this manner
3. Starch can be broken down into sugar molecules and thence to ethanol.	c) in the same way
4. Fortunately, when the alcoholic content of wine is more than 12 per cent, the bacteria become inactive.	d) luckily
5. If the gunpowder was left dry enough to ignite, it was «proof» that the liquor did not contain much water.	e) even now

6. Similarly, a wide variety of wines may be made from substances containing either starches or sugars.	f) today
7. In contrast, when the alcoholic content of wine reaches about 17 per cent, the yeast enzymes cease to function.	g) quite
8. In addition to grapes, such substances as elderberries, beetroot etc., can be used.	h) from them (molecules)
9. Nowadays, the amount of alcohol is determined with a hydrometer.	i) fairly
10. Many people in Britain make wine in their homes in this way.	j) as opposed to

Ex. 11. *Choose a suitable word or a phrase from the list given below for Russian fragments in brackets.*

Thus, is brought about, on exposure to, it is estimated, be broken down, the resulting, the liquor under test, in the making.

1. (Считается) that many people make wine in this way.
2. Different compounds containing forms of starch can (таким образом) be used to make alcoholic beverages.
3. It was «proof» that (исследуемый спиртной напиток) did not contain too much water.
4. The increase in the alcoholic content of the solution (осуществляется) by distillation.
5. Starch can (быть разложен на) sugar molecules.
6. The carbon dioxide produced is usually used (для производства) «fizzy» drinks.
7. Wines and spirits do not turn sour (когда подвергаются воздействию) air.
8. (Получаемый) alcoholic solution is boiled with hops to give it a bitter taste.

Ex. 12. *True or false.*

1. The yeast enzymes cease to function when the alcoholic content of wine reaches less than 17 per cent.
2. The Customs and Excise officer determines the amount of alcohol by an exciting method of pouring the alcohol liquor over gunpowder.
3. A great variety of wines are made from grapes.
4. Beer has a higher alcoholic content than wines.
5. To be 40° proof or 70° proof means that such solutions contain 40 per cent or 70 per cent alcohol.

6. The resulting alcoholic solution should be boiled with rhubarb to give it a bitter taste.
7. When the yeast enzymes cease to function the further increase in the alcoholic content of the solution is achieved by addition of alcohol.
8. An old method of finding out the alcohol content means that the alcoholic liquor was poured over a flame of gunpowder.
9. In the same way, a wide variety of wines may be made from substances containing both starches and sugars.
10. Wines and spirits do not turn sour when subjected to air.

Ex. 13. *Fill in the gaps with the prepositions* ***on, with, about, during, over, out, of, of, by, to, at, of, with.***

The advent ... the petrochemical industry has provided a reasonably cheap alternative means ... preparation, which can be carried ... much more speedily. This involves using ethene produced ... the 'cracking' of petroleum oils. The ethene is made to react ... water according ... the following equation: $C_2H_4(g) + H_2O(l) \sim C2H5OH(l)$.

This reaction can be brought ... in two ways: (1) by absorbing the gas in concentrated sulphuric acid ... 80°C and 25-atmospheres pressure, and treating the resultant solution ... steam; (2) by passing ethene and steam ... a catalyst of phosphoric acid ... kieselguhr, at a temperature ... 300°C and a pressure of 60 atmospheres.

Notes: equation, n – уравнение; kieselguhr, n – кизельгур, инфузорная земля; resultant, adj – полученный.

Ex. 14. *Testing questions.*

1. Name the general characteristics of alcohol.
2. How was the «proof» of alcohols determined in old times?
3. How were alcohols prepared in ancient times?
4. Why are stabilizers added to alcohols?
5. What is an alcohol molecule made up of?

ОГЛАВЛЕНИЕ