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Санкт-Петербургский горный университет
императрицы Екатерины II**

Кафедра иностранных языков

**ИНОСТРАННЫЙ ЯЗЫК.
ПЕРЕРАБОТКА МИНЕРАЛЬНОГО СЫРЬЯ
(АНГЛИЙСКИЙ ЯЗЫК)**

*Методические указания к самостоятельным работам
(все специальности факультета
переработки минерального сырья)*

**САНКТ-ПЕТЕРБУРГ
2024**

УДК 811.111.6 (621)

Иностранный язык. Переработка минерального сырья (английский язык):

Методические указания к самостоятельным работам. / Санкт-Петербургский горный университет императрицы Екатерины II. Сост. *Э.Р. Скорнякова, Е.В. Тенева*, СПб, 2024. 35 с.

Методические указания к самостоятельным работам предназначены для студентов всех специальностей факультета переработки минерального сырья. Предлагаемый материал направлен на совершенствование и закрепление навыков профессионально ориентированного чтения студентов на английском языке. Методические указания включают тексты на языке оригинала, специально разработанные упражнения и задания, способствующие развитию речевой, языковой, социокультурной и информационной компетенций студентов, необходимых для общения в сфере профессиональных интересов. Методические указания к самостоятельным работам также содержат лексические и грамматические упражнения, целью которых является повторение материала, пройденного на практических занятиях, и подготовка к сдаче итоговой аттестации по дисциплине «Иностранный язык».

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FOREWORD

Данные методические указания предназначены для учебно-методического сопровождения курса английского языка для студентов всех специальностей факультета переработки минерального сырья. Методические указания составлены в соответствии с учебной программой по дисциплине «Иностранный язык» для формирования иноязычной профессиональной компетенции будущих специалистов. В методические указания включены аутентичные тексты, в которых освещаются следующие вопросы: «Комплексная переработка как важнейший принцип всех минерально-сырьевых отраслей промышленности», «История развития технологических процессов и производств в горной, металлургической, нефтегазовой промышленности», «Виды минерального сырья. Черные и цветные металлы. Сплавы», «Процессы обогащения полезных ископаемых», «Основные соединения, виды химических реакций и связей», «Основные технологические процессы получения неорганических материалов», «Типы автоматизированных систем», «Средства автоматизации и управления», «Современное оборудование и технологии в металлургии и на горно-обогатительных предприятиях», «Воздействие процессов, использующихся при переработке минерального сырья, на экологию».

Изучение материала преследует цель развития навыков и умений просмотрового и изучающего чтения текстов по направлению подготовки, а также их перевода на русский язык с последующим использованием полученной информации для речевой практики; овладение студентами иноязычной коммуникативно-речевой компетенцией, позволяющей будущему специалисту осуществлять профессиональную коммуникацию.

UNIT 1. MINERAL RESOURCE INDUSTRY METALLURGY

Task 1. Translate the following passage from English into Russian:

The key aspects of metallurgy can be classified into two: extractive metallurgy and physical metallurgy.

Extractive metallurgy focuses on the extraction of metals from ores, followed by processes to refine and purify these metals. It involves hydrometallurgy and pyrometallurgy.

Physical metallurgy deals with the science of shaping and enhancing metallic materials. It refers to the study of metallic crystal structures, mechanical properties, electrical and magnetic properties, and chemical properties of metals. The key elements within physical metallurgy include: powder metallurgy, which involves creating materials or components from metal powders, and alloying known as the process of mixing different elements to enhance the properties of metals.

These key aspects of metallurgy are vital for understanding how metals are extracted, processed, and transformed into materials with diverse properties and applications in various industries.

(adapted from <https://www.petrosync.com/blog/what-is-metallurgy/>)

Task 2. Insert the missing words and expressions. Then translate the text.

<i>laboratory methods; ornamental; development; physical; extracting; gravels; metals; alloys; state; nuggets</i>

Metallurgy, art and science of (1) ... metals from their ores and modifying the (2) ... for use. Metallurgy refers to commercial as opposed to (3) It also concerns the chemical, (4) ..., and atomic properties and structures of metals and the principles whereby metals are combined to form (5) The present-day use of metals is the culmination of a long path of (6) ... extending over approximately 6,500 years. The first known metals were gold, silver, and copper, which occurred in the native or metallic (7) ..., of which the earliest were in all probability (8) ... of gold

found in the sands and (9) ... of riverbeds. Such native metals were appreciated for their (10) ... values during the latter part of the Stone Age.

(<https://www.britannica.com/science/metallurgy>)

Task 3. Match the terms with their definitions:

<i>terms</i>	<i>definitions</i>
1) metals	a) art and science of extracting metals from their ores and modifying the metals for use
2) alloys	b) extraction of metal from ore by preparing an aqueous solution of a salt of the metal and recovering the metal from the solution
3) hydrometallurgy	c) extraction and purification of metals by processes involving the application of heat
4) pyrometallurgy	d) any of a class of substances characterized by high electrical and thermal conductivity as well as by malleability, ductility, and high reflectivity of light
5) chemical property	e) an engineer trained in the extraction and refining and alloying and fabrication of metals
6) raw materials	f) a feature of a substance that can be measured without altering the identity of that substance
7) a metallurgist	g) a characteristic or behavior of a substance that may be observed when it undergoes a chemical change or reaction
8) metallurgy	h) metallic substances composed of two or more elements, as either a compound or a solution
9) a physical property	i) a small lump of gold or other precious metal found ready-formed in the earth.
10) a nugget	j) fossil fuels and inorganic chemicals

Task 5. Grammar revision. Open the brackets, using the verbs in the correct form of the Present Simple Tense or the Present Continuous Tense. Translate the sentences:

1) Metals ... (be) inorganic compounds that ... (consist) mostly of metallic elements, such as iron, aluminum, and nickel, but may also include trace amounts of non-metallic elements.

2) Mineral deposits generally ... (become) lower grade and mineralogically more complex.

- 3) The challenge for a lot of mining organizations ... (be) that many of them ... (not/have) standard operating environments at the automation and control level.
- 4) Metallurgy ... (encompass) the scientific and technological aspects of metals by investigating their physical and chemical properties.
- 5) Hydrometallurgy ... (include) a wide variety of operations, such as leaching, electrolysis, and electrowinning.
- 6) Innovations in mineral processing ... (focus) now on increasing production rates with the same equipment, reducing capital and unit operating costs, and minimizing energy, water and environmental impact.
- 7) The study of metals and their properties ... (be) the first step for each aspiring metallurgist.
- 8) In the area of oil refining, extremely complex applications ... (emerge) to handle tasks like automated batch processing.
- 9) In common use, the term 'metallurgy' ... (denote) industrial processes as opposed to scientific ones.
- 10) Automation and control systems ... (shape) the mine of the future as the technology ... (move) into generation three.

Task 5. Write an essay on the topic 'Why is metallurgy so important in the industrial world?' (100-120 words). Give your opinion.

UNIT 2. THE HISTORY OF TECHNOLOGICAL PROCESSES DEVELOPMENT

Task 1. Revise the vocabulary on the topic, give the English equivalents to the following Russian word combinations and fill the gaps in the sentences, using them:

технология автоматизации; цифровое преобразование; механические устройства; нефтегазовая отрасль; горнодобывающие компании; новое оборудование; нефтегазовые скважины; промышленная революция; искусственный интеллект; цифровой компьютер

- 1) ... has evolved from the related field of mechanization, which had its beginnings in the Industrial Revolution.

- 2) ... are increasingly turning to autonomous haulage systems to improve efficiency and productivity.
- 3) ... has historically been characterized by its reliance on complex operations.
- 4) In recent years, ... and automation technologies have emerged as powerful catalysts for transformation within the industry.
- 5) The integration of advanced technologies has opened up new possibilities for improving drilling and completion operations in
- 6) ... is the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing.
- 7) ... operates on data, including magnitudes, letters, and symbols, that are expressed in binary code—i.e., using only the two digits 0 and 1.
- 8) The Industrial Revolution provided the opportunity to replace the manual work with the
- 9) ... is designed according to the latest technical achievements in sea transportation.
- 10) ... refers to the ability of a digital computer or a computer-controlled robot to perform tasks commonly associated with intelligent beings.

Task 2. Read, translate and retell the following text:

If we look at the history of technology, there are many examples of machines replacing human beings. More recently, the introduction of robotics has seen millions of production line jobs in factories simply disappear.

Now, thanks to Artificial Intelligence, anyone whose work largely involves following a routine set of procedures and making a routine set of decisions – from call center workers to property lawyers and bank clerks – may soon find that a computer can do it better, more quickly and cheaply than they can.

More importantly, there's the issue of the jobs that Artificial Intelligence will create. Many of those former weavers took jobs as machine operators in mills; once the internal combustion engine arrived, many workers found themselves working in a car plant. Artificial Intelligence is set to become a huge industry in its own right, employing countless pro-

grammers, computer scientists and engineers – and that's not to mention new jobs we haven't even thought of yet.

(<https://www.sciencefocus.com/future-technology/automation-the-next-industrial-revolution>)

Task 3. Translate the following sentences and answer if they are true (T) or false (F):

- 1) There are many examples of machines replacing human beings.
- 2) Now, thanks to Artificial Intelligence, anyone whose work largely involves following a routine set of procedures may soon find that a computer can do it more effectively and much quicker than they can.
- 3) Since 2020, there has been exponential progress in the automation of mining systems.
- 4) The introduction of robotics has seen millions of production line jobs in factories simply emerge.
- 5) The technology of mechanization has evolved from the related field of automation, which had its beginnings in the Industrial Revolution.
- 6) Automation has revolutionized those areas in which it has been introduced, and there is scarcely an aspect of modern life that has been unaffected by it.
- 7) The word 'automation' is derived from ancient Greek words of Auto (means 'self') and Matos (means 'moving').
- 8) Automation systems include control systems.
- 9) Every area of mining is set to use automation technologies within the next few years.
- 10) Artificial intelligence is an advanced field of computer science in which the computer is programmed to exhibit characteristics commonly associated with human intelligence.

Task 4. Grammar revision. Open the brackets, using the verbs in the correct form of the Present Perfect Tense or the Present Perfect Continuous Tense. Then translate the sentences:

- 1) Automation ... (revolutionize) those areas in which it has been introduced, and there is scarcely an aspect of modern life that has been unaffected by it.

- 2) The development of this technology ... (become) increasingly dependent on the use of computers and computer-related technologies.
- 3) Siemens ... (work) with large ore truck companies since 2005.
- 4) The technology of automation ... (evolve) from the related field of mechanization, which had its beginnings in the Industrial Revolution.
- 5) Each new development in the history of powered machines ... (bring) with it an increased requirement for control devices to harness the power of the machine.
- 6) For the past three years, scientists ... (make) important modifications to a hot metal carrier.
- 7) Significant developments in various fields ... (occur) during the 20th century: the digital computer, improvements in data-storage technology and software to write computer programs, advances in sensor technology, and the derivation of a mathematical control theory.
- 8) All these developments ... (contribute) to progress in automation technology.
- 9) Finally, there ... (evolve) since World War II a highly advanced mathematical theory of control systems.
- 10) Through continuous innovation and re-imagining mining, we ... (introduce) new equipment for our dust suppression systems.

Task 5. Write an essay on the topic 'The pros and cons of using automation technologies in mining/metallurgical/oil and gas industries' (100-120 words). Give your opinion.

UNIT 3. TYPES OF MINERAL RAW MATERIALS. FERROUS AND NON-FERROUS METALS. ALLOYS

Task 1. Revise the vocabulary on the topic, give the English equivalents to the following Russian word combinations and match them to the given definitions:

<i>медь; серебро; титан; свинец; цветные металлы (2); черные металлы; легкий по весу алюминий; характеристики (свойства) меди; легированные стали</i>

- 1) ... are metals that do not contain any appreciable amounts of iron.
- 2) ..., such as cast irons or carbon steel, have a high carbon content, which generally makes them vulnerable to rust.
- 3) ... was the first metal to be forged; it was soft enough to be fashioned into various objects.
- 4) ... are used for a wide range of commercial, industrial, and residential applications.
- 5) ... and its alloys include high thermal conductivity, high electrical conductivity, good corrosion resistance, and high ductility.
- 6) ... makes it perfect for aerospace and automotive applications as well as for marine use in yachts.
- 7) ... is the heaviest common metal and is resistant to corrosion.
- 8) ... has been used as a precious metal for centuries.
- 9) ... was first discovered in 1791 and offers good corrosion resistance.
- 10) ... have a wide range of special properties, such as hardness, toughness, corrosion resistance, magnetizability, and ductility.

Task 2. Read, translate and retell the following text:

In the second row from the bottom of most periodic tables you'll find the lanthanides that are hard to distinguish from each other because of their similar colors and properties.

The lanthanides are members of a group known as rare earth elements that support everything from magnets that power clean energy technology to telescope lenses to the screen on device you're reading this upon. Mining them is difficult and ecologically costly.

So, chemists and engineers are trying to make the best use of rare earth elements that have already been processed by recycling them out of industrial waste and old electronics.

Most rare earth elements aren't actually that rare, but they're not easy to get. After their ore is mined from the ground, they have to be separated to make specialized products. Most rare earth mining homes in on lanthanum and cerium, but heavier metals like neodymium and dysprosium are especially desirable for the magnets used in a clean energy technology.

(<https://www.popsci.com/environment/rare-earth-metal-recycling/>)

Task 3. Translate the following sentences and answer if they are true (T) or false (F).

- 1) Alloy is a metallic substance composed of two or more elements, as either a compound or a solution.
- 2) Non-ferrous metals are never refined through electrolysis.
- 3) Ferrous metals, such as cast irons or carbon steel, have a low carbon content.
- 4) Ferrous metals were the first metals used by humans for metallurgy.
- 5) Due to their abundance, these gold, silver, and copper artifacts were treated as luxury items and handled with great care.
- 6) Due to their extensive use, non-ferrous scrap metals are usually recycled.
- 7) The properties of copper and its alloys include high thermal conductivity, high electrical conductivity, good corrosion resistance, and high ductility.
- 8) Aluminum is also found in bicycle frames, saucepans, and drink cans.
- 9) The discovery of copper in 5,000 BC marked the end of the Stone Age and the beginning of the Copper Age.
- 10) Rare earth elements are a special series of metallic non-ferrous mineral resources.

Task 4. Grammar revision. Open the brackets, using the verbs in the correct form of the Past Simple Tense or the Past Continuous Tense. Then translate the following sentences:

- 1) The history of ferrous metallurgy ... (begin) far back in prehistory, most likely with the use of iron from meteors.
- 2) In the late 1850s, Henry Bessemer ... (invent) a new steelmaking process, which involved blowing air through molten pig iron to produce mild steel.
- 3) Cast iron development ... (lag) in Europe, as the smelters ... (can) only achieve temperatures of about 1000 C; or perhaps they ... (not/want) hotter temperatures, as they ... (seek) to produce blooms as a precursor of wrought iron, not cast iron.

- 4) In England, the gradual exhaustion of timber ... (lead) first to prohibitions on cutting of wood for charcoal and eventually to the introduction of coke, derived from coal, as a more efficient fuel.
- 5) One difficulty with the bloomery process for the production of soft bar iron ... (be) that, unless the temperature was kept low, it ... (be) difficult to keep the carbon content low enough so that the metal ... (remain) ductile.
- 6) The most important development of the 19th century ... (be) the large-scale production of cheap steel.
- 7) Gold ... (be) one of the first metals utilized, being mined from streambeds of sand and gravel where it ... (occur) as a pure metal because of its chemical stability.
- 8) According to historians, the Egyptians ... (mine) copper on the Sinai Peninsula as long ago as 3000 BCE, although some bronze (copper alloyed with tin) is dated as early as 3700 BCE.
- 9) In the 1860s, Henry Clifton Sorby of Sheffield, England ... (use) light microscopy on the smooth surfaces of rocks and meteorites, thereby becoming the first real metallographer.
- 10) The 20th century ... (witness) a colossal expansion of electrical power generation and distribution.

Task 5. Write an essay on the topic 'Do the advantages of ferrous / non-ferrous metallurgy outweigh the disadvantages?' (100-120 words). Give your opinion.

UNIT 4. MINERAL PROCESSING

Task 1. Translate the following passage from English into Russian and retell the text.

Mineral processing is an art of treating crude ores and mineral products in order to separate the valuable minerals from the waste rock, or gangue. The primary operations are comminution and concentration, but there are other important operations in a modern mineral processing plant, including sampling and analysis. Sampling and analysis of the raw material are undertaken in order to acquire information necessary for the economic appraisal of ores and concentrates.

Many different sampling devices are available, including shovels, pipe samplers, and automatic machine samplers. For these sampling machines to provide an accurate representation of the whole lot, the quantity of a single sample, the total number of samples, and the kind of samples are of decisive importance. After one or more samples are taken, the samples are reduced to quantities suitable for further analysis. Analytical methods include chemical, mineralogical, and particle size.

(<https://www.britannica.com/technology/mineral-processing>)

Task 2. Insert the missing words and expressions. Then translate the text.

flotation process; coating; repellent; processing; finely; mineral particles; extracting; attracted; separate; concentration plants;

Flotation, in mineral (1) ..., method used to (2) ... and concentrate ores by altering their surfaces to a hydrophobic or hydrophilic condition — that is, the surfaces are either repelled or (3) ... by water. The (4) ... was developed on a commercial scale early in the 20th century to remove very fine (5) ... that formerly had gone to waste in gravity (6) Flotation has now become the most widely used process for (7) ... many minerals from their ores. Most kinds of minerals require (8) ... with a water ... (9) to make them float. By coating the minerals with small amounts of chemicals or oils, (10) ... ground particles of the minerals remain unwetted and will thus adhere to air bubbles.

(<https://www.britannica.com/technology/flotation-ore-dressing>)

Task 3. Match the terms with their definitions:

<i>terms</i>	<i>definitions</i>
1) crude ore	a) any of the processes used in separating the components of mixtures of heterogeneous solid particles,
2) separation	b) a method used to separate and concentrate ores by altering their surfaces to a hydrophobic or hydrophilic condition
3) comminution	c) an art of treating crude ores and mineral products in order to separate the valuable minerals from the waste rock, or gangue

4) mineral processing	d) to separate the valuable components of an ore from the waste rock, the minerals must be liberated from their interlocked state physically by this process
5) sampling	e) the removal from a given lot of material a portion that is representative of the whole yet of convenient size for analysis
6) raw materials	f) the mass of a unit volume of a material substance
7) density	g) the ore as it leaves the mine in an unconcentrated form
8) flotation	h) separating of particles by their relative densities (specific gravity)
9) gravity concentration	i) fossil fuels and inorganic chemicals
10) water-repellent	j) not easily penetrated by water, especially as a result of being treated for such a purpose with a surface coating.

Task 4. Grammar revision. Open the brackets, using the verbs in the correct Future form. Then translate the sentences:

- 1) We ... probably ... (be able) to prevent landslides by building a wall here.
- 2) It's unlikely that there ... (be) an avalanche on this mountain.
- 3) The remote subsea equipment ... (be activated).
- 4) Be attentive! 50 kilometres of booms ... (be dropped) into the sea and the blowout preventer ... (be activated) in a few minutes.
- 5) The rig for the relief well ... (be transported) to the site.
- 6) The International meeting concerning environmental impacts on extraction and processing of raw materials ... (start) on September, 2.
- 7) The train to Volgograd ... (depart from) the railway station at 5.30 p.m.
- 8) Rio Tinto Iron Ore next year ... (cut) the ribbon on its state-of-the-art remote operations center in Perth in Western Australia, a facility that the company claims is an industry first and one which ... (galvanize) the three-year lead in automation Rio says it has over its peers.
- 9) Scientists from Kaliningrad ... (visit) the Hermitage tomorrow at 3 p.m.
- 10) Prof. Ivanov ... (fly) to Moscow next Monday to make a speech on the topic "Digitalization of mining: major challenges".

Task 5. Write an essay on the topic ‘Why are the responsible extraction and sustainable use of mineral resources essential for our harmonious future?’ (100-120 words). Give your opinion.

UNIT 5. BASIC COMPOUNDS. TYPES OF CHEMICAL REACTIONS AND BONDS

Task 1. Translate the following passage from English into Russian. In your opinion, how do chemical reactions occur in space?

More haste and less speed can sometimes be required for intergalactic reactions. The temperature of objects in space varies massively. A comet travelling close to the Sun might experience millions of degrees centigrade as it hurtles around our star, but when it swings back out to the edges of the Solar System its surface will fall to -220°C .

In general, reaction speed is closely linked to temperature. The rate of reaction halves for every 10°C drop. So, a reaction that takes one second on that comet just as its ice surface melts might then take 1×10^6 years out in the Oort Cloud. However, there are other sources of energy that can power reactions: high energy cosmic rays or ultraviolet light from a nearby star can give chemicals enough energy to react at less astronomical timescales.

(<https://www.sciencefocus.com/space/how-do-chemical-reactions-occur-in-the-cold-of-space>)

Task 2. Insert the missing words and expressions. Then translate the text.

ionic bonds; covalent bond; hydrogen bond; metallic bond; nonmetals; chemical bonds; electron; metallic; electronegative; atoms

Chemical bonds are forces that hold the (1) ... together in a molecule. The main types of (2) ... are ionic bond, covalent bond, hydrogen bond, and metallic bond.

(3) ... result from the attraction between ions. Ions are formed when an atom loses or gains an (4)

In the case of a (5) ..., an atom shares one or more pairs of electrons with another atom and forms a bond. Such a type of bonding is common between two (6)

A (7) ... is a chemical bond between a hydrogen atom and an (8) ... atom. A (9) ... is a force that holds atoms together in a (10) ... substance.

(<https://www.chemistrylearner.com/chemical-bonds>)

Task 3. Match the terms with their definitions:

<i>terms</i>	<i>definitions</i>
1) an electron	a) the study of the composition and properties of elements and compounds, the structure of their molecules, and the chemical reactions that they undergo
2) an atom	b) any of the interactions that account for the association of atoms into molecules, ions, crystals, and other stable species that make up the familiar substances of the everyday world
3) chemistry	c) a process in which one or more substances, the reactants, are converted to one or more different substances, the products
4) chemical bonding	d) any atom or group of atoms that bears one or more positive or negative electrical charges
5) a chemical element	e) any substance composed of identical molecules consisting of atoms of two or more chemical elements.
6) a chemical reaction	f) one of the three basic subatomic particles—along with protons and neutrons—that make up atoms, the basic building blocks of all matter and chemistry
7) an ion	g) a group of two or more atoms that form the smallest identifiable unit into which a pure substance can be divided and still retain the composition and chemical properties of that substance
8) a chemical compound	h) any substance that cannot be decomposed into simpler substances by ordinary chemical processes
9) a molecule	i) the basic building block of all matter and chemistry
10) a substance	j) a unique form of matter with constant chemical composition and characteristic properties.

Task 4. Grammar revision. Open the brackets, using the correct form of the modal verbs. Then translate the following sentences:

- 1) One of the potential disadvantages of complex automation and control systems is that they ... (a modal verb of possibility) add significant new costs to acquisitions in cases where technologies are not compatible.
- 2) We at “Global Road Technology” believe that Dust suppression systems ... (a modal verb of obligation) evolve to meet the needs of autonomous mining applications.
- 3) Many experts suggest that the number of jobs that new technologies create also ... (a modal verb of obligation) be taken into account in relation to their impact on employment.
- 4) For example, a robot with artificial intelligence ... (a modal verb of possibility) be capable of the command “assemble the product”.
- 5) Machines of the future ... (a modal verb of ability) to autonomously adjust their speed and function depending on the operating environment.
- 6) Machines of the future ... (a modal verb of ability) communicate optimal operating speeds, potential breakdowns, the wear of key components and appropriate maintenance schedules.
- 7) While artificial intelligence brings a lot of advantages, many people are worried that Artificial Intelligence ... (a modal verb of possibility) spell the end of their jobs.
- 8) According to the modern view of chemical reactions, bonds between atoms in the reactants ... (a modal verb of logical assumption) be broken.
- 9) This family of elements ... (a modal verb of possibility) seemed to be irrelevant to understanding of chemical bonds.
- 10) The existence of related families of compounds ... (a modal verb of logical assumption) immediately be explained.

Task 5. Write an essay on the topic ‘The applications of Chemistry in daily life’ (100-120 words). Give your opinion.

UNIT 6. CHEMICAL TECHNOLOGIES OF INORGANIC SUBSTANCES

Task 1. Read and translate the following text. Are metals the products of the inorganic chemical industry?

Industrial inorganic chemistry includes subdivisions of the chemical industry that manufacture inorganic products on a large scale such as the heavy inorganics and fertilizers as well as segments of fine chemicals that are used to produce high-purity inorganics on a much smaller scale. Among these are reagents and raw materials used in high-tech industries, the pharmaceutical industry, and the electronics industry, for example, as well as in the preparation of inorganic specialties such as catalysts, pigments, and propellants.

Metals find a variety of uses. They are manufactured from ores and purified by many of the same processes as those used in the manufacture of inorganics. However, if they are commercialized as alloys or in their pure form such as iron, lead, copper, or tungsten, they are often considered products of the metallurgical rather than products of the inorganic chemical industry.

(<https://www.sciencedirect.com/science/article/abs/pii/B9780128498910000035>)

Task 2. Insert the missing words and then translate the text:

<i>purification; an electron; cathode; a chemical change; compounds; solution; electrode; extraction; an electrolytic cell; ions</i>
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Electrolysis is a process by which electric current is passed through a substance to effect (1) The chemical change is one in which the substance loses or gains (2) ... (oxidation or reduction). The process is carried out in (3) ..., an apparatus consisting of positive and negative electrodes that are dipped into a solution that contains positively and negatively charged (4) Electric current enters through the negatively charged electrode - (5) ...; components of the (6) ... travel to this electrode, combine with the electrons, and are transformed. If the substance to be transformed is the (7) ..., the reaction is often one in which the elec-

trode dissolves by giving up electrons. Electrolysis is used extensively in metallurgical processes, such as in (8) ... or (9) ... of metals from ores or (10) ... and in deposition of metals from solution.

(<https://www.britannica.com/science/electrolysis>)

Task 3. Match the English and Russian equivalents and make up 10 sentences using them:

<i>English</i>	<i>Russian</i>
1) a solution	a) катализатор
2) an electric current	b) аммиак
3) a catalyst	c) электролиз
4) pharmaceuticals	d) неорганические вещества
5) ammonia	e) водородные связи
6) thermal decomposition	f) удобрения
7) electrolysis	g) раствор
8) hydrogen bonds	h) лекарственные препараты
9) fertilizers	i) термическое разложение
10) inorganic chemicals	j) электрический ток

Task 4. Grammar revision. Choose the correct quantifier and explain the differences in their usage. Then translate the following sentences:

1) Binary compounds are very common in inorganic chemistry, and they exhibit ... (many/a few/little) structural variety.

2) Ionic compound is ... (some/many/any) of a large group of chemical compounds that consist of oppositely charged ions.

3) (Some/Any/Many) ... atoms, such as lead, iron, chromium, mercury, tin, and nickel, have more than one stable ionic form.

4) In the early days of the science of chemistry, there was ... (some/little/no) systematic approach to naming compounds.

5) In contrast, only a handful of inorganic compounds contain carbon atoms. Carbon dioxide (CO₂) is one of the ... (little/a few/few) examples.

6) Inorganic compounds exhibit a range of bonding properties. (Some/Many/Little) ... are ionic compounds, consisting of very simple cations and anions joined by ionic bonding.

7) (Many/Any/ Some) ... inorganic compounds are characterized by high melting points. (Few/Some/Little) ... salts (e.g., NaCl) are very soluble in water.

8) In a more general definition, (any/some/no) ... chemical species capable of binding to electron pairs is called a Lewis acid.

9) Every day we handle many substances which are chemicals, and we even consume them. Table salt (NaCl), sugar, and vinegar are ... (a few/a little/ little) chemical substances used in our daily routine.

10) Treatment with ... (a few/a little/many) chemicals can isolate morphine, the active ingredient in opium.

Task 5. Write an essay on the topic “The importance of inorganic chemistry in our life” (100-120 words). Give your opinion.

UNIT 7. TYPES OF AUTOMATION SYSTEMS

Task 1. Revise the vocabulary on the topic. Give the English equivalents to the following Russian word combinations and match them to the given definitions below:

<i>программируемая автоматизация; гибкая автоматизация; фиксированная система автоматизации; автоматическая станочная линия; производить изделия партиями; промышленные роботы; станок с ЧПУ; производственное оборудование; конфигурация оборудования; автоматические сборочные машины</i>

1) ... is the ideal system for batch processes and shops.

- 2) ... is a type of automation system that allows the order of operations to be governed by a specific program.
- 3) ... is a manufacturing system which consists of a predetermined sequence of machines connected by an automated material handling system and designed for working on a very small family of parts.
- 4) ... is the automated control of tools by means of a computer.
- 5) ... any machinery and related components which is used, or can be used, to produce or process other tangible property.
- 6) ... an automated manufacturing system in which equipment programmed specifically for one purpose handles each production and assembly operation.
- 7) ... a manufacturing process in which items or products are produced in groups.
- 8) ... any line, circuit, router package, or other technical configuration used to provide a connection to the exchange data feeds.
- 9) ... programmable machines designed to perform both repetitive activities as well as activities that are dangerous for people or require high precision and high speed on a constant basis.
- 10) ... automatic mechatronic systems, used for assembling of two or more parts.

Task 2. Read, translate and retell the following text:

Each of the types of industrial automation has its own advantages and disadvantages.

Fixed automation systems are the simplest and cheapest to install, but they are limited in the number of tasks they can perform.

Programmable automation systems, on the one hand, are more expensive to install than fixed automation systems, but they allow factories to produce a wider range of products.

Flexible automation systems can be the most expensive to install, but they allow factories to produce a wider range of products and to make changes to their production line quickly and easily.

In factory automation, the type of industrial automation system that best works will depend on the specific needs of the factory. Howev-

er, in general, programmable automation systems are the most versatile, whereas flexible automation systems are the most efficient.

(<https://www.tm-robot.com/en/types-of-factory-automation/>)

Task 3. Translate the following sentences and answer if they are true (T) or false (F), according to the text. Identify the sentences with verbs in Passive Voice:

- 1) In a fixed automation system, the machines are permanently set up to perform a specific task.
- 2) Examples of a flexible automation system are mass production factories for food and other items where the products are moved through a conveyor.
- 3) In a programmable automation system, the sequence of operations and machines involved cannot be changed.
- 4) Flexible automation systems can be the cheapest to install.
- 5) Programmable automation systems are used in industries where the tasks vary from one batch to the next.
- 6) Flexible automation is the simplest type of industrial automation.
- 7) Programmable automation is more complex than fixed automation.
- 8) The type of automation system depends on the specific needs of the factory.
- 9) In a flexible automation system, the machines can be programmed to perform a variety of tasks, but they can also be adjusted to change the way they perform those tasks.
- 10) Flexible automation systems are less efficient than programmable automation systems.

Task 4. Grammar revision. Choose the correct form of the verbs (Active or Passive Voice) for each gap below. Then translate the sentences:

- 1) Humans ... always (be) a part of automation history.
- 2) The machines can ... (program) to perform a variety of tasks.
- 3) Last year the sequence of operations ... significantly (change).
- 4) ... fixed automation systems ... (not limit) in the number of tasks they can perform?

- 5) The term 'automation' ... (coin) in the automobile industry around 1946.
- 6) Digital Revolution allowed computer systems ... further (refine).
- 7) Industrial robots ... (complete) a variety of tasks.
- 8) When ...the first programmable electronic computer... (complete)?
- 9) There ... (be) improvements in program storage technologies and robotics in the near future.
- 10) Before the advent of automated systems, many chemicals ... (make) in batches.

Task 5. Write an essay on the topic 'The pros and cons of using computer technologies in manufacturing' (100-120 words). Give your opinion.

UNIT 8. INDUSTRIAL AUTOMATION EQUIPMENT

Task 1. Translate the following passage from the text and choose the best title for each paragraph:

- 1) What is a PLC?
- 2) How does a PLC work?
- 3) What does a PLC consist of?

(1) _____

A PLC is an industrial computer that serves a basic function: to manage the movements of the automated handling equipment operating in a facility, e.g., stacker cranes and conveyors. To do this, the PLC activates and deactivates electrical devices on each machine, such as signal beacons, relays and motors.

(2) _____

PLCs are made up of several components. One is the central processing unit (CPU), which processes the PLC program and stores all related data. PLCs also have modules to enable the physical connection between the industrial computer and the automated systems to be moved. Likewise, PLCs need hardware and software to interpret the instructions and functions each machine needs to follow and perform.

(3) _____

Through the information received by the sensors and input devices connected to each machine, the PLC processes the data and sends orders to the handling equipment. When the sensor detects the unit load, the PLC will order the pallet to be transferred to the lift and then moved to the corresponding level.

(<https://www.mecalux.com/blog/plc-automation>)

Task 2. Insert the missing words and expressions from the box into the text. Then translate the text.

production line, application, standalone units, performance, sensors, industrial computers, electrical signals, error, need, commands

Programmable Controllers are similar to (1) PLCs can work as (2) ... that can continuously monitor and automate a process, specific machine function. PLCs can be networked; such a network can control an entire (3) PLCs can be adapted to monitor and control many (4) ... and actuators; they process (5) ... and use them to carry out preprogrammed (6) ... for almost any (7) PLCs are used in industrial automation to increase reliability, system stability and (8) ..., which minimize the (9) ... for human operators and the chances of human (10)

(<https://www.unitronicsplc.com/what-is-industrial-automation/>)

Task 3. Match the terms with their definitions:

<i>terms</i>	<i>definitions</i>
1) a PLC	a) the measurement of overall system performance, accessibility and usability
2) a CPU	b) the connection of at least two computer systems, either by a cable or a wireless connection.
3) industrial automation	c) a system in which the functions of a human operator (or a group of operators) and a machine are integrated
4) a human operator	d) the ability of a system or component to function under stated conditions for a specified period of time
5) a network	e) a person's mistake rather than on the failure of a machine
6) a human-machine system	f) an industrial computer control system that conti-

	continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices.
7) reliability	g) to program in advance
8) a human error	h) a part of a computer that controls all the other parts
9) system stability	i) a natural person in the vehicle with immediate access to controls for steering, braking, and acceleration.
10) to pre-program	j) a set of technologies that uses control systems and devices, such as computer software and robotics, to enable automatic operation of industrial processes and machinery without the need for human operators.

Task 4. Grammar Revision. Use either Infinitive or Gerund (or both, if possible). Then translate the following sentences:

- 1) A PLC finished ... (manage) the movements of the equipment.
- 2) Our company needs ... (buy) PLCs as well as other hardware and software.
- 3) This software allows the manufacturing process ... (automate).
- 4) Does the system contain instructions that ensure the operation of each machine and the movements ... (execute)?
- 5) The project required ... (use) different kind of the automated equipment. The director required us (purchase) the necessary equipment.
- 6) PLCs should ... (network) only if there are sound business and technical reasons for it.
- 7) Data storage refers to ... (retain) information so it can be easily accessed later or even kept in perpetuity.
- 8) In a nutshell, a CPU is responsible for ... (handle) the processing of logical and mathematical operations and ... (execute) instructions that it is given.
- 9) There are programs that manage ... (click) and (select) elements with a computer mouse and (press) down on your laptop's touchpad.
- 10) Programs are sets of instructions that need ... (execute) in sequential.

Task 5. Write an essay on the topic ‘Will robots replace human workers in all industries?’ (100-120 words). Give your opinion.

UNIT 9. MODERN TECHNOLOGIES AND INNOVATIONS IN METALLURGY AND MINING

Task 1. Revise the vocabulary on the topic. Translate the words and phrases into English and fill the gaps in the sentences below:

Интернет вещей; 3D печать; данные в реальном времени; современные материалы; коллаборативная робототехника; металлообработка; автоматизированное производство; цифровизация; передовые материалы; изготовление

- 1) ... refers to the use of computers in the different functions of production planning and control.
- 2) For the process of ... both human labor and automation is required.
- 3) ... is when automatically operated robot systems share the same workspace with humans.
- 4) Only the most ... are used for production, which give the design lightness and functionality.
- 5) ... is connecting humans and machines and virtually everything around us.
- 6) Design is inherently linked to methods of
- 7) ... processing is instantaneous analysis of incoming data which enables informed business decisions and reducing operational costs.
- 8) ... enables you to produce complex shapes using less material than traditional manufacturing methods.

9) ... is closely related to informatization.

10) Only the most ... of the highest quality are selected for the making of the product.

Task 2. Read and translate the text. How do you understand the meaning of the word 'sustainable'?

Digitization is a challenge that must be accepted to adapt to the new market. However, there are certain factors that help or hinder this transformation. First, there is the environmental issue. There is a growing concern on the part of society and companies to be responsible and sustainable. As a result, various technologies have been developed in this area, such as those used in water optimization, dust management, reduction of energy consumption or blasting processes. The aim is to achieve a greener and more sustainable mining industry.

Another major challenge is the profile of the new miner. Digitization implies a modernization and transformation of the personnel, who must modernize and adopt new skills in line with market changes. This implies a transition towards a more modern and digital model of the profession, capable of attracting new talent to the sector.

(<https://sptab.com/digitization-mining/>)

Task 3. Match the words in the two columns and make up sentences using them:

1) growing	a) technologies
2) water	b) models
3) dust	c) issues
4) energy	d) industry
5) blasting	e) processes
6) mining	f) optimization
7) digital	g) management
8) new	h) consumption

9) environmental	i) markets
10) various	j) concerns

Task 4. Grammar revision. Fill the gaps with the correct degrees of comparison from the table below. Then discuss the benefits of digitization for the mining companies.

Digitization allows for (1) ... visibility into production processes such as planned maintenance shutdowns, inspections, audits and compliance records; reduced risk through (2) ... use of resources (eg. capital investment); (3) ... collaboration between teams within the organisation – particularly across geographies; increased visibility into operations across geographies. It enables (4) ... decision-making processes; (5) ... management of resources in terms of time, materials, and manpower; management teams to make (6) ... decisions about how (7) ... to use on-site resources at any given time. The (8) ... a company's operations are, the (9) ... it will be able to manage its resources in terms of time, materials, and manpower.

(<https://www.planradar.com/au/digitising-the-mining-industry/>)

1)	a more great	b greater	c the greatest
2)	a efficiently	b the most efficient	c more efficient
3)	a the best	b better	c more better
4)	a the fastest	b more faster	c faster
5)	a good	b the best	c better
6)	a smarter	b more smarter	c more smart
7)	a best	b better	c more good
8)	a less data-driven	b more data-driven	c most data-driven
9)	a more	b best	c better

Task 5. Write an essay on the topic “Is modern technology good or bad for humanity?” (100-120 words).

UNIT 10. THE ENVIRONMENTAL IMPACT OF MINERAL PROCESSING

Task 1. Revise the vocabulary on the topic. Insert the missing words into the sentences below and translate the sentences:

the burning of fossil fuels; raw material extraction; water consumption; greenhouse gases; chemical processes; climate change; water pollution; materials processing; emissions; environmental footprint

- 1) In the past three years, global emissions of carbon dioxide from ... have levelled after rising for decades.
- 2) The smallest particles of matter - atoms, molecules, ions, electrons – are involved in the
- 3) One of the biggest factors in ... is our deep reliance on fossil fuels.
- 4) Ground ... is a serious problem in many areas.
- 5) Increasing levels of ... are damaging our climate.
- 6) The extraction and processing of raw materials are associated with potentially significant environmental impacts, including contributing to approximately half of the greenhouse gas (GHG) ... globally.
- 7) The ... of metals significantly varies depending on multiple factors, such as the type of metal ore and the method used to process it.
- 8) ... is the series of steps that converts a starting material into a useful form with controlled structural features and properties.
- 9) ... includes the processes required to extract from the environment the raw materials included in the product.
- 10) Increased ... can lead to electrolyte imbalance resulting in water intoxication.

Task 2. Read and translate the following extract from the text:

Water is impacted in two ways by mining: extraction and processing of ore and poor waste management can cause water pollution, and excessive water consumption can cause water scarcity. Insufficiently treated toxic effluent waters generated during hydrometallurgical processing can directly pollute surface waters. Such effluent waters often contain hazardous chemicals used in mineral ore processing, such as cya-

nide, mercury, arsenic, lead and zinc. In addition, these waters may have high levels of acidity.

In mineral production, water is required for processing ore. Water is both important for hydrometallurgical and pyrometallurgical processes. Water is mostly extracted from groundwater, streams, rivers, lakes or commercial water service suppliers. There is a strong correlation between the amounts of water used per kg mineral and the ore grade. The lower the ore grade, the more water is needed to extract the specific metal. Also dewatering of mines can have tremendous impacts.

(<https://www.pbl.nl/system/files/document/2024-02/PBL-2024-Environmental-impacts-of-extraction-and-processing-of-raw-materials-for-the-energy-transition-5364.pdf>)

Task 3. Fill the gaps in the following sentences, using the words from the box. Then translate the sentences.

toxic waters; hydrometallurgical processing; hazardous chemicals; mineral ore processing; acidity; water scarcity; waste management; excessive water consumption; to pollute; a tremendous impact

- 1) Toxic heavy metals may pose a threat to both humans and animals, particularly when they ... water and soil.
- 2) Today 36 mines are shut, their equipment was looted, and mine workings continue to flood with
- 3) During anode electrochemical treatment, water ... grows.
- 4) Global warming, climate change, the greenhouse effect - our modern industrialized lifestyle has a ... on the environment.
- 5) In particular, there is a need to protect the developing countries' water resources (national and international) from the discharges of industrial effluents and from ... by enterprises.

- 6) These tanks are used to store petroleum products and
- 7) ... deals with all types of waste, including industrial, biological, household, municipal, organic, biomedical, radioactive wastes.
- 8) Droughts and ... have already disrupted your entire ecosystem.
- 9) The highest concentrations of sulfur dioxide in the air are found around petrol refineries, chemical manufacturing industries, ... plants and power stations.
- 10) Mechanical processing can recover valuable cathode materials directly, and ... can be lower cost.

Task 4. Grammar challenge. Make up as many conditional sentences as you can (Start with 'If...'):

- 1) We won't take care of our planet, so we will have many environmental problems.
- 2) Factories will release waste into rivers, so thousands of fish will die.
- 3) Industrial plants released a lot of toxic substances into the air, so the air was polluted.
- 4) Rivers and lakes were polluted, so they were empty of fish.
- 5) There had been more litter in the streets in the past, so they had looked more awful.
- 6) People breathed polluted air in the past, so it caused serious diseases.
- 7) The water was clean, so we could swim there.

8) People are too reliant on natural resources, so they will be in shortage in the near future.

9) People drank less contaminated water, so they could live longer.

10) The more people will think about environment, the better it will be for preserving the ecological balance of our planet.

Task 5. Write an essay on the topic “Is industrial pollution the main cause of modern environmental disasters?” (100-120 words). Give your opinion.

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