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Кафедра иностранных языков

ИНОСТРАННЫЙ ЯЗЫК (АНГЛИЙСКИЙ ЯЗЫК)

Базовое инженерное образование. Часть 2.

Методические указания для самостоятельной работы студентов всех специальностей

FOREIN LAGUAGE (ENGLISH LANGUAGE)

Basic engineering education. Part 2.

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ИНОСТРАННЫЙ ЯЗЫК (АНГЛИЙСКИЙ ЯЗЫК). Базовое инженерное образование. Часть 2: Методические указания для самостоятельной работы / Санкт-Петербургский горный университет. Сост. *С.А. Бойко, Ю.В. Борисова*. СПб, 2025**.** 36 с.

Данные методические указания составлены для выполнения самостоятельной работы по дисциплине «Иностранный язык». Предлагаемый материал направлен на развитие навыков технического перевода, анализа оригинальной литературы, накопление и усвоение лексического материала в рамках профессиональной тематики и приобретение разговорных навыков по специальности.

Методические указания предназначены для студентов всех специальностей, изучающих иностранный язык.

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ВВЕДЕНИЕ

Данные методические указания для самостоятельной работы по английскому языку предназначены для студентов всех специальностей. Методические указания составлены в соответствии с учебной программой по дисциплине «Иностранный язык» для формирования иноязычной профессиональной компетенции будущих специалистов.

Предложенные методические материалы предназначены для внеаудиторной работы студентов и состоят из пяти разделов, содержащих информацию об изучаемой дисциплине. Каждый текст сопровождается комплексом предтекстовых и послетекстовых заданий и упражнений, направленных на контроль понимания прочитанного материала, формирование умения ориентироваться в оригинальных научно-технических текстах, отработку и закрепление лексико-грамматического материала в устной речи, контроль навыков перевода.

Изучение предложенного материала имеет целью развитие и совершенствование навыков чтения и перевода оригинальной литературы, расширение словарного запаса и приобретение разговорных умений.

UNIT 1 EARTH SCIENCES AND PHYSICS

TEXT 1.1 Earth sciences

1 Read and translate the following word combinations. Practice pronouncing them correctly.

Environmental sustainability, primary objective, hydrologic cycle, solid elements, atmospheric conditions, precipitation patterns, valuable insights, remarkable accuracy.

2 Give the verbs corresponding to the following nouns:

A reference, an exploration, an interest, a rotation, a development, a contribution, an examination, a knowledge.

3 Read and translate the text.

Earth science is the name for all the sciences that collectively seek to understand Earth and its neighbors in space. It includes geology, oceanography, meteorology, and astronomy. Understanding Earth science is challenging because our planet is a dynamic body with many interacting parts and a complex history. Throughout its long existence, Earth has been changing. In fact, it is changing as you read this page and will continue to do so into the near future. Sometimes the changes arc rapid and violent, as when severe storms, landslides, and volcanic eruptions occur. Conversely, many changes tame place so gradually that they go unnoticed during a lifetime. Scales of size and space also vary greatly among the phenomena studied in Earth science.

Earth science is often perceived as science that is performed in the outdoors, and rightly so. A great deal of an Earth scientist's study is based on observations and experiments conducted in the field. However, Earth science is also conducted in the laboratory, where, for example, the study of various Earth materials provides insights into many basic processes, and the creation of complex computer models allows for the simulation of our planet's complicated climate system. Frequently, Earth scientists require an understanding and application of knowledge and principles from physics, chemistry, and biology. Geology, oceanography, meteorology, and astronomy are sciences that seek to expand our knowledge of the natural world and our place in it.

Geology a subset of earth science involves examining the solid elements found within our world. It helps in the processes that shape the Earth's structure. It explores the formation of rocks, geological history, volcanoes, and earthquakes. Geology additionally targeted the earth's species and the way the planet has modified over time.

Oceanography focuses on the study of the Earth's oceans and seas. It studies the physical and chemical properties of the oceans and marine life. It also studies the interactions between the oceans and the atmosphere.

Meteorology examines the mixture of gases that is held to the planet by gravity and thins rapidly with altitude. Acted on by the combined effects of Earth's motions and energy from the Sun, and influenced by Earth's land and sea surface, the formless and invisible atmosphere reacts by producing an infinite variety of weather, which in turn creates the basic pattern of global climates. Meteorology is the study of the atmosphere and the processes that produce weather and climate. Like oceanography, meteorology involves the application of other sciences in an integrated study of the thin layer of air that surrounds Earth.

Astronomy is also referred to as the "Science of the Universe". It includes the study of planets, stars, galaxies, and beyond. Astronomy allows us to study the depths of the earth, explore the mysteries and expand our knowledge of our beloved earth. The field of astronomy already unveils many secrets and wonders of the earth but there is still more to explore.

Hydrology is a branch of Earth science that studies water in its all forms that are available on the Earth. Those that study the hydrologic cycle are interested in all physical, chemical, and biological processes involving water. Water's routes in the sky, over and beneath the Earth's surface, and growing plants are all included. [1]

4 Work with a partner. Discuss the questions below.

- How would you characterize each branch of Earth science?
- What branches of earth science are particularly useful for your future profession?
- What branch of earth science explores the formation of rocks and earthquakes?

5 Translate into Russian paying attention to the form of the verb-predicate in the Passive Voice.

1. The rocks that are found in a variety of parts of the earth provide data about the evolution of rocks in ancient times. 2. The Earth is the only planet which supports life and the only planet where life is said to be continuously sustained. 3. Also, the study of the different fossil forms that are present under the earth's surface gives us information about the forms of life present in a geological sense and is also known to establish a bond between the ancestral and the living forms. 4. The significance of this is understood by knowing the regions that are covered by the different branches of it. 5. Oceans are considered as the areas of the origin of life on the earth and a major determinant of the earth's atmospheric condition that serves as determinants of various life processes on various parts of the earth. 6. Today, we are also faced with the challenge of developing new forms and sources of energy that are being researched and developed by earth scientists. 7. More than 50 years passed before enough data were gathered to transform this controversial hypothesis into a sound theory that wove together the basic processes known to operate on Earth. 8. Careful examination of mountainous terrains reveals that most are places where thick sequences of rocks have been squeezed and highly deformed, as if placed in a gigantic vise. 9. Thus, we conclude that these rocks were once part of an ancient mountain system that has since been eroded away to produce these expansive, flat regions. 10. At -200°C (-328°F), the tiny particles in the outer portion of the nebula were likely covered with a thick layer of ices made of frozen water, carbon dioxide, ammonia, and methane. 11. This process occurs along oceanic ridges where, over spans of millions of years, hundreds of thousands of square kilometers of new seafloor have been generated. 12. Other megacities are exposed to seismic and volcanic hazards where inappropriate land use and poor construction practices, coupled with rapid population growth, are increasing vulnerability. 13. When viewed in the context of Earth's 4.6-billion-year history, an event that occurred 100 million years ago may be characterized as "recent" by a geologist, and a rock sample that has been dated at 10 million years may be called "young". [2]

TEXT 1.2 Physics

1 Translate the following word combinations.

Pressing problem, solid science, be under scrutiny, heliocentric model, set down laws, the earliest pioneers, belief in constants and predictability.

2 Scan the text and identify the main difference between classical physics and modern physics.

The period of physics and its development from the Renaissance through The Enlightenment and to around the year 1900 is a period known as “Classical Physics”. It's separate from Modern Physics today because it was, in some ways, flawed. However, the move to classical physics is noteworthy for the marked shift away from philosophy and intuition-based theory to observation and experimentation. The emergence of optical tools such as the microscope and the telescope allowed the discovery of the atom, the challenge to the notion that the Earth was not just the center of the solar system but the center of the universe, and the identification of gravity. This is the age of Copernicus who defined the heliocentric model of the Solar System, Johannes Kepler who set down laws determining how planetary bodies moved, Galileo whose astounding work in developing telescopes reinforced the Copernican view of the solar system, Isaac Newton who set down universal laws on motion and gravity. Alongside all this were important changes to mathematics. Isaac Newton was also responsible for the invention of calculus, which enabled physics to begin to solve some of its most complicated problems.

Changes from the early 19th century that led to the Industrial Revolution were based, in part, on the advanced in engineering that was fueled by advances in physics. Without physics becoming a solid science in the 18th-19th centuries, we may not have had the combustion engine and the use of fossil fuels, new developments in metallurgy and building construction and many other things that pushed towards industrialization. It was also the age of electricity and the light bulb - a great age of invention. But despite all this invention and applied physics, classical physics could not explain everything. In fact, it fell down in some complex areas and by the time the 20th century came along, many of its flaws and limitations were already under scrutiny. The ultimate problem was its belief in constants and predictability - understandable in the Age of Enlightenment because science is based on predictability. But physics and the laws that surround it are not unchanging. It would take the recognition of these flaws to develop several subfields in the 20th century.

As noted above, classical physics, despite its uses, is flawed in several fundamental ways. The 20th century was the beginning of modern physics which would incorporate many discoveries and theories and give birth to some of our most celebrated scientists such as Marie Curie (for her work with radioisotopes), her daughter Irene (who discovered artificial radioactivity), Max Planck (who began developed quantum theory), Vera Rubin (who discovered Dark Matter) Albert Einstein (who revolutionized physics with his Theories of Relativity which solved and corrected a few problems that had bugged various physicists for generations) and Professor Stephen Hawking for a wide range of discoveries, solved paradoxes, and complex theories particularly those relating to the nature of Black Holes. This is also the age of space exploration, calculating the size of our solar system and distance to nearest stars and other galaxies. Through mathematical measurements and physics, we have been able to calculate that the size of the visible universe at around 200 billion galaxies. It's even been used to attempt to calculate the potential number of civilizations in the universe. Known as The Drake Equation, it uses mathematical modeling based on what we know about the physical aspects of solar systems, the number of planets, and the relative size of “The Goldilocks Zone”, coming to a conclusion of potentially millions.

Quantum Theory gave way to Quantum Mechanics, one of the most complex sciences for the layperson to understand. Its earliest pioneers included Paul Dirac, Werner Heisenberg and Erwin Schrödinger and it remains a complex science today. The early 20th century saw a number of complex experiments in many subfields of physics, none more so than the discovery of the Higgs Boson at CERN's Large Hadron Collider, the world's largest particle accelerator. But physics has never been about the complex and lofty - it's also about the everyday. It's at the core of engineering and many other sciences. [3]

3 Translate the text above from English into Russian.

4 Match the words to make collocations. Translate into Russian.

1 quantum	**A** physics
2 mathematical	**B** problem
3 applied	**C** matter
4 fossil	**D** modeling
5 combustion	**E** work
6 physical	**F** engine
7 ultimate	**G** theory
8 astounding	**H** aspects
9 dark	**I** fuels

5 Match the English terms with the Russian equivalents.

1	fossil	**a**	под пристальным вниманием
2	combustion	**b**	заслуживающий внимания
3	under scrutiny	**c**	гелиоцентрическая модель
4	astounding	**d**	ошибочный
5	particle accelerator	**e**	сгорание
6	layperson	**f**	ископаемое
7	flawed	**g**	поразительный
8	lofty	**h**	обыватель
9	heliocentric model	**i**	ускоритель частиц
10	noteworthy	**j**	возвышенный
11	Enlightenment	**k**	появление
12	identification	**l**	солнечный
13	enable	**m**	включать в себя
14	limitations	**n**	предсказуемость
15	unchanging	**o**	несмотря на
16	calculus	**p**	просвещение
17	solar	**q**	представление
18	celebrated	**r**	лампочка
19	incorporate	**s**	давать возможность
20	predictability	**t**	квантовый
21	pioneer	**u**	исчисление
22	emergence	**v**	выявление
23	notion	**w**	первооткрыватель
24	quantum	**x**	ограничения
25	light bulb	**y**	неизменный
26	despite	**z**	прославленный

UNIT 2 MECHANICS AND MATHEMATICS

TEXT 2.1 Mechanics

1 Read and translate the following word combinations. Practice pronouncing them correctly.

Structural integrity, permanent deformation, failure theories, efficient operation, engineering mechanics, anticipated loading conditions, constant velocity.

2 Read and translate the text.

Mechanics is the branch of engineering dealing with bodies and their dynamical behavior. Often, it is necessary to replace the actual physical actions and the participating bodies with hypothetical and simplified substitutions so as to arrive at solutions that are easier and yet are close to the physical reality.

The fundamental idealizations of mechanics are the following:

Continuum: Bodies are assumed to be made up of a hypothetical continuous distribution of matter, instead of the actual picture consisting of a conglomeration of discrete, tiny particles such as molecules, atoms, electrons, etc. (in contrast to the "corpuscular theory" which takes into account the atomic/subatomic structure of matter).

Rigid body: When the deformation of the body is not of interest, we are justified to make use of the rigid body idealization in which the continuum is assumed not to undergo any deformation whatsoever. For example, in the calculation of the forces transmitted to the supports by a beam, the considerations of the deflection of beam is unimportant. The error that is caused by the rigid body assumption in this instance is negligible.

Point force: A finite force exerted on one body by another is always associated with a finite area of contact between the bodies. A point force is that idealization in which we assume that a force is being applied through a single point (of area zero).

Particle: An object that has a mass but no size is called a particle. This is useful in dealing with the translatory motion of rigid bodies that could have the size of a car or even a planet. This assumption ceases to be valid when rotation of the rigid body is also involved. Many other simplifications pervade mechanics. Engineering mechanics is a core discipline within engineering that examines the behavior of physical bodies under the influence of forces and displacements.

Vector and Scalar Quantities

Many physical quantities could be described by means of their magnitude alone. For example, the temperature at a point in a body or the mass of a particle. Such quantities are called scalars. On the other hand, there are certain quantities of interest, which need in addition to the magnitude the specification of a direction. Vectors: have magnitude and direction, and add according to the parallelogram law For example, the velocity of a car is a vector quantity as its description is complete with the specification of both the speed of the vehicle and its direction of motion.

Laws of Mechanics

The fundamental laws of mechanics are: Newton’s first and second laws of motion, Newton’s third law, the gravitational law of attraction, the parallelogram law.

Newton’s first law: Every particle continues in a state of rest or uniform motion in a straight line unless it is compelled to change that state by forces imposed on it.

Newton’s second law: The change of motion is proportional to the natural force impressed and is made in a direction of the straight line in which the force is impressed.

It is essential to consider a frame of reference while discussing the above two laws. It has been experimentally observed that the first and second laws of Newton are highly accurate with respect to the fixed stars as a reference. It is sufficient to consider any reference that moves uniformly and without rotation relative to the fixed stars as a reference with equal accuracy. All such references are called inertial references. The earth’s surface is usually employed as a reference in most of the engineering works though it is not, strictly speaking, an inertial one (since it rotates).

Newton’s third law: To every action there is always an equal reaction, or the mutual actions of two bodies upon each other are always equal and directed to contrary points. [4]

3 Translate the sentences noticing the words if-then**.**

1. If the load exceeds the material's yield strength, then the structure will experience permanent deformation. 2. If the temperature increases, then the thermal expansion of the material will cause dimensional changes. 3. If the applied force is not aligned with the member’s axis, then there will be additional bending stresses. 4. If a beam is simply supported at both ends and a load is applied at the center, then the maximum bending moment occurs at the midpoint. 5. If the friction coefficient between two surfaces increases, then the required force to move an object also increases. 6. If a structural member is shortened due to thermal contraction, then the internal stresses may develop in the assembly. 7. If the moment of inertia of a cross-section is increased, then the structure's resistance to bending improves. 8. If the dynamic load factor is considered in design, then the safety margin against transient forces is increased. 9. If the damping ratio in a vibrating system is high, then the system's oscillations will diminish more quickly. 10. If the velocity of a fluid exceeds the critical speed in flow through a pipe, then turbulence will develop. 11. If the superposition principle is applied correctly, then complex load conditions can be analyzed by summing simpler cases. 12. If the applied torque exceeds the torsional yield strength of a shaft, then permanent twisting may occur. [4]

5 Fill in the gaps using the words in the box. Translate the text.

energy	stress	forces	deformation	strain	momentum

1 ______ is defined as a material's change in shape or size in response to an applied force. 2 ________ measures how much a body changes shape when stressed. 3 ________measures the internal forces acting on a body. 4 ______is a vector quantity representing an object's tendency to continue moving in a straight line. 5 ________ comes in various forms, such as kinetic, potential, and thermal. 6 _________ can be either attractive or repulsive, and they can be either conservative or non-conservative. [5]

TEXT 2.2 Advanced mathematics

1 Read and translate the following text.

When it comes to advanced mathematics, the first reaction of many students is often filled with various formulas on the blackboard and numerous computations in their minds. Definitions, theorems, and corollaries come one after another. Concepts such as limits, continuity, differentiability, and integrability encompass each other. The extensive content, high level of difficulty, and abstract nature are all characteristics of advanced mathematics. Moreover, the narrow application scope of examples or exercises in advanced mathematics textbooks, as well as the disconnection from professional knowledge, contributes to some students' insufficient understanding of the widespread applications of advanced mathematics. They may even consider learning mathematics useless, fear mathematics, or become tired of it.

In fact, advanced mathematics is an essential foundational course in universities and has a wide range of applications in various disciplines such as physics, chemistry, astronomy, biomedical science, aerospace engineering, engineering technology, and economics and management. For example, mathematical models are used in macroeconomics to study the dynamics of exchange rates and how they are affected by the fiscal and monetary policies of multiple countries. In addition, the application of mathematics in microeconomics is also very extensive, such as the maximization of consumer utility subject to the price of various goods and money income. It serves as not only an important tool for developing intellect and learning various specialized knowledge but also a crucial tool for scientific research. It can cultivate and enhance college students' logical thinking, problem-solving abilities, and scientific expression skills. These abilities are particularly important for students' learning in their major courses and for further expanding their knowledge and adjusting their knowledge structure in the future.

Advanced calculus techniques are fundamental for exploring the complexities of multivariable mathematics. These techniques, including multivariable calculus, extend the concepts of differentiation and integration to functions with multiple variables, allowing intricate analysis of surfaces and curves in higher dimensions. Partial derivatives play a vital role, examining how a function changes with one variable while others remain constant. The Fundamental Theorem of Calculus bridges differentiation and integration, essential for evaluating definite integrals. Taylor series expansion approximates complex functions, while L'Hôpital's Rule simplifies resolving indeterminate limits.

Building on the understanding of advanced calculus techniques, the exploration of linear algebra concepts offers a thorough framework for analyzing multidimensional data and systems. This foundational subject focuses on vectors and vector spaces, providing essential tools for those seeking to serve others through problem solving. Key elements include matrices, which facilitate the representation and solution of systems of linear equations. Eigenvalues and eigenvectors reveal the essence of linear transformations, aiding in data reduction and stability analysis.

Number theory, often hailed as the "queen of mathematics," enthralls mathematicians with its focus on the properties and relationships of integers, making it a cornerstone of mathematical study. Central to number theory are prime numbers, which, according to the Fundamental Theorem of Arithmetic, distinctly factories integers. Divisibility and congruence play critical roles, while modular arithmetic facilitates cryptography. Diophantine equations, seeking integer solutions, challenge enthusiasts with problems like Fermat's Last Theorem. The Euclidean algorithm efficiently computes the greatest common divisor, aiding in fraction simplification.

Set theory, a cornerstone of modern mathematics, underlies much of the logical framework used across various mathematical disciplines. It deals with sets, collections of distinct objects, and is foundational to logic and probability. Understanding the basic operations - union, intersection, and difference - is essential to grasping set relationships. Venn diagrams visually represent these relationships, aiding comprehension. Cardinality, the measure of a set's size, helps compare different sets. Through mathematical reasoning and proofs grounded in logic, set theory establishes the validity of mathematical statements.

As one investigates the logical structures in set theory, another fascinating mathematical domain to contemplate is topology. Topology examines properties of space preserved under continuous transformations, focusing on concepts like open sets, continuity, and compactness. With subfields such as algebraic topology and differential topology, it provides diverse perspectives and applications. The Brouwer Fixed Point Theorem illustrates its depth, asserting that any continuous function mapping a convex compact set to itself has a fixed point. [6]

2 Answer the following questions.

- What theory is often hailed as the "queen of mathematics"?
- What derivatives play a vital role, examining how a function changes with one variable while others remain constant?
- What theory underlies much of the logical framework used across various mathematical disciplines?

3 Match the left and the right columns.

1) Advanced calculus extends differentiation	prime numbers, and modular arithmetic, which are vital for cryptography.
2) The Fundamental Theorem of Calculus bridges differentiation and integration,	such as the sum of the first n natural numbers, and is invaluable in combinatorics, particularly with binomial coefficients.
3) Diophantine equations, seeking integer solutions,	and ensuring the correctness of recursive algorithms.
4) Set theory underpins modern mathematics,	using matrices and eigenvalues to solve linear equations and transformations..
5) Topology examines properties of space preserved under continuous transformations,	challenge enthusiasts with problems like Fermat's Last Theorem.
6) Number theory explores integers,	essential for evaluating definite integrals.
7) Mathematical induction is crucial for proving infinite statements	and integration to multivariable functions using partial derivatives and Taylor series.
8) Induction is significant in demonstrating formulas for sequences,	focusing on concepts like open sets, continuity, and compactness.
9) Linear algebra analyses vector spaces,	focusing on operations such as union, intersection, and the concept of cardinality.

4 Match the words to make collocations. Translate into Russian.

1 Venn	**A** geometry
2 Advanced	**B** Rule
3 mathematical	**C** algebra
4 Euclidean	**D** equations
5 multiple	**E** induction
6 L'Hôpital's	**F** diagrams
7 non-Euclidean	**G** calculus
8 Diophantine	**H** variables
9 linear	**I** algorithm

5 Translate the sentences noticing the word *since*.

1. **Since** we used some topics from complex function theory, we also introduced in Chapter 11 a section with the basic facts in this important field. 2. But **since** set theory cannot reflect these nuances in any simple and graceful way, we shall take an indexed set to be the indexing function. 3. Our results are consistent with the claims made by Plato, and many others **since**, that studying advanced mathematics is associated with improved logical reasoning skills. 4. Calculus is an important topic **since** it's heavily used in optimization problems to find local minima. 5. **Since** prime numbers can only divisible by 1 and themselves, they are not factored any further like whole numbers. 6. Sampling and other collection techniques are discussed **since** appropriate methods of data collection are necessary in order to obtain any meaningful information.7. The length of the arc increases in proportion to the radius **since** the length of the arc = radius(central angle in radians). 8. Moreover, such methods are of practical importance **since** many ODEs have complicated solution formulas or no solution formulas at all, whereby numeric methods are needed. 9. Linear Algebra is pretty much omnipresent in modern computing **since** it lets you efficiently do calculations on multi-dimensional data. 10. While both topics are sometimes taught separately it makes sense to learn them in conjunction **since** statistics and probabilities share a deep underlying relationship.11 The cosine terms on both sides must be equal, and the coefficient of the sine term on the left must be zero since there is no sine term on the right. 12. **Since** more than 75% scored within 2 standard deviations, a verification of Chebyshev's theorem is complete in this instance.13. Trigonometry is interesting in itself **since** it can be immediately applied to real life problems. [6]

UNIT 3 CHEMISTRY

TEXT 3.1 Inorganic chemistry

1 Read and translate the following word combinations.

Electrical conductivity, covalent bonds, bent molecular structure, electrostatic attraction, oxidation states, paramagnetic compounds, delocalized electrons, coordination complexes.

2 Read and translate the text.

In contrast to organic chemistry, which focuses on carbon-based molecules, inorganic chemistry or "inorganics," looks at elements that don't contain carbon atoms as their primary focus. It focuses primarily on elements from the periodic table, such as hydrogen, sulfur, nitrogen, and oxygen. Why else do you think inorganics is sometimes referred to as "non-carbon" chemistry? This field covers metal-containing compounds, coordination complexes, catalysis, bioinorganic chemistry, etc. Inorganic chemistry also helps with the production of many everyday products.

Chemical bonds in inorganic compounds can be categorized into three main types: ionic, covalent, and metallic. Ionic bonds form when electrons transfer from one atom to another, forming ions with opposite charges. These ions are held together by electrostatic attraction. Ionic bonds are prevalent in compounds composed of elements with significantly different electronegativities. For example, sodium chloride ($NaCl$) entails positively charged sodium ions ($Na+$) bonded with negatively charged chloride ions ($Cl-$) held together by ionic bonds. Covalent bonds manifest when atoms share electrons to achieve a stable electron configuration. These bonds are prevalent in compounds composed of nonmetals and often result in the formation of molecules. An example is carbon dioxide ($CO2$), where two oxygen atoms share two pairs of electrons with a carbon atom, resulting in a linear molecule. Metallic bonds occur in metals and involve a "sea" of delocalized electrons shared among a lattice of positively charged metal ions. This arrangement gives metals characteristic properties, such as malleability and electrical conductivity.

Ionic bonds often result in compounds with high melting and boiling points, with excellent conductivity, when dissolved in water or melted. Covalent bonds form diverse molecular structures with varying physical and chemical properties. Metallic bonds are responsible for metals' unique properties, such as ductility and thermal conductivity. Coordination complexes are molecules or ions formed by coordinating central metal ions with surrounding ligands (molecules or ions with lone pairs of electrons). These complexes often exhibit unique colors, magnetic properties, and reactivity. Ligands donate electron pairs to the metal center, forming coordination bonds. Transition metals are a group of elements characterized by their partially filled d orbitals. They often form colorful and paramagnetic compounds and are known for their variable oxidation states and complex chemistry.

The organic compounds that are classified under Inorganic chemistry are:

Acids are compounds that dissolve in water and generate hydrogen ions H+. For example, hydrochloric acid, citric acid, sulphuric acid, vinegar, etc.

A *base* is a compound that produces hydroxyl ions when kept in water. For example, potassium hydroxide, calcium hydroxide, ammonia, sodium hydroxide produces OH− ions when dissolved in water. Depending on the relationship to water, the bases are divided into soluble (alkaline) and insoluble, Ba (OH) 2, Ra (OH) 2) as well as aqueous ammonia solution. All other bases are almost insoluble in water. Inorganic chemistry deals with the behaviour and synthesis of inorganic and organometallic compounds. The field of inorganic chemistry covers chemical compounds that are not carbon-based. Inorganic chemistry has applications in many of the chemical industry, like catalysis, materials science, pigments, surfactants, coatings, fuels, and agriculture.

Salt is a substance obtained as a result of the reaction between an acid and a base. The table salt of sodium hydroxide is one of the common examples of salts.

Oxides are compounds that consist of one oxygen atom.

Organometallic chemistry is the study of an organometallic compound. Coordination compounds had applications long before the establishment of inorganic chemistry. An investigation of structure and bonding in coordination chemistry started with the inquisitiveness of Tassaert. The elements placed in group 13 to group 18 constitute the p-block. The properties of p block elements are greatly influenced by their atomic size, ionization enthalpy and electronegativity. [7]

3 Work with a partner. Discuss the questions below.

- What is inorganic chemistry or “inorganics”?
- What are the three main types of chemical bonds in inorganic compounds?
- What are the notable examples of organic compounds that are classified under Inorganic chemistry?

4 Translate into Russian noticing ***there is, there are*****.**

1. It also has good ultraviolet light resistance properties, and **there is** a growing demand for its use in photocatalysts. 2. **There are** three basic types of chemical formula, the empirical formula, the molecular formula and the structural formula. 3. Moreover, **there are** some aspects of molecular structure that are beyond the scope of the simple theories. 4. When electrons are removed from the same shell, the main effect is that with each successive ionization **there is** one less electron left to repel the others. 5. **There are** about four types of chemical reactions in Inorganic chemistry namely combination, decomposition, single displacement and double displacement reactions. 6. **There is** a substantial increase of nuclear charge between each element, and although extra inner shells are occupied, they do not provide perfect shielding. [7]

5 Match the English terms with the Russian equivalents.

1	ammonia	**a**	пластичность
2	chloride ions	**b**	ферментативные реакции
3	thermal conductivity	**c**	хлорид натрия
4	carbon dioxide	**d**	удобрения
5	oxidation states	**e**	теплопроводность
6	malleability	**f**	газированные напитки
7	fertilizers	**g**	аммиак
8	sodium chloride	**h**	степени окисления
9	carbonated beverages	**i**	ионы хлора
10	enzymatic reactions	**j**	углекислый газ

TEXT 3.2 Organic chemistry

1 Read and translate the following words and word combinations.

Chemical elements, carbon, compounds, hydrogen, oxygen, nitrogen, sulfur, cellular mechanisms, acid, carbohydrates, substance, organic and nonorganic compounds.

2 Read and translate the text, devoted to organic chemistry.

Organic chemistry is a field of science concerned with the composition, properties, and structure of chemical elements and compounds that contain carbon atoms. Carbon is unique in the variety and extent of structures that can result from the three-dimensional connections of its atoms.

Organic chemistry is the largest area of specialization among the various fields of chemistry. It derives its name from the fact that in the 19th century most of the carbon compounds then known were considered to have originated in living organisms. When combined with variable amounts of hydrogen, oxygen, nitrogen, sulfur, phosphorus, or other elements, the structural possibilities of carbon compounds become limitless. Indeed, their number far exceeds the total of all nonorganic compounds.

The development of structural organic chemistry was one of the great achievements of 19th-century science, providing an essential basis for the field of biochemistry. The elucidation of the chemical transformations undergone by organic compounds within living cells was a central problem of biochemistry. The determination of the molecular structure of the organic substances present in living cells was necessary to the study of cellular mechanisms. Physical organic chemistry focuses on the correlation of the physical and chemical properties of organic compounds with their structural features.

A major focus of organic chemistry is the isolation, purification, and structural study of naturally occurring substances, since many natural products are simple organic molecules. Simple carbon-containing compounds produced by photosynthesis—the process by which carbon dioxide and water are converted to oxygen and compounds known as carbohydrates—form the raw material for the myriad organic compounds found in the plant and animal kingdoms.

Once the properties endowed upon a substance by specific structural units called functional groups are known, it becomes possible to design novel molecules that may exhibit desired properties. The preparation, under controlled laboratory conditions, of specific compounds is known as synthetic chemistry. Some products are easier to synthesize than to collect and purify from their natural sources. For example, large amounts of vitamin C are synthesized annually. Many synthetic substances have novel properties that make them especially useful. Plastics are a prime example, as are many drugs and agricultural chemicals. A continuing challenge for synthetic chemists is the structural complexity of most organic substances.

To synthesize a desired compound, the atoms must be pieced together in the correct order and with the proper three-dimensional relationships. A fixed number of atoms can be connected in various ways to produce different molecules. However, only one structural arrangement out of the many possibilities will be identical with a naturally occurring molecule [8].

3 Decide whether the statements are *TRUE* (T) or *FALSE* (F).

1) Organic chemistry derives its name from the living organisms.
2) The structural possibilities of carbon compounds are really limited.
3) Physical organic chemistry focuses on the correlation of the physical and chemical properties of nonorganic compounds.

4) The development of structural organic chemistry was an ordinary event of 19th-century science.
5) The preparation, under controlled laboratory conditions, of specific compounds is known as industrial chemistry.
6) Many synthetic substances have ordinary novel properties and they are useless.

4 Work with a partner. Discuss the questions below.

- What is organic chemistry?
- How did organic chemistry get its name?
- What is the main focus of study in organic chemistry?

5 Translate the text dealing with basic chemicals.

In the petrochemical industry, the organic chemicals produced in the largest volumes are methanol, ethylene, propylene, butadiene, benzene, toluene, and xylenes.
Ethylene, propylene, and butadiene, along with butylenes, are collectively called alkenes. Alkenes are acyclic (branched or unbranched) hydrocarbons having one carbon-to-carbon double bond (C=C), with the general molecular formula CnH2n. Because alkenes contain less than the maximum possible number of hydrogen atoms per carbon atom they belong to a class of unsaturated aliphatic hydrocarbons.
Olefins contain one or more double bonds, which make them chemically reactive. Benzene, toluene, and xylenes, commonly referred to as aromatics, are unsaturated cyclic hydrocarbons containing one or more rings. Olefins, aromatics, and methanol are precursors to a variety of chemical products and are referred to as primary petrochemicals [9].

UNIT 4 DESCRIPTIVE GEOMETRY AND ENGINEERING DRAWING

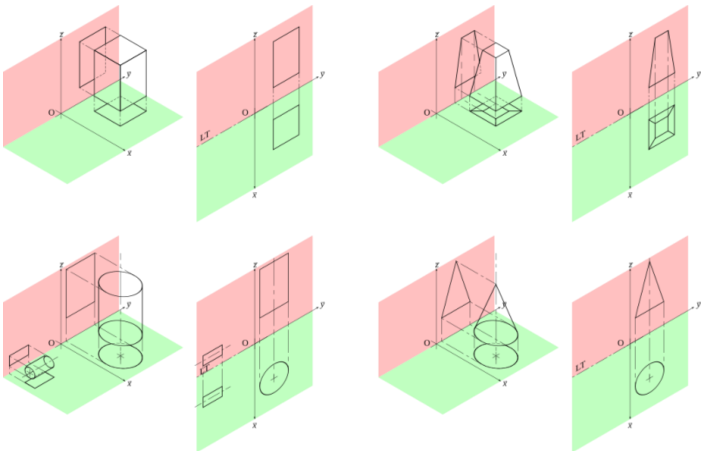
TEXT 4.1 Descriptive geometry

1 Read and translate the following word combinations.

Descriptive geometry; projections onto planes; three-dimensional solids; the structure of a building; rectangular projection; horizontal projection; lateral projection; reflect different views of an object; two-dimensional drawings; spatial relationships; building design.

2 Read and translate the text.

What is the basis of descriptive geometry?



The central idea of descriptive geometry is that projections onto planes can represent complex three-dimensional solids. This allows for the analysis of their structure and spatial relationships while remaining in the realm of two-dimensional drawings. This approach is of great importance in engineering and architecture, where it is often crucial to precisely plan the structure of a building or machine before proceeding to its implementation.

Descriptive geometry provides an easy way to understand space. Thanks to the rectangular projection – one of the basic techniques of this field – it is possible to look at a solid from different perspectives, making this method an extremely versatile tool. An image seen from above (horizontal projection), from the side (lateral projection), or from the front (vertical projection) captures a lot of information about an object that can be analyzed in a design context.

Its advantage is its ability to combine theoretical mathematics with practical applications. The design of buildings, bridges, or machinery is based on the ability to predict how the various elements will interact in reality. Thanks to Monge’s methods, engineers were able to plan and solve construction problems before work even began on the construction site.

The central element of descriptive geometry is rectangular projections, which allow three-dimensional objects to be represented on a flat surface in an unambiguous way. This technique allows for creating drawings that reflect different views of an object: from above, from the front, and from the side. Each projection shows various aspects of the structure, allowing a full understanding of its geometry.

Rectangular projections, for example, demonstrate their practicality in building design. A building’s floor plan shows the layout of rooms and the arrangement of doors and windows, while vertical projections show the height and proportions of the facade. In addition, side projections allow analysis of the depth and details of the structure, such as roof protrusions or facade details.

Drawing geometry also makes it possible to solve complex spatial problems, such as the interpenetration of solids. In architecture, the example is used to illustrate vaulted roofs, helping to determine how the various elements come together. In mechanical engineering, these techniques are used in the design of machine parts, where each component must fit perfectly with the others.

A key feature of descriptive geometry is its versatility. The projection method allows creating images of both simple geometric figures and complex shapes, such as ellipsoidal or hyperboloid surfaces. The introduction of this technique into design practice was the invaluable contribution of Gaspard Monge, who turned descriptive geometry into a tool that combines mathematical precision with aesthetics and functionality.

Thanks to descriptive geometry, it also became possible to visualize concepts previously remaining in the realm of imagination. These techniques are not only a tool for creating drawings but also a tool for spatial analysis to understand and optimize designs [10].

3 Work with a partner. Discuss the questions below.

- Who developed the fundamentals of descriptive geometry?
- What is the central idea of descriptive geometry?
- Why does descriptive geometry provide an easy way to understand space?

4 Match the English terms with the Russian equivalents.

1	three-dimensional solids	**a**	отражать различные виды предмета
2	lateral projection	**b**	проектирование частей детали
3	practical applications	**c**	высота и пропорции фасада
4	descriptive geometry	**d**	трехмерные твердые тела
5	reflect different views of an object	**e**	понимать и улучшать проект
6	two-dimensional drawings	**f**	практическое применение
7	design of machine parts	**g**	начертательная геометрия
8	height and proportions of the facade	**h**	боковая проекция
9	understand and optimize designs	**i**	двухмерные рисунки
10	spatial relationships	**j**	пространственные отношения

5 Decide whether the statements are *TRUE* (T) or *FALSE* (F).

1) With the help of projections onto planes we can represent complex three-dimensional solids.
2) The central element of descriptive geometry is lateral projections.
3) Engineers cannot predict the design of buildings, bridges, or machinery.
4) Drawing geometry can help in solving complex spatial problems.
5) It is still impossible to visualize complex concepts.

6 Translate the text dealing with Monge's applications and innovations in descriptive geometry

One of Gaspard Monge's most impressive achievements was the application of the principles of descriptive geometry to the solution of practical construction problems. His research was not limited to the creation of theoretical spatial models but also included specific engineering methods, such as stereotomy – the science of cutting stone, whose application to vaulting and mortarless construction revolutionized 18th-century architecture.

Monge noted that a key element in successful design is a proper understanding of the lines of curvature on the surface of objects. These lines, an orthogonal arrangement on the surface, provide an aesthetic emphasis on its character and, most importantly, facilitate the planning of the division of structural elements. These principles allowed stone vaults to be assembled from precisely matched elements that formed stable structures without using mortar.

Monge's innovation was not limited to architectural structures. His methods have also been applied in mechanical engineering, where design accuracy is crucial. Rectangular projection was used in machine design, allowing for the precise definition of the shapes and proportions of individual parts and how they fit together.

Another breakthrough was the combination of descriptive geometry and aesthetics. Monge believed that construction lines should reflect the character of the surface on which they are located. With this, he introduced a new quality to architectural design, where form and functionality complement each other. Dividing lines on vaults or building facades became a decorative element, giving a harmonious appearance to the whole.

Monge showed that draughtsman geometry is not just a mathematical tool but a universal language that combines theoretical foundations with the practical needs of construction and design. As a result, his achievements remain relevant and inspire successive generations of designers [11].

TEXT 4.2 Engineering drawing

1 Read and translate the following word combinations.

Engineering drawing; dimensional representation of a three dimensional object; technical drawing; precisely; structures; dams; circuits; design; structures.

2 Read and translate the text.

Introduction to Engineering Drawing

Engineering drawing can be defined as a graphical language used by engineers and other technical personnel associated with the engineering profession which fully and clearly defines the requirements for engineered items. It is a two dimensional representation of a three dimensional object.

In other words, the art of representing a real or imaginary object precisely using some graphics, symbols, letters and numbers with the help of engineering drawing instruments is called engineering drawing.

Applications of Engineering Drawing

Engineering drawing is a discipline that uses a standardized graphical language to convey the geometry and other information needed to manufacture a product, system, or structure. It is a subcategory of technical drawing and is broken down into various specializations, including civil, mechanical, and electrical engineering drawings, each with specific applications for their respective fields.

Civil Engineering Drawing is used for structures like roads, bridges, and dams.

Mechanical Engineering Drawing is used for machines, engines, and equipment.

Electrical and Electronics Drawing deals with electrical systems and circuits.

Geometric Drawing focuses on the geometric aspects of designs [12].

3 Answer the following questions.

- How can the engineering drawing be defined?
- What main fields of engineering drawing applications can you name?

4 Translate into Russian.

Engineering Working Drawings Basics

Engineering graphics is an effective way of communicating technical ideas and it is an essential tool in engineering design where most of the design process is graphically based. Engineering graphics is used in the design process for visualization, communication, and documentation.

Graphics is a visual communications language that includes images, text, and numeric information. Graphics communications using engineering drawings and models is a clear and precise language with definite rules that must be mastered in order to be successful in engineering design. Graphics communications are used in every phase of engineering design starting from concept illustration all the way to the manufacturing phase.

An engineering (or technical) drawing is a graphical representation of a part, assembly, system, or structure and it can be produced using freehand, mechanical tools, or computer methods.

Working drawings are the set of technical drawings used during the manufacturing phase of a product. They contain all the information needed to manufacture and assemble a product.

Codes and Standards

Codes and standards are made to organize and unify the engineering work.

Imagine: what if there was no standard for bolts?

A code is a set of specifications for the analysis, design, manufacture, and construction of something.

A standard is a set of specifications for parts, materials, or processes intended to achieve uniformity, efficiency, and specific quality.

Examples of the organizations that establish standards and design codes: ISO, AISI, SAE, ASTM, ASME, ANSI, DIN.

ISO Standards Handbook: Technical drawings, Volume 2: Mechanical engineering drawings; Construction drawings; Drawing equipment [13].

UNIT 5. COMPUTER SCIENCE AND FOREIGN LANGUAGES

TEXT 5.1 Computer science

1 Read and translate the following word combinations.

Processing information, modeling data, computing, artificial intelligence, probability and statistics, electronic circuit design, hardware and software, research programs, algorithmic foundations, human-computer interaction.

2 Read and translate the text.

Computer science is the study of computers and computing, including their theoretical and algorithmic foundations, hardware and software, and their uses for processing information. The discipline of computer science includes the study of algorithms and data structures, computer and network design, modeling data and information processes, and artificial intelligence. Computer science draws some of its foundations from mathematics and engineering and therefore incorporates techniques from areas such as queueing theory, probability and statistics, and electronic circuit design. Computer science also makes heavy use of hypothesis testing and experimentation during the conceptualization, design, measurement, and refinement of new algorithms, information structures, and computer architectures. Computer science is considered as part of a family of five separate yet interrelated disciplines: computer engineering, computer science, information systems, information technology, and software engineering. This family has come to be known collectively as the discipline of computing. These five disciplines are interrelated in the sense that computing is their object of study, but they are separate since each has its own research perspective and curricular focus. (Since 1991 the Association for Computing Machinery [ACM], the IEEE Computer Society [IEEE-CS], and the Association for Information Systems [AIS] have collaborated to develop and update the taxonomy of these five interrelated disciplines and the guidelines that educational institutions worldwide use for their undergraduate, graduate, and research programs.)

The major subfields of computer science include the traditional study of computer architecture, programming languages, and software development. However, they also include computational science (the use of algorithmic techniques for modeling scientific data), graphics and visualization, human-computer interaction, databases and information systems, networks, and the social and professional issues that are unique to the practice of computer science. As may be evident, some of these subfields overlap in their activities with other modern fields, such as bioinformatics and computational chemistry. These overlaps are the consequence of a tendency among computer scientists to recognize and act upon their field’s many interdisciplinary connections [14].

3 Answer the following questions.

- What is the best way to define computer science?
- What five separate disciplines are included into the family of interrelated disciplines?
- Can you name the major subfields of computer science?

4 Match the English terms with the Russian equivalents.

1	software	**a**	взаимодействие человека и машины
2	artificial intelligence	**b**	искусственный интеллект
3	human-computer interaction	**c**	вероятность
4	processing information	**d**	программное обеспечение
5	probability	**e**	обработка информации
6	interrelated disciplines	**f**	предмет изучения
7	network design	**g**	взаимосвязанные дисциплины
8	subfields	**h**	проектирование сетей
9	object of study	**i**	измерения
10	measurement	**j**	подотрасли

5 Scan the text above and complete the sentences.

1) Computer science is the study of….
2) The discipline of computer science includes….
3) Computer science also makes heavy use of ….

4) Computer science is considered as part of a family of ….
5) These five disciplines are.…

6 Translate into English.

1. Информатика стала самостоятельной наукой в начале 1960-х годов.
2. Электронный цифровой компьютер изобрели примерно на 20 лет раньше.
3. Информатика произошла из четырёх наук – математики, электротехники, физики и систем обработки данных.
4. Любая информация может быть записана с помощью нулей и единиц. Это называется двоичной системой.
5. Электротехника заложила основы проектирования схем. Также, благодаря электротехнике изобрели транзистор и научились делать схемы меньшего размера. Это позволило создать более компактные и надёжные компьютеры.
6. Физика помогла создать электронные, магнитные и оптические носители информации, например, жёсткие и оптические диски.
7. Системы обработки данных предоставили алгоритмы сортировки и поиска информации и графические интерфейсы.

TEXT 5.2 Foreign languages

1 Read and translate the following word combinations.

Tool for communication, transmitting cultural heritage, career advancement, multitasking capabilities, enhanced communication skills, cognitive development, to improve problem-solving skills, become more effective and confident.

2 Read and translate the text.

Learning foreign languages

A language is a system of communication that a particular community or nation uses and consists of words, grammar, and syntax. There are more than 7,000 officially known languages in the world. And the majority of people on the planet only speak about 23 languages!

Languages are the primary tool for communication. They allow us to convey ideas, emotions, thoughts, and understanding between students. Languages reflect the culture and identity of a community and play a crucial role in preserving and transmitting cultural heritage.

Being proficient in multiple languages can open up opportunities for international collaboration, career advancement, and cross-cultural experiences. Beyond merely improving one's language skills, learning a new language has many benefits for students.

Here are some reasons why students learn a new language:

Cognitive Development and Brainpower

Learning a new language has been shown to enhance cognitive development in students. It improves problem-solving skills, critical thinking abilities, and boosts overall mental flexibility. It has been linked to better memory retention and multitasking capabilities.

Improved Academic Performance

Learning a new language can enhance a student's ability to focus, concentrate, and retain information, which can benefit their performance in other subjects as well.

Enhanced Communication Skills

Learning a new language not only improves a student's ability to communicate in different languages but also enhances their overall communication skills. It helps them become more effective and confident communicators, enabling them to express themselves clearly and understand others better.

Career Opportunities

Being proficient in multiple languages can give students a competitive edge in the job market, as it allows them to work in international companies and communicate with clients or colleagues from different countries.

Access to Knowledge and Resources

Language proficiency provides students with access to a vast amount of knowledge and resources. It allows them to explore literature, research, and information from different cultures and countries. Being able to navigate different languages opens up opportunities for students to access global networks, educational programs, and professional development resources that may not be available in their native language [15].

3 Work with a partner. Discuss the questions below.

- What does a language represent?
- Why is learning foreign languages crucially important?
- What are the main reasons for a student to learn a foreign language?

4 Decide whether the statements are TRUE (T) or FALSE (F).

1) The majority of people on the planet only speak about 10 languages.
2) Learning a new language improves cognitive skills in students.
3) Knowledge of foreign languages can’t help in formation of professional competence.
4) Language proficiency doesn’t give students access to an enormous amount of knowledge and resources.

ANSWER KEY

Unit 1

<u>TEXT 1.2: Physics</u>

Ex. 4: 1 G; 2 D; 3 A; 4 I; 5 F; 6 H;7 B; 8 E; 9 C.

Ex. 5: 1 F; 2 E; 3 A; 4 G; 5 I; 6 H; 7 D; 8 J; 9 C; 10 B; 11 P; 12 V; 13 S; 14 X; 15 Y; 16 U; 17 L; 18 Z; 19 M; 20 N; 21 W; 22 K; 23 Q; 24 T; 25 R; 26 O.

Unit 2

<u>TEXT 2.1: Mechanics</u>

Ex. 5: 1 deformation; 2 strain; 3 stress; 4 momentum; 5 energy; 6 forces.

<u>TEXT 2.2: Advanced mathematics</u>

Ex. 3: 1 and integration to multivariable functions using partial derivatives and Taylor series; 2 essential for evaluating definite integrals.; 3 challenge enthusiasts with problems like Fermat's Last Theorem; 4 focusing on operations such as union, intersection, and the concept of cardinality; 5 focusing on concepts like open sets, continuity, and compactness; 6 prime numbers, and modular arithmetic, which are vital for cryptography.; 7 and ensuring the correctness of recursive algorithms; 8 such as the sum of the first n natural numbers, and is invaluable in combinatorics, particularly with binomial coefficients; 9 using matrices and eigenvalues to solve linear equations and transformations.

Ex. 4: 1 F; 2 G; 3 E; 4 I; 5 H; 6 B;7 A; 8 D; 9 C.

Unit 3

<u>TEXT 3.1: Inorganic chemistry</u>

Ex. 5: 1 G; 2 I; 3 E; 4 J; 5 H; 6 A;7 D; 8 C; 9 F; 10 B

<u>TEXT 3.2: Organic chemistry</u>

Ex. 4: 1 T; 2 F; 3 F; 4 F; 5 T; 6 F.

Unit 4

<u>TEXT 4.1: Descriptive geometry</u>

Ex. 4: 1 D; 2 H; 3 F; 4 G; 5 A; 6 I;7 B; 8 C; 9 E; 10 J.

Ex. 5: 1 T; 2 F; 3 F; 4 T; 5 F.

Unit 5

<u>TEXT 5.1: Computer science</u>

Ex. 4: 1 F; 2 T; 3 F; 4 F.

<u>TEXT 5.2: Learning foreign languages</u>

Ex. 4: 1 F; 2 T; 3 F; 4 F.

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