МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ
«ХАРКІВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ»

МЕТОДИЧНІ ВКАЗІВКИ
та проблемні завдання з англійської мови
до курсу навчання професійного спрямування
для студентів спеціальності 161 «Хімічні технології та інженерія»
Частина перша

English learner guide
and problem tasks for the professional course
for students of specialty 161 “Chemical Engineering”
Part 1

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Методичні вказівки та проблемні завдання з англійської мови до курсу навчання професійного спрямування для студентів спеціальності 161 «Хімічні технології». Частина перша / уклад. Я. А. Подольська. – Харків : НТУ «ХПІ». – 42 с.

English learner guide and problem tasks for the professional course for students of specialty 161 “Chemical Engineering”. Part 1.

Укладач: Я. А. Подольська
Рецензент: Т. Є. Гончаренко

Кафедра іноземних мов

Contents

Вступ

Дані методичні вказівки (у двох частинах) призначені для здобувачів вищої освіти спеціальності 161 «Хімічні технології» першого (бакалаврського) рівня. Головна мета даного посібника – розвиток і вдосконалення комунікативних навичок та мовної компетентності на основі професійно-орієнтованого матеріалу.

Методичні вказівки мають чітку, інтегровану структуру, що передбачає розвиток усіх видів мовленнєвої діяльності: читання, говоріння, аудіювання та письма. Тексти мають цікаву професійну тематику. До першої частини посібника увійшло дві теми: «Matter» та «Three states of matter».

Завдання поділені на претекстові, текстові і узагальнюючі, мають універсальний характер, сприяють засвоєнню лексичного та граматичного матеріалу, розумінню та практичному застосуванню в майбутній фаховій діяльності. Система вправ включає завдання на контроль розуміння прочитаного, активізацію відповідних граматичних і лексичних явищ, визначення логічних думок, викладених у тексті, пошук інформації, викладення змісту текстів у довільній формі. Практичні завдання стимулюють творчий процес роботи студентів та підвищують їх зацікавленість у самостійній підготовці.

Навчальний посібник також пропонує завдання для відпрацювання граматичних тем, які студенти вивчають під час практичних занять.

Unit 1.

Matter

Figure 1.1. The Earth

Speaking

1.1. The planets in the universe are made of millions of substances. What does the Earth consist of?

Reading

1.2. Look through the text and choose the correct statement.

a. The text describes different types of materials.

b. The text describes what happens during chemical reactions between elements.

1.3. Read the text and find the following:

a. The quantity of elements which occur naturally.

b. Names of the group of elements consisting of individual atoms.

c. Composition of brass.

Elements. Compounds. Mixtures

The universe is made up of a very large number of substances, and our own world is no exception. If this vast array of substances is examined more closely, it is found that they are made up of some basic substances which were given the name elements in 1661 by Robert Boyle.

In 1803, John Dalton (Figure 1.2) suggested that each element was composed of its own kind of particles, which he called atoms. Atoms are much too small to be seen.

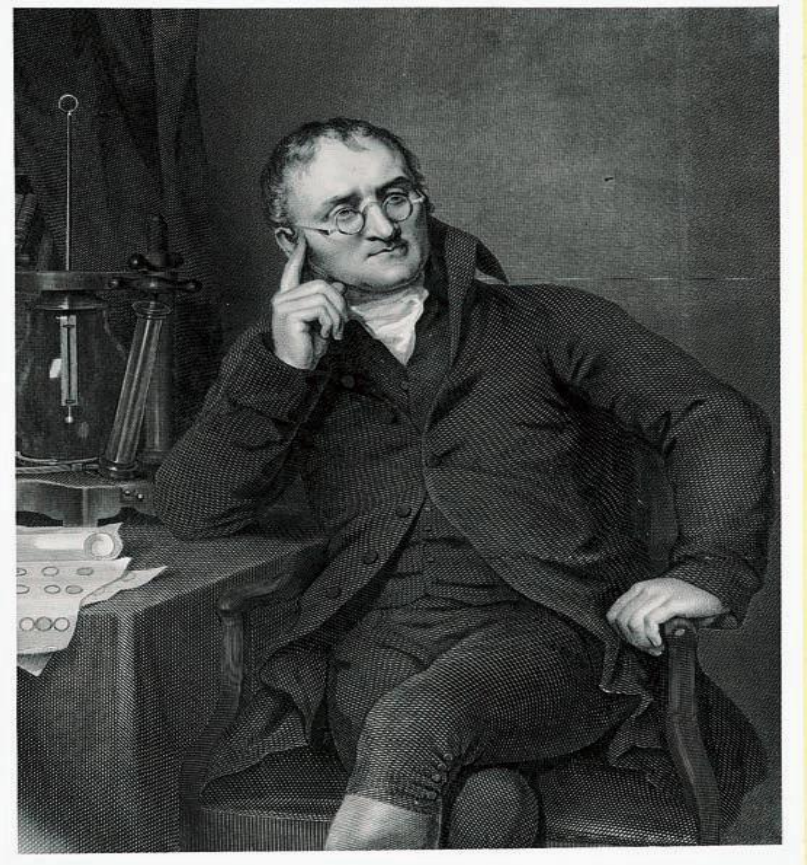

Figure 1.2. John Dalton (1766–1844).

Elements. Robert Boyle used the name element for any substance that cannot be broken down further, into a simpler substance. This definition can be extended to include the fact that each element is made up of only one kind of atom. The word atom comes from the Greek word atomos meaning ‘unsplittable’.

For example, aluminium is an element which is made up of only aluminium atoms. It is not possible to obtain a simpler substance chemically from the aluminium atoms. You can only make more complicated substances from it, such as aluminium oxide, aluminium nitrate or aluminium sulfate.

There are 118 elements which have now been identified. Twenty-seven of these do not occur in nature and have been made artificially by scientists. They include elements such as curium and unnilpentium. Ninety-one of the elements occur naturally and range from some very reactive gases, such as fluorine and chlorine, to gold and platinum, which are unreactive elements.

Atoms – the smallest particles. Everything is made up of billions of atoms. The atoms of all elements are extremely small. The smallest atom known is hydrogen, with each atom being represented as a sphere having a diameter of 0.00000007 mm (or 7×10^{-8} mm).

Atoms of different elements have different diameters as well as different masses.

Molecules. The atoms of some elements are joined together in small groups. These small groups of atoms are called molecules. For example, the atoms of the elements – hydrogen, oxygen, nitrogen, fluorine, chlorine, bromine and iodine – are each joined in pairs and they are known as diatomic molecules. The gaseous elements helium, neon, argon, krypton, xenon and radon are called noble gases and composed of separate and individual atoms. When an element exists as separate atoms, then the molecules are said to be monatomic.

Molecules are not always formed by atoms of the same type joining together. For example, water exists as molecules containing oxygen and hydrogen atoms.

Compounds. Compounds are pure substances which are formed when two or more elements chemically combine together. Water is a simple compound formed from the elements hydrogen and oxygen. This combining of the elements can be represented by a word equation:

$$hydrogen + oxygen \rightarrow water$$

Water molecules contain two atoms of hydrogen and one atom of oxygen, and hence water has the chemical formula H_2O. Elements other than hydrogen will also react with oxygen to form compounds called oxides. For example, magnesium reacts violently with oxygen gas to form the white powder magnesium oxide (Figure 1.3). This reaction is accompanied by a release of energy as new chemical bonds are formed.

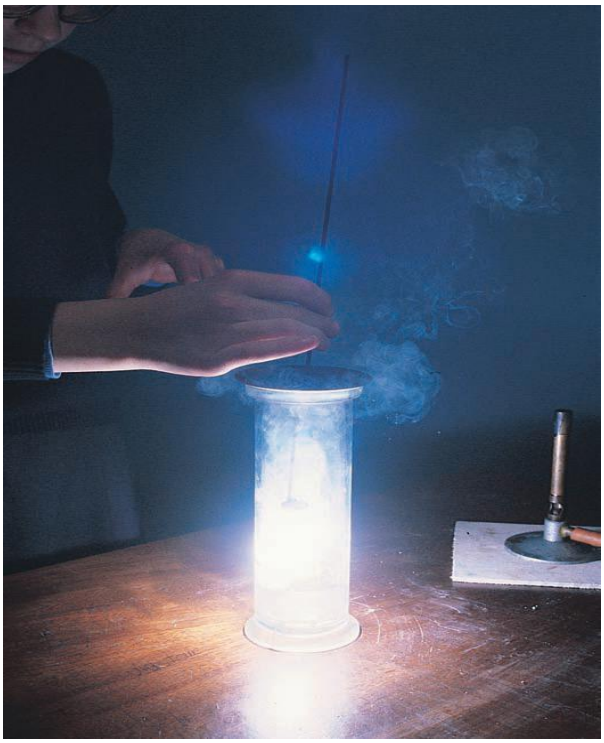

Figure 1.3. Magnesium burns brightly in oxygen to produce magnesium oxide.

When a new substance is formed during a chemical reaction, a chemical change has taken place:

magnesium + oxygen → magnesium oxide

Mixtures. Many everyday things are not pure substances, they are mixtures. A mixture contains more than one substance (elements and/or compounds). An example of a common mixture is sea water. Other mixtures include the air, which is a mixture of elements such as oxygen, nitrogen and neon and compounds such as carbon dioxide, and alloys such as brass, which is a mixture of copper and zinc.

What is the difference between mixtures and compounds?

There are differences between compounds and mixtures. This can be shown by considering the reaction between iron filings and sulfur. A mixture of iron filings and sulfur looks different from the individual elements (Figure 1.4).

Figure 1.4. The elements sulfur and iron at the top of the photograph, and (below) black iron (II) sulfide on the left and a mixture of the two elements on the right.

This mixture has the properties of both iron and sulfur; for example, a magnet can be used to separate the iron filings from the sulfur (Figure 1.5).

Figure 1.5. A magnet will separate the iron from the mixture.

Substances in a mixture have not undergone a chemical reaction and it is possible to separate them provided that there is a suitable difference in their physical properties. If the mixture of iron and sulfur is heated a chemical reaction occurs and a new substance is formed called iron (II) sulfide. The word equation for this reaction is:

iron + sulfur heat iron (II) sulfide

During the reaction heat energy is given out as new chemical bonds are formed. This is called an exothermic reaction and accompanies a chemical change. The iron (II) sulfide formed has totally different properties to the mixture of iron and sulfur (Table 1.1). Iron (II) sulfide, for example, would not be attracted towards a magnet.

Table 1.1 – Different properties of iron, sulfur, an iron/sulfur mixture and iron (II) sulfide

Substance	**Appearance**	**Effect of a magnet**	**Effect of dilute hydrochloric acid**
Iron	Dark powder	Attracted to it	Very little action when cold. When warm, a gas is produced with a lot of bubbling
Sulfur	Yellow powder	None	No effect when hot or cold
Iron/sulfur mixture	Iron/sulfur mixture	Iron powder attracted to it	Iron powder reacts as above
Iron (ii) sulfide	Black solid	No effect	A foul-smelling gas is produced with some bubbles

In iron (II) sulfide, FeS, one atom of iron has combined with one atom of sulfur. No such ratio exists in a mixture of iron and sulfur, because the atoms have not chemically combined. Table 1.2 summarizes how mixtures and compounds compare.

Table 1.2 – The major differences between mixtures and compounds.

Mixture	**Compound**
It contains two or more substances	It is a single substance
The composition can vary	The grey composition is always the same

No chemical change takes place when a mixture is formed	When the new substance is formed it involves chemical change
The properties are those of the individual elements/compounds	The properties are very different to those of the component elements
The components may be separated quite easily by physical means	The components can only be separated by one or more chemical reactions

Mixtures for strength. Composite materials. Composite materials are those that combine the properties of two constituents in order to get the exact properties needed for a particular job. Glass-reinforced plastic (GRP) is an example of a composite material combining the properties of two different materials (Figure 1.6).

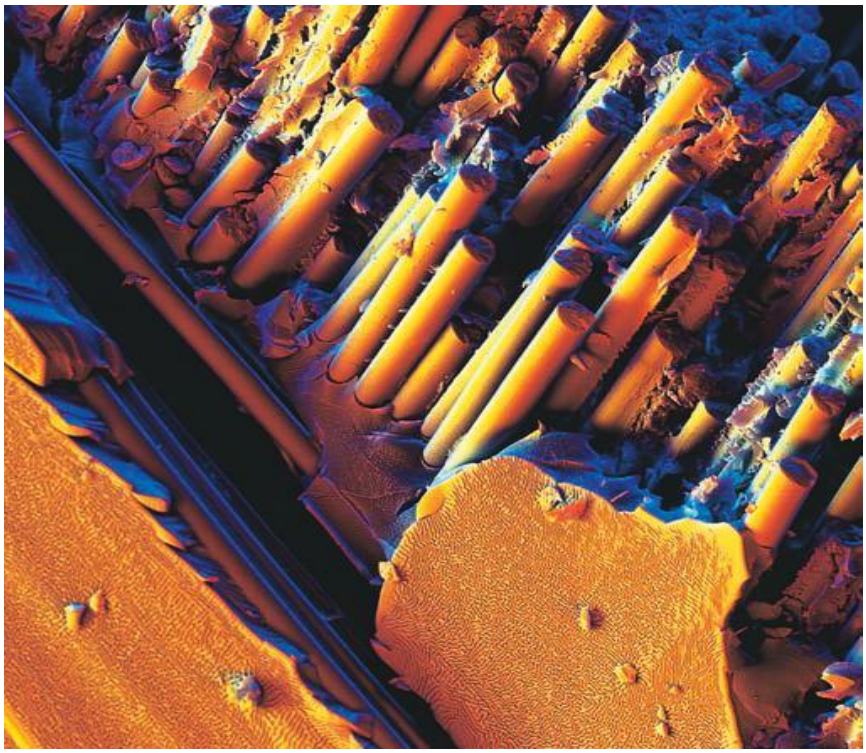

Figure 1.6. GRP consists of glass fibers (rod shapes) embedded in plastic, in this case polyester.

It is made by embedding short fibers of glass in a matrix of plastic. The glass fibers give the plastic extra strength so that it does not break when it is bent or moulded into shape. The finished product has the lightness of plastic as well as the strength and flexibility of the glass fibers (Figure 1.7).

Figure 1.7. The glass-reinforced plastic used to make boats like this is a composite material.

With a little investigation you will find that many composite materials are found in the natural world. Our bones, for example, are a composite material formed from strands of the protein collagen and the mineral calcium phosphate (Figure 1.8).

The calcium phosphate is hard and therefore gives strength to the bone. Another example is wood. Wood consists of cellulose fibers mixed with lignin, which is largely responsible for the strength of the wood.

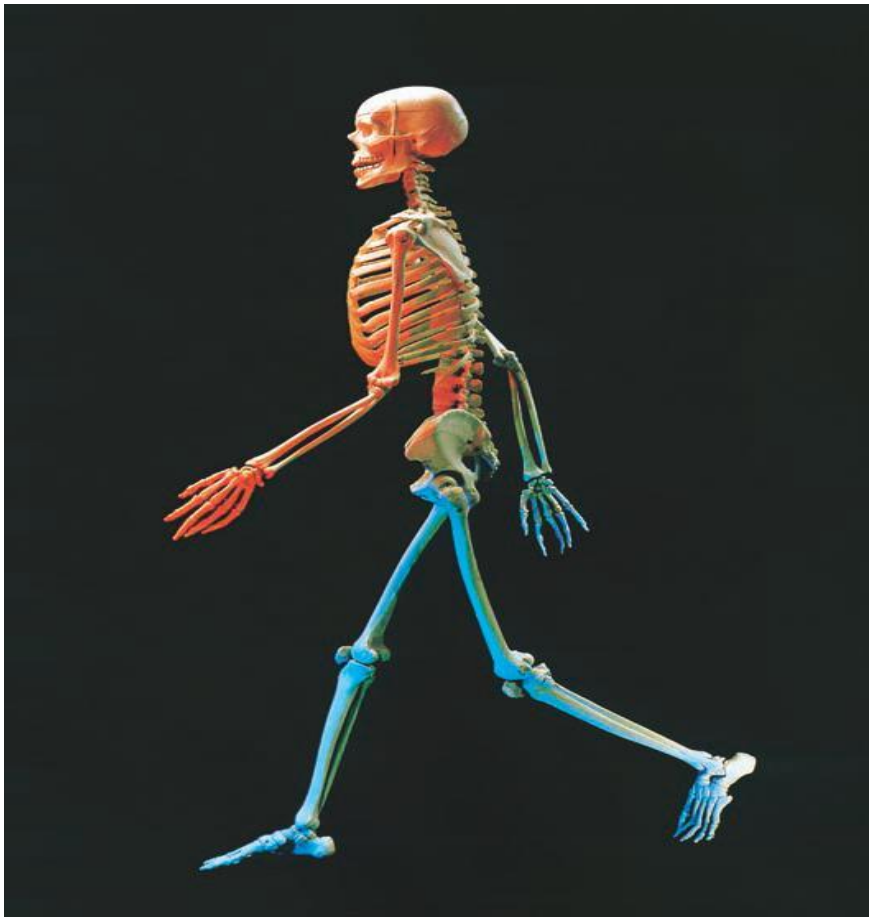

Figure 1.8. Bone is a composite material.

1.4. Do the following statements agree with the information in the text? Write

TRUE	if the statements agree with the information
FALSE	if the statements contradict the information
NOT GIVEN	if there is no information on this

1. All materials on the Earth consist of one or several elements.
2. It is possible to split elements into less complicated components.
3. Major of the identified elements don’t occur naturally.
4. Substances in a mixture undergo a chemical reaction.
5. It is possible to separate the components of a mixture by physical means.

6. Infrared spectroscopy is used to identify compounds.

7. There are a lot of composite materials in nature.

Vocabulary

1.5. Match the terms with their meaning.

1	Atom	a	A substance formed by the combination of two or more elements in fixed proportions.
2	Centrifuging	b	A technique employed for the separation of mixtures of dissolved substances.
3	Compound	c	The smallest part of an element that can exist as a stable entity.
4	Chromatography	d	A permanent change in which a new substance is formed.
5	Chemical change	e	Materials which combine the properties of two substances in order to get the exact properties required for a particular job.
6	Composite materials	f	A system of two or more substances that can be separated by physical means.
7	Mixture	g	The separation of the components of a mixture by rapid spinning.
8	Element	h	A molecule containing two atoms, for example hydrogen, H_2, and oxygen, O_2.
9	Molecule	i	A molecule which consists of only one atom, for example neon and argon.

10	Metals	j	A class of chemical elements that are typically poor conductors of heat and electricity.
11	Oxidation	k	A group of atoms chemically bonded together.
12	Monatomic molecule	l	The process of combining with oxygen.
13	Diatomic molecule	m	A substance which cannot be further divided into simpler substances by chemical methods.
14	Non-metals	n	A class of chemical elements which have a characteristic lustrous appearance and which are good conductors of heat and electricity.

1.6. Answer the questions.

1. Which of the substances listed below are:

a. metallic elements?

b. non-metallic elements?

c. compounds?

d. mixtures?

Silicon, sea water, calcium, argon, water, air, carbon monoxide, iron, sodium chloride, diamond, brass, copper, dilute sulfuric acid, sulfur, oil, nitrogen.

2. At room temperature and pressure, which of the substances listed below is:

a. a solid element?

b. a liquid element?

c. a gaseous mixture?

d. a solid mixture?

e. a liquid compound?

f. a solid compound?

Bromine, carbon dioxide, helium, steel, air, oil, marble, copper, water, sand, tin, bronze, mercury, salt.

1.7. Fill in the gaps with the correct alternative.

1. Substances differ from one another in _____.

a. condition

b. appearance

c. construction

d. composition

2. What are substances identified by?

a. their properties and composition

b. their places and their differences

c. their particles and consumption

d. their density and melting point

3. What does hydrogen gas form burning in oxygen?

a. air

b. ice

c. water

d. gas

4. What is the melting point of a substance?

a. a chemical property

b. a natural property

c. a physical property

d. a biological property

5. Which gas is given off during respiration?

a. oxygen

b. nitrogen

c. ozone

d. carbon dioxide

6. Distribute the substances in order of their abundance in the Earth:

a. iron

b. aluminum

c. silicon

d. calcium

7. Chlorine is a part of _____ family of elements.

a. noble

b. halogen

c. metallic

d. alkaline

Writing

1.8. Fill in the gaps with the words from the box.

homogeneous	condition	compounds	molecules
uniform		mixtures	heterogeneous

Classifying matter

Scientists have dozens of ways to describe matter. For instance, scientists classify materials based on their characteristics. Homogeneous materials have characteristics that are 1_____ throughout them. Conversely, the characteristics of heterogeneous materials are just the opposite. For example, salt water is 2_____ while wood is 3_ ____. Matter is also classified by its phase. Phases are another 4_____ that separates homogeneous and heterogeneous matter. Scientists also

classify materials by how easily they separate. Substances or 5_____ are materials that could not separate by physical means. However, physical means will separate 6_____. Finally, scientists classify matter by the types of 7_____ in them. Elements are substances that share the same atom type, compounds or substances with more than one type of atom.

Listening

1.9. Listen to a conversation between a student and an adviser. Do the following statements agree with the information in the conversation? Write

TRUE if the statements agree with the information

FALSE if the statements contradict the information

1. The student describes the methods of separating mixtures.
2. The student describes how materials are classified.
3. The adviser is satisfied with the answer.

1.10. Listen again and complete the conversation.

Advisor: Let's review matter classifications. Who feels prepared?

Student: I'll give it a shot.

Advisor: Okay, what is the 1 _____ between a mixture and a substance?

Student: A mixture can 2_____ into two different materials. By physical means, I mean.

Advisor: Yes, that's correct. And a 3_____?

Student: A substance on the other hand, cannot 4_____ into different materials. At least not through physical means.

Advisor: That's right. Now can you give me an example of each?

Student: Well, 5_____ itself is a substance and chocolate chip cookie dough is a 6_____.

Figure 1.9. Chocolate chip cookie dough

Speaking

1.11. Carbon-fiber-reinforced plastic (CRP) is used in the manufacture of golf clubs and tennis rackets. Answer the questions.

a. What are composite materials?

b. Which two substances are used to manufacture this composite material?

Consider the data in the table 1.3 and discuss in pairs the advantages and disadvantages of using the three materials above in the manufacture of golf clubs.

Table 1.3 – Material properties used in the manufacture of golf clubs

Material	**Strength/ GPa**	**Stiffness/ GPa**	**Density/g cm−3**	**Relative cost**
Aluminium	0.2	75	2.7	Low
Steel	1.1	200	7.8	Low
CRP	1.8	195	1.6	High

Grammar

1.12. Read the given extracts of critical reviews of the book "Air" and decide if they are positive (P) or negative (N):

1. After reading and rereading Dr. Steward's new book "Air", I simply can 't understand why some of the reviewers have found something wrong with the conclusions which this famous writer makes.

2. Since the time Dr. Steward began writing his book, new information has been obtained which clearly shows how questionable the conclusions that he makes are.

3. His books are always written in a very understandable manner, but even his clear style cannot hide the lack of understanding of what he describes.

4. It will be a great pity if Dr. Steward's new book "Air" is read only by specialists in the field of inorganic chemistry because a writer of such high qualification surely deserves a much greater audience of readers.

5. Although Dr. Steward 's new book "Air" doesn't contain many pages, I find it impossible to imagine how a better description of the subject could ever be produced.

6. On page after page of Dr. Steward's new book "Air" I found statements which my own experience in this field certainly leads me to a number of questions.

7. One cannot help expressing pity that more writers in this field have Dr. Steward's talent of clear expression combined with convincing proof of his conclusions.

8. There is certainly a great need in this field for a short, general review which combined scientific theory with good literary style, but, though Dr. Steward's literary style is worth speaking about, the theory which he tries to develop, leaves one unsatisfied.

9. In my previous books in this difficult field, I expressed the opinion that no satisfactory treatment of the subject had ever been published; and after reading Dr. Steward's latest attempt in the same area, 1'm ready to report that the situation remains unchanged.

10. In his latest book Dr. Steward has tried to present the beginning student with a popular introduction to the subject, and, although I am certainly in full sympathy with his purpose, I must honestly report here that in so many popular treatments in the field of science, the effort to give a simple but yet true picture of a difficult subject has proved to be far beyond the capacity of the writer.

1.13. Decide if the verbs in brackets need to be active or passive and put them in the right form.

The final and most important step in the development of the periodic table (take) in 1869, when the Russian chemist Dmitry Ivanovich Mendeleyev (1834-1907) (make) a thorough study of the relation between the atomic weights of the elements and their physical and chemical properties, with special attention to valence. Mendeleyev (propose) a periodic table containing seventeen columns, resembling in a general way the present periodic table without the noble gases. In 1871 Mendeleyev (revise) this table. A number of elements (place) in different positions, corresponding to revised values of their atomic weights.

The “zero” group (add) to the periodic table after the discovery of helium, neon, argon, krypton and xenon by Lord Rayleigh and Sir William Ramsay in 1894 and the following years.

The periodic law (accept) immediately after its proposal by Mendeleyev because of its success in making predictions with its use which afterward (verify) by experiment. In 1871 Mendeleyev (find) that by changing seventeen elements from the positions indicated by the atomic weights which (accept) for them into new positions, their properties better (can correlate) with the properties of the other elements.

1.14. Transform the sentences using complex subject as in example.

Example: We heard that a car stopped outside the door. — A car was heard to stop outside the door.

It is believed that the poem was written by Byron. —The poem is believed to have been written by Byron.

1. We know Bernard Shaw to have been a very witty man.
2. People consider the climate there to be very healthful.
3. It was announced that the Chinese dancers were arriving next week.
4. It is expected that the performance will be a success.
5. It is said that the book is popular with both old and young.
6. It is believed that the poem was written by an unknown soldier.
7. It is supposed that the playwright is working at a new comedy.
8. It is reported that the flood has caused much damage to the crops.
9. It was supposed that the crops would be rich that year.
10. It has been found that this mineral water is very good for the liver.
11. Scientists consider that electricity exists throughout space.
12. It is said that the weather in Europe was exceedingly hot last summer.
13. It is said that this man was very handsome in his youth.
14. It was reported that five ships were missing after the battle.

Unit 2.

Three states of matter

Speaking

2.1. Look at the picture of the railway track (figure 2.1). Explain why there are expansion gaps between the rails.

Figure 2.1. The railway track

Reading

2.2. Read the text and answer the following questions:

a. What particles do all substances consist of?

b. What keeps the particles in solids and liquids together?

c. What is the pressure of gas at the boiling point?

Three states of matter

What is matter? This word is used to cover all the substances and materials from which the physical universe is composed. There are many millions of different substances known, and all of them can be categorized as solids, liquids or gases.

Solids, liquids and gases.

A solid (Figure 2.2), at a given temperature, has a definite volume and shape which may be affected by changes in temperature.

Figure 2.2. Solid

A liquid (Figure 2.3), at a given temperature, has a fixed volume and will take up the shape of any container into which it is poured. Solids and liquid usually increase slightly in size when heated (expansion) and usually decrease in size if cooled (contraction).

A gas (Figure 2.4), at a given temperature, has neither a definite shape nor a definite volume. It will take up the shape of any container into which it is placed and will spread out evenly within it. Unlike those of solids and liquids, the volumes of gases are affected quite markedly by changes in temperature. Liquids and gases, unlike solids, are relatively compressible. This means that their volume

can be reduced by the application of pressure. Gases are much more compressible than liquids.

Figure 2.3. Liquid

Figure 2.4. Gas

The kinetic theory of matter. The kinetic theory helps to explain the way in which matter behaves. The main points of the theory are:

● All matter is made up of tiny, moving particles, invisible to the naked eye. Different substances have different types of particles (atoms, molecules or ions) which have different sizes.

● The particles move all the time. The higher the temperature, the faster they move on average.

● Heavier particles move more slowly than lighter ones at a given temperature.

The kinetic theory can be used as a scientific model to explain how the arrangement of particles relates to the properties of the three states of matter.

Explaining the states of matter. In a solid the particles attract one another. There are attractive forces between the particles which hold them close together. The particles have little freedom of movement and can only vibrate about a fixed position. They are arranged in a regular manner, which explains why many solids form crystals.

In a liquid the particles are still close together but they move around in a random way and often collide with one another. The forces of attraction between the particles in a liquid are weaker than those in a solid. Particles in the liquid form of a substance have more energy on average than the particles in the solid form of the same substance.

In a gas the particles are relatively far apart. They are free to move anywhere within the container in which they are held. They move randomly at very high velocities, much more rapidly than those in a liquid. They collide with each other, but less often than in a liquid, and they also collide with the walls of the container. They exert virtually no forces of attraction on each other because they are relatively far apart.

The arrangement of particles in solids, liquids and gases is shown in Figure 2.5.

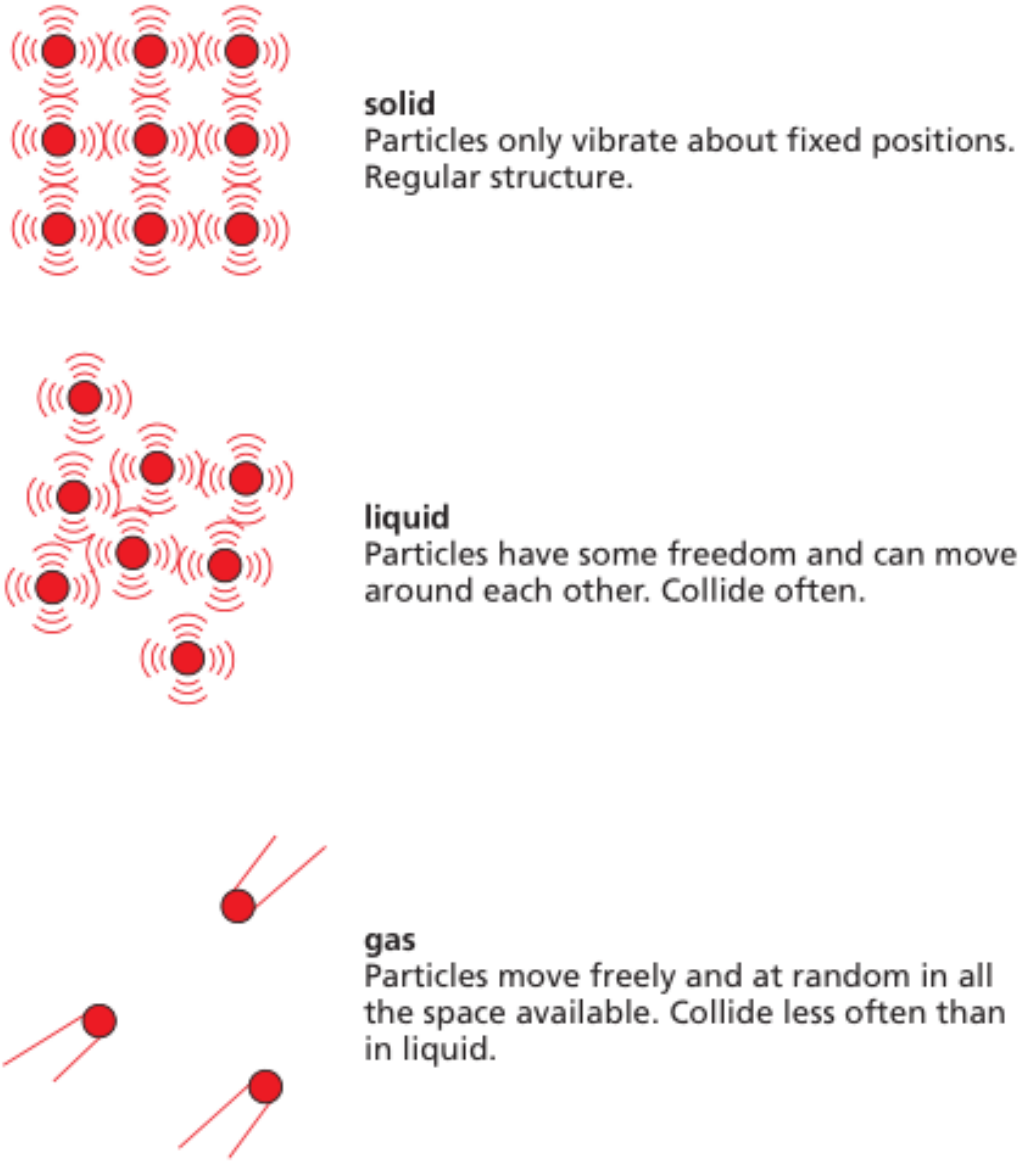

Figure 2.5. The arrangement of particles in solids, liquids and gases.

Changes of state. The kinetic theory model can be used to explain how a substance changes from one state to another. If a solid is heated the particles vibrate faster as they gain energy. This makes them ‘push’ their neighbouring

particles further away from themselves. This causes an increase in the volume of the solid, and the solid expands.

Eventually, the heat energy causes the forces of attraction to weaken. The regular pattern of the structure breaks down. The particles can now move around each other. The solid has melted. The temperature at which this takes place is called the melting point of the substance. The temperature of a pure melting solid will not rise until it has all melted. When the substance has become a liquid there are still very significant forces of attraction between the particles, which is why it is a liquid and not a gas.

Solids which have high melting points have stronger forces of attraction between their particles than those which have low melting points. A list of some substances with their corresponding melting and boiling points is shown in Table 2.1.

Table 2.1 – Melting and boiling points

Substance	**Melting point/°C**	**Boiling point/°C**
Aluminium	661	2467
Ethanol	−117	79
Magnesium oxide	827	3627
Mercury	−30	357
Methane	−182	−164
Oxygen	−218	−183
Sodium chloride	801	1413
Sulfur	113	445
Water	0	100

If the liquid is heated the particles will move around even faster as their average energy increases. Some particles at the surface of the liquid have enough energy to overcome the forces of attraction between themselves and the other particles in the liquid and they escape to form a gas. The liquid begins to evaporate as a gas is formed.

Eventually, a temperature is reached at which the particles are trying to escape from the liquid so quickly that bubbles of gas actually start to form inside the bulk of the liquid. This temperature is called the boiling point of the substance. At the boiling point the pressure of the gas created above the liquid equals that in the air – atmospheric pressure.

Liquids with high boiling points have stronger forces between their particles than liquids with low boiling points.

When a gas is cooled the average energy of the particles decreases and the particles move closer together. The forces of attraction between the particles now become significant and cause the gas to condense into a liquid. When a liquid is cooled it freezes to form a solid. In each of these changes energy is given out.

2.3. Do the following statements agree with the information in the text? Write

TRUE if the statements agree with the information

FALSE if the statements contradict the information

NOT GIVEN if there is no information on this

1. Volume of solids, liquids and gases increase if the temperature rises.
2. Liquids are as compressible as gases.
3. The kinetic theory explains why the properties of solids, liquids and gases are so different.
4. No energy is needed to change the state of a substance.
5. Heat energy increases the forces of attraction.

6. Solids with strong forces of attraction have low melting point.

7. Liquids evaporate at any temperature.

8. When boiling babbles of gas start to form in the liquid.

Vocabulary

2.4. Match the terms with their meaning.

1	Atmospheric pressure	a	A theory which explains properties of matter in terms of the constituent particles.
2	Sublimation	b	The pressure exerted by the atmosphere on the surface of the Earth due to the weight of the air.
3	Solids, liquids and gases	c	A process occurring at the surface of a liquid involving the change of state of a liquid into a vapour at a temperature below the boiling point.
4	Melting point	d	The process by which different substances mix as a result of the random motions of their particles.
5	Matter	e	The change of a vapour or a gas into a liquid. This process is accompanied by the evolution of heat.
6	Kinetic theory	f	The temperature at which the pressure of the gas created above a liquid equals atmospheric pressure.
7	Evaporation	g	The temperature at which a solid begins to liquefy.

8	Diffusion	h	The three states of matter to which all substances belong.
9	Condensation	i	The direct change of state from solid to gas and the reverse process.
10	Boiling point	j	Anything which occupies space and has a mass.

Writing

2.5. Fill in the gaps with the words from the box.

temperature	solid	evaporation	phases	condensation
liquid	pressure	transition	vapor	sublimation

The phase transitions of water

Like many substances water can exist in three 1_____. The phase depends on the surrounding 2_____ and 3_____. A phase diagram can illustrate such conditions. The 4_____ form of water is called Ice, freezing liquid water forms ice. At sea level, the melting point of ice is zero degrees Celsius. At this temperature ice goes through a phase 5_____ and becomes liquid water. Liquid water can become a gas by boiling or 6_____. The boiling point of water is 100 degrees Celsius at sea level. However, water evaporates into water 7_____ at lower temperatures. When water vapor touches a cool surface, it can undergo 8_____. This turns it back into a liquid. Water sometimes performs other phase transitions, for instance, ice can become water vapor directly through 9_____. Similarly, water vapor going through deposition directly into ice causes frost at 0.01 degrees Celsius, and 611.73 Pascal's water achieves its triple point. At its triple point, water exists as a solid, gas, and 10_____ at once.

2.6, a. Fill in the gaps in the description of the diagram in Figure 2.4 with the words from the box.

sufficient	particles	temperature	impurities	energy
levels off	flattens	rise	state	boil

Heating and cooling curves

The graph (figure 2.6) shows the temperature of water as it is heated steadily from −15 °C to 110 °C. You can see from the curve that changes of 1_____ have taken place. When the temperature was first measured only ice was present. After a short time, the curve 2_____, showing that even though heat energy is being put in, the temperature remains constant.

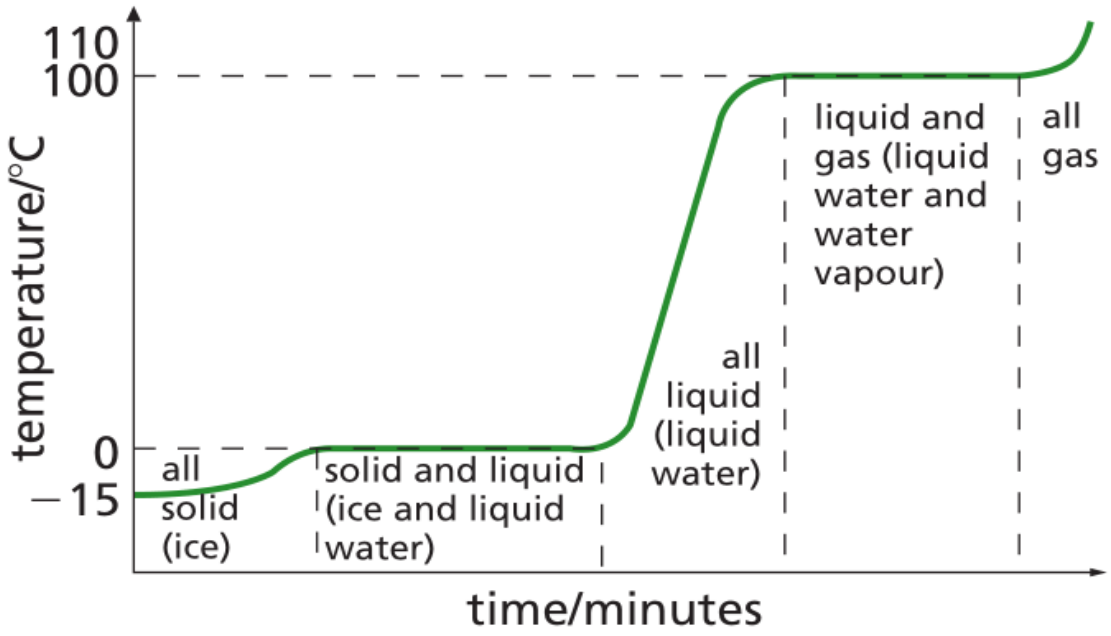

Figure 2.6. Graph of the change from ice to water to steam.

In ice the 3_____ of water are close together and are attracted to one another. For ice to melt the particles must obtain 4_____ energy to overcome the forces of attraction between the water particles to allow relative movement to

take place. This is where the heat energy is going. The 5_____ will begin to 6_____ again only after all the ice has melted. Generally, the heating curve for a pure solid always stops rising at its melting point and gives rise to a sharp melting point. A sharp melting point indicates a pure sample. The addition or presence of 7_____ lowers the melting point.

In the same way, if you want to 8_____ a liquid such as water you have to give it some extra 9_____. This can be seen on the graph where the curve 10_____at 100 °C – the boiling point of water.

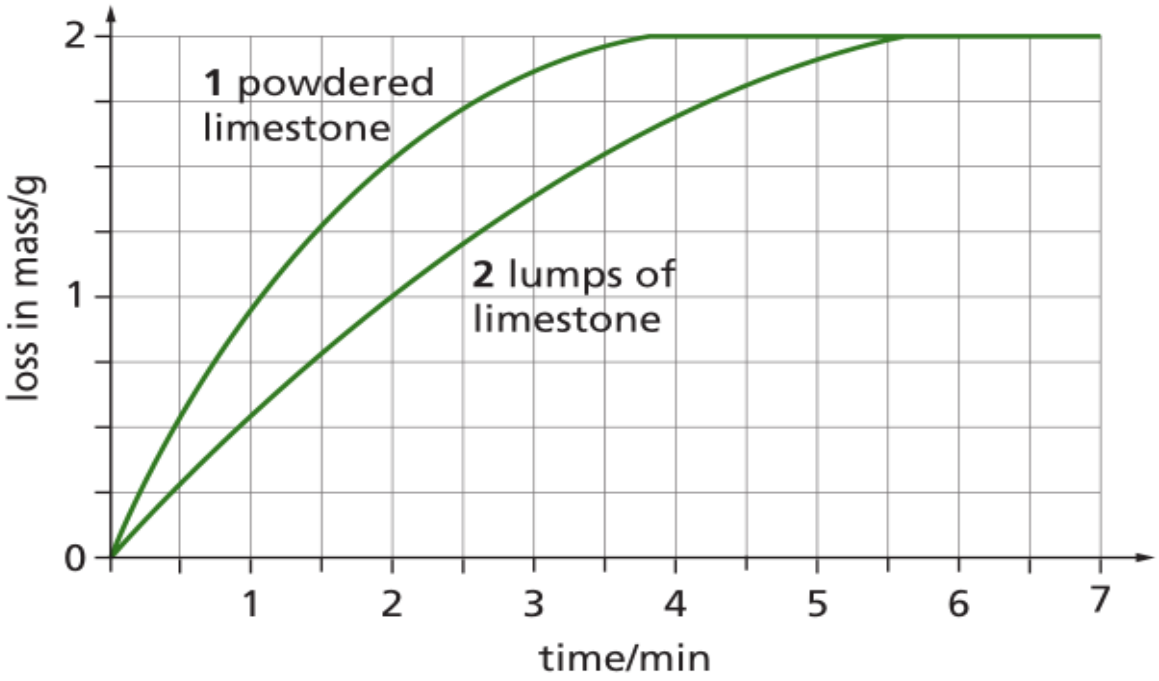

Figure 2.7. The rate of reaction

2.6, b. You can see in figure 2.7 two traces showing the rate of reaction with the powdered limestone and the lump form. Think about the reason why they are so different. Write about the two reactions using the appropriate vocabulary from the Useful language box below.

Useful language

Expressing changes	
to hold/remain steady	to fluctuate
to be stable	a fluctuation
to be constant	
	to rise / a rise
to decrease / an decrease	to increase / an increase
to decline / a decline	to go up
to fall / a fall	to double
dramatic / dramatically	slight / slightly gradual /
steep / steeply	gradually steady /
sharp / sharply	steadily
to reach a peak	to level off

Listening

2.7. Listen to a conversation between a student and an adviser. Do the following statements agree with the information in the conversation? Write

TRUE if the statements agree with the information

FALSE if the statements contradict the information

1. The student is not sure that his phase diagram for mercury is correct.
2. The student explains where the triple point is in the diagram.
3. The adviser finds a mistake in the diagram.

2.8. Listen again and complete the conversation.

Student: Excuse me. Could you help me for a second?

Advisor: Sure. What do you need?

Student: I'm creating a 1_____ diagram for mercury. And I want to verify I have the phase 2 _____ right.

Advisor: Okay. At sea level, when does mercury 3_____ from a solid into a liquid?

Student: My diagram says Mercury's melting point is negative 38.83 degrees Celsius.

Advisor: That sounds right. At the same 4_____ what is its boiling point?

Student: Mercury's boiling point is 356.73 degrees Celsius.

Advisor: That seems correct too. What is its triple point?

Student: I don't know. What is a triple point?

Advisor: It's the pressure and 5_____ at which a 6_____ can be all three phases simultaneously. It's where the three phases meet on your phase diagram.

Student: Oh, in that case, Mercury's triple point happens at negative 38.3344 degrees Celsius and 1.65 times 10 to the negative seven Pascals.

Advisor: Well, your phase diagram 7_____ completely correct to me.

Speaking

2.9. Discuss with the group the why the following phenomena take place. Use the kinetic theory to explain them.

a. When salt is placed on ice the ice melts.

b. When a jar of coffee is opened, people in all parts of the room soon notice the smell.

c. Ice on a car windscreen will disappear as you drive along, even without the heater on.

d. When you take a block of butter out of the fridge, it is quite hard. However, after 15 minutes it is soft enough to spread.

e. A football is blown up until it is hard on a hot summer's day. In the evening the football feels softer.

Grammar

2.10. Use as + adjective + as or not as / so … as to fill in the gaps in the sentences.

1. Mike is ___ tall ___ Pete.
2. Kate is not ___ nice ___ Ann.
3. My room is ___light ___ this one.
4. This book is not ___ thin ___ that one.
5. Sergei is ___ old ___ Michael.
6. She is ___ young ___ Tom's brother.
7. Nick's English is not ___ good ___ his friend's.
8. ___ far ___ I know, your sportsmen won not ___ many medals ___ ours.
9. His textbook is twice ___ thick ___ mine.

Read the rule.

We use **the + comparative …, the + comparative** to show that two things change together or that one thing depends on another thing.

e.g. The longer he talked, the more confused they became.

2.11. Complete the sentences using the + comparative, as in the example.

Example: The half-life period of an element is short. Its radioactivity is great.

The shorter the half-life period of an element, the greater its radioactivity.

1. The object moves fast. The air resistance is great.
2. The temperature of a metal is high. Its resistance is high.
3. You read much. You learn much.

4. The water-pipe is large. Much water passes through it.

5. The wire is short. Its resistance to current is little.

6. The number of free electrons in a substance is great. That substance conducts electricity well.

Read the rule.

Order of adjectives.

- Opinion adjectives go before fact adjectives.
  e.g. a handsome young man
- When there are two or more fact adjectives in a sentence, they usually go in the following order:

Size	Age	Shape	Colour	Origin	Material	Noun
a big	old	round	white	French	china	plate

- We do not usually use a long list of adjectives before a single noun. A noun is usually described by one, two or three adjectives at the most.
  e.g. an expensive Italian leather bag

2.12. Put the adjectives in the correct order.

1. a(n) black / old telephone
2. a rectangular / brass I lovely picture frame
3. two white / porcelain / pretty statues
4. some English / old / valuable books
5. a(n) antique / interesting clock
6. a wooden / traditional rocking chair
7. a glass / small / blue dish

8. a(n) English / wooden / old desk

9. a(n) china / oval / lovely plate

2.13 Read and translate the text paying attention to comparative forms of adjectives.

Investigations of Spectra

The more profound is the investigation of the structure of atoms and molecules, the more problems arise. It was not long ago that consideration of the extra-nuclear electrons was restricted to an indication that their number must equal the atomic number of the element, and to a mention of the fact that they form a relatively open structure about the central nucleus. The question of their arrangement must now be discussed in detail, and in this connection valuable information has been obtained from an examination of both optical and X-ray spectra, the former term being used to describe spectra in the ultraviolet, visible and infra-red regions. When a solid is heated to incandescence, it emits a more or less continuous spectrum, but gases and vapours under the same conditions, when examined spectroscopically, show a scries often very complicated, of distinct lines or bands occupying definite positions, that is, with definite wave lengths. The more information concerning the composition of various spectra was obtained, the clearer it became that the line spectra arc produced by atoms and so are not unfrequently referred to as atomic spectra, whereas the so-called band spectra, which can, in fact, often be resolved into large number of closely spaced lines, arc obtained from molecules.

A line spectrum is the one formed when radiation from an incandescent gas is passed through a slit and then dispersed. The lines arc produced by energy changes when electrons pass from high energy quantum levels to low energy

quantum levels. The electrons arc excited from low to high levels by the input of energy into the gas — usually in a discharge tube under a high voltage.

In a molecular spectrum, a series of fairly broad bands is formed. These bands arc sharp at one edge but dying away on the other. They arise from the complex energy changes possible in a molecule. Under high resolution, the band is shown to be made up of many lines sharper and clearer together at the head of the band but more diffuse away from the head of the band. It seems not at all unlikely that the more complex the molecule, the more complicated the spectrum is.

It is from atomic spectra in particular that information concerning the extra-nuclear electrons has been obtained.

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Навчальне видання

МЕТОДИЧНІ ВКАЗІВКИ

та проблемні завдання з англійської мови
до курсу навчання професійного спрямування
для студентів спеціальності 161 «Хімічні технології та інженерія»
Частина перша.

English learner guide
and problem tasks for the professional course
for students of specialty 161 “Chemical Engineering”
Part 1.

Укладач:
ПОДОЛЬСЬКА Яніна Анатоліївна

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