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Часть 1

для студентов направлений
15.03.01 «Машиностроение»,
15.03.04 «Автоматизация технологических процессов и производств»

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UNIT 1

THE MECHANICAL ENGINEERING PROFESSION

Text What is a Mechanical Engineer? **Grammar Revision**: Tenses in Active and Passive Forms. Types of questions.

LEAD-IN

1. Answer the questions.

* Why did you decide to become a mechanical engineer?
* What do you know about your future profession?
* Do you agree with the statement that without mechanical engineers production would be impossible? Why?

READING

2. Before reading the text, remember the following words and word combinations.

to encompass	включать, охватывать
to enhance	улучшать; увеличивать
safety	безопасность; сохранность
vitality	жизнеспособность; жизнестойкость
force	сила
motion	движение
enjoyment	использование
manufacture	производство; изготовление; обработка
aircraft	авиация; самолет
equipment	оборудование
computer-aided design (CAD)	система автоматизированного проектирования
tools	станки
implantable	имплантируемый
to spur efforts	прикладывать усилия
recyclable	утилизированный
refinement	очищение; очистка

3. You are going to read the text about what a mechanical engineering profession is like. For questions 1–10, decide if they are true (T) or false (F).

WHAT IS A MECHANICAL ENGINEER?

Mechanical Engineering is a very broad field. It encompasses machines, materials, energy, manufacturing, automation, biomedical engineering, aerospace and more.

Mechanical engineering plays a dominant role in enhancing safety, economic vitality, enjoyment and overall quality of life throughout the world. Mechanical engineers are concerned with the principles of force, energy and motion. The men and women who work as mechanical engineers are professionals with expert knowledge of the design and manufacture of mechanical systems and thermal devices and processes. Some examples of products and processes developed by mechanical engineers include engines and control systems for automobiles and aircraft, electric power generation plants, life-saving medical devices and consumer products ranging from air conditioners to personal computers and athletic equipment. They also design the machines that mass-produce these products. Virtually every aspect of life is touched by mechanical engineering. If something moves or uses energy, a mechanical engineer was probably involved in its design or production.

The explosive development and expansion in computer technology has literally changed the face of mechanical engineering. The drawing board has given way to computer-aided design (CAD), and sophisticated computational software tools have enabled mechanical engineers to develop efficient solutions to complex technical problems. For example, the emerging high-tech field of nanotechnology is attracting mechanical engineers to design ultra-miniature machines and tiny implantable medical devices that navigate the human body searching for disease and damaged tissue. Also, the growing concern for the planet and the quality of life for future generations have spurred continuing efforts by mechanical engineers to design resource-efficient and recyclable products and develop equipment and processes to clean-up existing environmental problems and prevent their reoccurrence.

These technologies and a host of others will have an impact on lives in the 21st century, and their development and refinement require the skills, intuition and creative ability of mechanical engineers. At the same time, mechanical engineers are expected to understand and convey the real-world consequences of technology development alternatives to decision-makers and the public.

Mechanical engineering is a profession requiring specific skills. These skills are acquired through education, training and experience. Throughout high school, students must enroll in certain courses as preparation for acceptance into engineering programs at a college or university. A solid foundation in mathematics, science and the language arts is critical. Strong mathematics preparation includes algebra, geometry, trigonometry and calculus.

Chemistry, biology and physics form the basic science foundation. Ability in oral and written communications is important to success in mechanical engineering studies, and courses in mechanical or computer-aided drafting/drawing and other technology-related subjects can help students begin to understand the important practicalities of technological projects.

STATEMENTS	T/F
1. Mechanical Engineering includes machines, materials, energy, manufacturing, automation, biomedical engineering, aerospace, etc. 2. Enhancing safety or economic vitality are not the spheres of mechanical engineers' concern. 3. Mechanical engineers deal with the principles of force, energy and motion. 4. Mechanical engineering has hardly changed with the development of computer technology. 5. Every aspect of life is touched by mechanical engineering. 6. The drawing board still plays an important role in designing ultra-miniature machines. 7. To develop efficient solutions to complex technical problems mechanical engineers use computational software tools. 8. Mechanical engineering does nothing with tiny implantable medical devices. 9. To protect the planet mechanical engineers develop equipment and processes to clean-up existing environmental problems. 10. Specific skills of mechanical engineering profession are acquired through education, training and experience.	

4. Find the endings (a–j) to the given beginnings (1–10) on the basis of the text. Translate the sentences into Russian.

Example*: *1f

Mechanical engineers are concerned with the principles of force, energy and motion.
Инженеры-механики имеют дело с воздействием силы, энергии и движения.

1. Mechanical engineers are	a) touched by mechanical engineering.
2. They also design the machines	b) attracting mechanical engineers to design ultra-miniature machines.
3. Virtually every aspect of life is	c) a profession requiring specific skills.
4. The drawing board has given way	d) and science is critical.
5. The emerging high-tech field of nanotechnology is	e) is important to success in mechanical engineering studies.
6. These technologies and a host of others will	f) concerned with the principles of force, energy and motion.
7. Mechanical engineering is	g) to computer aided-design.
8. A solid foundation in mathematics	

9. Strong mathematics preparation includes 10. Ability in oral and written communications	h) that mass-produce these products. i) have an impact on lives in the 21st century. j) algebra, geometry, trigonometry and calculus.

USE OF ENGLISH

5. Match the words on the left (1–20) to the words on the right (a–t) to make the collocations and translate them into Russian.

Example*: *1f
plays a dominant role – играет важную роль

1. plays	a) devices
2. biomedical	b) the world
3. overall	c) engineers
4. throughout	d) engineering
5. mechanical	e) knowledge
6. expert	f) a dominant role
7. thermal	g) quality
8. control	h) development
9. explosive	i) subjects
10. computer	j) systems
11. the drawing	k) solutions
12. efficient	l) body
13. high-tech	m) technology
14. implantable	n) board
15. the human	o) problems
16. recyclable	p) field
17. environmental	q) medical devices
18. the real-world	r) foundation
19. a solid	s) consequences
20. technology-related	t) products

6. Choose the English equivalent (a, b or c) to the given Russian word.

1) качество	a) quantity	b) quality	c) quotation
2) станок	a) device	b) equipment	c) tool
3) проект	a) design	b) decision	c) designation
4) движение	a) notion	b) motivation	c) motion
5) оборудование	a) equipment	b) tool	c) device
6) развитие	a) improvement	b) development	c) enjoyment
7) вовлекать	a) involve	b) evolve	c) indicate
8) доска	a) broad	b) abroad	c) board
9) наука	a) science	b) since	c) source
10) навык	a) training	b) skill	c) experience

7. Match the English words (1–10) to their Russian equivalents (a–j) on the basis of the text.

1) safety	a) последствия
2) vitality	b) имплантируемый
3) enjoyment	c) ткань; материя
4) engine	d) безопасность
5) solid	e) утилизированный
6) enable	f) жизнеспособность
7) implantable	g) твердый
8) tissue	h) двигатель
9) recyclable	i) использование
10) consequences	j) давать возможность

8. Match the words from A to the words from B which are similar in meaning.

A	**B**
1) broad	a) illness
2) to encompass	b) to enter
3) to enhance	c) to look for
4) products	d) wide
5) efficient	e) to involve
6) complex	f) little
7) tiny	h) goods
8) to search for	i) to increase
9) disease	j) resultant
10) to enroll	k) difficult

9. Translate the sentences into English on the basis of the text.

1. Машиностроение играет огромную роль в улучшении безопасности, экономической жизнеспособности и общего качества жизни во всем мире.
2. Инженеры-механики являются профессионалами с экспертными знаниями разработки и производства механических систем и тепловых устройств и процессов.
3. Машиностроение вовлечено практически во все сферы жизни.
4. Развитие и расширение компьютерных технологий буквально изменили облик машиностроения.
5. Появление высокотехнологичных нанотехнологий привлекает инженеров-механиков к разработке крошечных имплантируемых медицинских приборов.
6. Эти технологии окажут влияние на жизнь людей в XXI веке.

7. Машиностроение – это профессия, требующая от специалистов особых навыков.
8. Студент, желающий обучаться по машиностроительным специальностям, должен иметь хорошую математическую подготовку.
9. Химия, биология, физика являются основным научным фундаментом.
10. Все это поможет студентам понимать важные особенности технологических проектов.

GRAMMAR REVISION

The Active Voice	The Passive Voice
• подлежащее предложения выполняет действие; • форма образования: Vo develop *Engineers **develop** these technologies.* *Инженеры разрабатывают эти технологии.*	• подлежащее предложения подвергается действию; • форма образования: be + Ved be + developed *These technologies are developed by engineers.* *Эти технологии разрабатываются инженерами.*

10. Search the text for the sentences in the passive voice and translate them into Russian.

11. Change the forms of the verbs in the sentences from the active into the passive voice. Translate the sentences into Russian.

1. Mechanical engineering touches every aspect of life.
2. Experimental models attract young engineers.
3. He obtains his technical experience in the workshop.
4. The engineer showed the new machines.
5. Faraday made many discoveries.
6. The practical engineers will improve this heat engine.
7. The laboratory assistant will study the problem.
8. The researchers are carrying out an experiment.
9. The mechanical engineers have invented a new device.
10. By the end of the year they had arranged two important conferences.

Types of questions
1. General: **Do you** study mechanical engineering at your university? 2. Special: What **do you** study at your university? 3. Alternative: **Do you** study mechanical engineering or management? 4. Tag: You study mechanical engineering, **don't you**? 5. A question to the subject: **Who showed** the new machines? ***Remember*** the following auxiliary verbs: **am, is, are, do, does, did, have, has, will, can, must, may, should, would** which are used before the subject in the questions. ***Remember*** the following interrogative words: **who, whose, whom, what, which, when, where, why, how, how many, how much, how long** which start special questions.

12. Make up different types of questions to the following sentences.

1. Our engineers work hard at this problem. (general)
2. They designed this instrument. (special)
3. People are going to use bicycles instead of cars. (alternative)
4. This plant will produce only tyres. (tag)
5. The car has crashed into the tree. (general)
6. The laboratory is provided with new equipment. (special)
7. Irrigation systems were devised by skilled technicians. (alternative)
8. The education and training of engineers must be a partnership between industry and higher education. (tag)
9. Mechanical engineering touches every aspect of life. (a question to the subject)
10. These technologies will have an impact on lives in the 21st century. (a question to the subject)

SPEAKING

13. Use the words and phrases below to make sentences.

mechanical engineering, mechanical engineers, expert knowledge, develop, design, involved, change, the drawing board, computational software tools, environmental problems, real-world consequences, specific skills, technology-related subjects

14. Work in pairs. Think of some questions to review the contents of the text about the mechanical engineering profession and ask each other. Use the words and the word combinations bellow to mention the main aspects.

* plays a dominant role * changed the face of mechanical engineering * computer aided-design	* design the machines * high-tech field of nanotechnology * are concerned with * have an impact on lives

15. Say about "The mechanical engineering profession".

WRITING

16. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

PROBLEM SOLVING IN ENGINEERING

Engineers use their knowledge of science, mathematics, logic, economics, and appropriate experience or tacit knowledge to find suitable solutions to a problem. Creating an appropriate mathematical model of a problem allows them to analyze it (sometimes definitively), and to test potential solutions. Usually multiple reasonable solutions exist, so engineers must evaluate the different design choices on their merits and choose the solution that best meets their requirements. Genrich Altshuller, after gathering statistics on a large number of patents, suggested that compromises are at the heart of "low level" engineering designs, while at a higher level the best design is one which eliminates the core contradiction causing the problem.

Engineers typically attempt to predict how well their designs will perform to their specifications prior to full-scale production. They use, among other things: prototypes, scale models, simulations, destructive tests, nondestructive tests, and stress tests. Testing ensures that products will perform as expected. Engineers take on the responsibility of producing designs that will perform as well as expected and will not cause unintended harm to the public at large. Engineers typically include a factor of safety in their designs to reduce the risk of unexpected failure. However, the greater the safety factor, the less efficient the design may be. The study of failed products is known as forensic engineering, and can help the product designer in evaluating his or her design in the light of real conditions. The discipline is of greatest value after disasters, such as bridge collapses, when careful analysis is needed to establish the cause or causes of the failure.

UNIT 2

TRENDS IN THE MODERN MACHINE-BUILDING INDUSTRY

Text The two main headlines in modern machine-building. **Grammar Revision**: Tenses in Active and Passive Forms. Types of questions.

LEAD-IN

1. Answer the questions.

* Do you know anything about any trends in the modern machine-building industry? What are these?
* Have you ever heard about a vacuum plasma method? Where can it be applied?

READING

2. Before reading the text, remember the following words.

automation	автоматизация
reliability	надёжность
workpiece	рабочее место
to trace	проследить
coal-digging complexes	угольно-добывающие комплексы
installation	установление
casting	литье
treatment	обработка
welding equipment	сварочное оборудование
flexible	гибкий
application	применение
to evolve	выявлять
to reinforce	укреплять
vulnerable	уязвимый
wear	изнашивание
tear	разрывание
to proceed	исходить
grain harvester	зерноуборочная машина
to last	сохраняться

3. You are going to read the text about the trends in modern machine-building industry. For questions 1–8, choose the right letter A, B, C or D.

THE TWO MAIN HEADLINES IN MODERN MACHINE-BUILDING

The scientific and technological progress will continue in engineering along two main headlines. Firstly, it is automation, including the creation of "unmanned" industries. Secondly, raising the reliability and extending the service life of machines.

This certainly requires new technology. The machine modules on a large scale are well suited for "unmanned" industries.

Intense work is being carried out on new robots. What we need is not merely manipulators which can take up a workpiece and pass it on, but robots which can identify objects, their position in space, etc.

We also need machines that would trace the entire process of machining. Some have been designed and are manufactured. Modern engineering thinking has created new automated coal-digging complexes and machine systems, installations for the continuous casting of steel, machine-tools for electro-physical and electrochemical treatment of metals, unique welding equipment, automatic rotor transfer lines and machine-tool modules for flexible industries.

New technologies and equipment have been designed for most branches of engineering. In the shortest time possible the engineers are to start producing new generations of machines and equipment which would allow manufacturers to increase productivity several times and to find a way for the application of advanced technologies.

Large reserves in extending service life for machines can be found in the process of designing. At present, advanced methods have been evolved for designing machines proceeding from a number of criteria. Automatic design systems allow an optimizing of the solutions in design and technology when new machines are still in the blueprint stage.

A promising reserve in increasing the life of parts is strengthening treatment. In recent years new highly efficient methods have been found.

First and foremost of them are the vacuum plasma methods for coating components with hard alloy compounds, such as nitrides and carbides of titanium, tungsten and boron. Methods have been designed for reinforcing machine parts most vulnerable to wear and tear, such as in grain harvesters, to make them last several times longer.

Thus, it is not merely quantity engineers and scientists it is a matter of major characteristics. In other words, this is a matter of quality, and not of the mere number of new machines, apparatus and materials.

1. The two main headlines in engineering nowadays are _____.
   A. automation of industries and raising the reliability of machines
   B. increasing the number of engineers and the quality of machines
   C. evolving a number of criteria for designing machines and optimizing design technology
   D. increasing promising reserve and automation
2. According to the text "unmanned" industries need greatly in _____.
   A. automated coal-digging complexes
   B. unique welding equipment
   C. the machine module
   D. advanced methods
3. According to the text robots are needed for _____.
   A. intense work
   B. taking up a workpiece
   C. identification of objects, their position in space
   D. designing machines
4. The creation of "unmanned" industries is _____.
   A. not the sphere of mechanical engineers' concern
   B. included into automation
   C. the only sphere of mechanical engineers' concern
   D. designed for most branches
5. Automation and raising the reliability of machines require _____.
   A. new branches of engineering
   B. improving the design process
   C. new technologies
   D. a number of criteria
6. New technologies and equipment _____.
   A. are being designed for most branches of engineering
   B. have been designed for most branches of engineering
   C. will be designed for most branches of engineering
   D. has been designed for most branches of engineering
7. The service life of machine parts can be increased by _____.
   A. strengthening treatment
   B. unique welding equipment
   C. coating components
   D. new technologies

8. Hard alloy compounds are employed for _____.
   A. welding equipment
   B. coating components
   C. designing machines
   D. reinforcing machine parts

4. Find the endings (a–j) to the given beginnings (1–10) on the basis of the text. Translate the sentences into Russian.

Example*: *1c
Intense work is being carried out on new robots. –
Ведется напряженная работа по созданию новых роботов.

1. Intense work is being carried	a) new generations of machines.
2. We need robots which can identify	b) life for machines can be found in the process of designing.
3. We also need machines that would	c) out on new robots.
4. Modern engineering thinking has	d) methods have been found.
5. New technologies and equipment have	e) reinforcing machine parts.
6. The engineers are to start producing	f) objects, their position in space, etc.
7. Large reserves in extending service	g) strengthening treatment.
8. A promising reserve in increasing the life of parts is	h) been designed for most branches of engineering.
9. In recent years new highly efficient	i) trace the entire process of machining.
10. Methods have been designed for	j) created new automated coal-digging complexes.

USE OF ENGLISH

5. Match the words on the left (1–11) with the words on the right (a–k) to make the collocations and translate them into Russian.

Example*: *1g
"unmanned" industries – «не управляемые человеком» индустрии

1) "unmanned"	a) of machines
2) the service life	b) treatment
3) the machine	c) productivity
4) electrochemical	d) technologies
5) welding	e) design systems
6) to increase	f) stage
7) advanced	g) industries
8) automatic	h) compounds
9) the blueprint	i) plasma methods
10) the vacuum	j) modules
11) alloy	k) equipment

6. Choose the English equivalent (a, b or c) to the given Russian word.

1) вдоль, по	a) along	b) alone	c) among
2) создание	a) estimation	b) creation	c) rotation
3) надежность	a) capability	b) reliability	c) mobility
4) поднимать	a) chase	b) rise	c) raise
5) выполнять	a) carry off	b) carry out	c) carry on
6) занимать (место)	a) take after	b) take up	c) take aback
7) сварка	a) casting	b) harvesting	c) welding
8) найти	a) find	b) found	c) search
9) решения	a) solutions	b) inventions	c) decisions
10) многообещающий	a) promoting	b) prompting	c) promising
11) проект	a) blueprint	c) whiteprint	d) redprint
12) дольше, длиннее	a) long	c) longer	d) longest

7. Match the English words to their Russian equivalents on the basis of the text.

1) headlines	a) определенно
2) including	b) требует
3) raising	c) занимать
4) requires	d) весь, целый
5) transfer lines	e) основные направления
6) certainly	f) передовой, продвинутый
7) life of machines	g) включая
8) take up	h) повышая
9) suit	i) позволять
10) extending	j) давать возможность
11) allow	k) качество
12) entire	l) подходить
13) branches	m) протягивающий
14) advanced	n) грунтовка
15) increase	o) сплав
16) strengthening	p) продолжительность работы машин
17) coating	q) смесь, состав
18) alloy	r) укрепляющий
19) compound	s) отрасли
20) quality	t) увеличивать

8. Find the following word combinations in the text.

срок эксплуатации машин; технический прогресс; модули машин; плотная работа; индустрии без вмешательства человека; весь процесс; современная инженерная мысль; автоматизированные угольно-добывающие комплексы; машинные системы; продолжительное литье; электрохимическая обработка; сварочное оборудование; transfer lines;

модули станка; гибкое производство; передовые технологии; многообещающий резерв; срок службы; упрочение деталей машин; высоко эффективные методы; за последние годы; методы вакуумной плазмы; hard alloy compounds; детали машин; зерноуборочные машины; общая характеристика

9. Translate the sentences from Russian into English on the basis of the text.

1. Научно-технический прогресс способствует повышению надежности и увеличению срока службы машин.
2. Большая работа выполняется новыми роботами.
3. Нам нужны роботы, которые могут идентифицировать объекты, их местонахождение в пространстве и т.д.
4. Для большинства отраслей инженерного дела были разработаны новые технологии и оборудование.
5. Современные инженеры создали новые автоматизированные машинные системы для электрохимической обработки металлов.
6. В ближайшее время инженеры начнут производство машин и оборудование нового поколения, которые позволят увеличить производительность в несколько раз.
7. Автоматизированные проектные системы способствуют оптимизации решений в проектировании и технологии.
8. За последние годы были найдены эффективные методы обработки металлов.
9. Методы вакуумной плазмы служат упрочению деталей машин.
10. Другими словами, дело не в количестве создания новых машин, аппаратуры, оборудования, а в их качестве.

GRAMMAR REVISION

10. Search the text for the sentences in the passive voice and translate them into Russian.

11. Change the forms of the verbs in the sentences from the active into the passive voice. Translate the sentences into Russian.

1. Robots can identify objects.
2. Modern engineering thinking has created new automated coal-digging complexes.
3. Raising the reliability certainly requires new technologies.
4. We need not merely manipulators.

5. The engineers are going to start producing new generations of machines.
6. The engineers have created machine-tool modules for flexible industries.
7. It will definitely increase productivity several times.
8. The scientists are searching for new highly efficient methods.
9. Unfortunately, it did not extend.
10. They improved the quality of the machine.

12. Make up different types of questions to the following sentences.

1. The scientific and technological progress will continue automation in engineering. (general)
2. Intense work is being carried out on new robots. (special)
3. Some machines have been designed. (alternative)
4. This equipment will allow manufacturers to increase productivity. (tag)
5. The new machines are in the blueprint stage. (general)
6. At present advanced methods have been evolved. (special)
7. These machines are vulnerable to wear. (alternative)
8. It is a matter of major characteristics. (tag)
9. Large reserves can be found in the process of designing. (a question to the subject)
10. New machines are still in the blueprint stage. (a question to the subject)

SPEAKING

13. Use the words and phrases below to make sentences.

the scientific and technological progress; the creation of “unmanned” industries; raising the reliability; the service life of machines; intense work; robots; trace the entire process of machining; modern engineering thinking; to increase productivity; advanced methods; reinforcing machine parts; strengthening treatment; a matter of quality

14. Work in pairs. Think of some questions to review the contents of the text about the mechanical engineering profession and ask each other. Use the words and the word combinations bellow to mention the main aspects.

* two main headlines * automation * raising the reliability * robots	* trace the entire process * unique welding equipment * automatic design systems * the vacuum plasma methods

15. Say about "Trends in the modern machine – building industry".

WRITING

16. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

MODERN MANUFACTURING

Manufacturing technologies address the capability to design and to create products, and to manage that overall process. Product quality and reliability, responsiveness to customer demands, increased labor productivity, and efficient use of capital were the primary areas that leading manufacturing companies throughout the world emphasized during the past decade to respond to the challenge of global competitiveness. As a consequence of these trends, leading manufacturing organizations are flexible in management and labor practices, develop and produce virtually defect-free products quickly (supported with global customer service) in response to opportunities, and employ a smaller work force possessing multidisciplinary skills. These companies have an optimal balance of automated and manual operations.

To meet these challenges, the manufacturing practices must be continually evaluated and strategically employed. In addition, manufacturing firms must cope with design processes (e.g., using customers' requirements and expectations to develop engineering specifications, and then designing components), production processes (e.g., moving materials, converting materials properties or shapes, assembling products or components, verifying processes results), and business practices (e.g., turning a customer order into a list of required parts, cost accounting, and documentation of procedures.) Information technology will play an indispensable role in supporting and enabling the complex practices of manufacturing by providing the mechanisms to facilitate and manage the complexity of manufacturing processes and achieving the integration of manufacturing activities within and among manufacturing enterprises. A skilled, educated work force is also a critical component of a state-of-the art manufacturing capability. Training and education are essential, not just for new graduates, but for existing work force.

Manufacturing is evolving from an art or a trade into a science. We must understand manufacturing as a technical discipline. Such knowledge is needed to most effectively apply capabilities, quickly incorporate new developments, and identify the best available solutions to solve problems. The structure of the science of manufacturing is very similar across product lines since the same fundamental functions are performed and the same basic managerial controls are exercised.

SELF-STUDY

READING

Text 1

1. Read the text about the definition and function of a machine and how it works. For questions 1–7, choose the best answer A, B, C or D.

HOW A MACHINE WORKS

Defined in a simplest terms a machine is a device that uses force to accomplish something. More technically, it is a device that transmits and changes force or motion into work. This definition implies that a machine must have moving parts. A machine can be very simple, like a block and tackle to raise a heavy weight, or very complex, like a railroad locomotive or the mechanical systems used for industrial processes.

A machine receives input from an energy source and transforms it into output in the form of mechanical or electrical energy. Machines whose input is a natural source of energy are called prime movers. Natural sources of energy include wind, water, steam, and petroleum. Windmills and waterwheels are prime movers; so are the great turbines driven by water or steam that turn the generators that produce electricity; and so are internal combustion engines that use petroleum products as fuel. Electric motors are not prime movers, since an alternating current of electricity which supplies most electrical energy does not exist in nature.

Terms like work, force, and power are frequently used in mechanical engineering, so it is necessary to define them precisely. Force is an effort that results in motion or physical change. If you use your muscles to lift a box, you are exerting force on those blades, thereby setting them in motion. In a technical sense work is the combination of the force and the distance through which it is exerted. To produce work, a force must act through a distance. If you stand and hold a twenty-pound weight for any length of time, you may get very tired, but you are not doing work in an engineering sense because the force you exerted to hold up the weight was not acting through a distance. However, if you raised the weight, you would be doing work.

Power is another term used in a special technical sense in speaking of machines. It is the rate at which work is performed. The rate of doing work is sometimes given in terms of horsepower, often abbreviated *hp*. This expression resulted from the desire of the inventor James Watt to describe the work his steam engines performed in terms that his customers could easily under-

stand. After much experimentation, he settled on a rate of 33,000 foot-pounds per minute as one horsepower. In the metric system power is measured in terms of watts and kilowatts. The kilowatt, a more widely used term, equals a thousand watts or approximately 11/3 horsepower in the English system.

1. A machine is a device that _____.
   A. transmits and changes force into work
   B. uses its moving parts
   C. is used to raise a heavy weight
   D. moves its parts

2. A machine receives input from _____.
   A. a solar system
   B. an energy source
   C. a railroad locomotive
   D. mechanical energy

3. Prime movers are machines whose input is _____.
   A. an artificial source of energy
   B. an alternating current of electricity
   C. a natural source of energy
   D. a mechanical source of energy

4. Prime movers are *not* _____.
   A. windmills
   B. waterwheels
   C. electric motors
   D. the great turbines

5. Force is an effort that _____.
   A. helps you to hold up the weight
   B. results in motion
   C. makes you get tired
   D. is not acting through a distance

6. Power is the rate at which work _____.
   A. is performed
   B. equals a thousand watts
   C. equals 33,000 foot-pounds per minute
   D. is measured in terms of watts

7. One horsepower equals the rate of _____.
   A. 33,000 foot-pounds per minute
   B. a thousand watts
   C. a thousand kilowatts
   D. a hundred kilowatts

Text 2

2. You are going to read the text about petroleum engineering. For questions 1–10, decide if they are true (T) or false (F).

PETROLEUM ENGINEERING*

Petroleum engineering is involved in the exploration and production activities of petroleum as an upstream end of the energy sector. Upstream refers to the process of finding and extracting oil, which is usually buried deep beneath the earth's surface, to provide a continuous supply to consumers "downstream". Petroleum engineering covers a wide range of topics, including economics, geology, geochemistry, geo-mechanics, geophysics, oil drilling, geopolitics, knowledge management, seismology, tectonics, thermodynamics, well logging, well completion, oil and gas production, reservoir development, and pipelines.

Petroleum engineering has become a technical profession that involves extracting oil in increasingly difficult situations as the "low hanging fruit" of the world's oil fields are found and depleted. Improvements in computer modeling, materials and the application of statistics, probability analysis, and new technologies like horizontal drilling and enhanced oil recovery, have drastically improved the toolbox of the petroleum engineer in recent decades.

As mistakes may be measured in millions of dollars, petroleum engineers are held to a high standard. Deep water operations can be compared to space travel in terms of technical challenges. Arctic conditions and conditions of extreme heat have to be contended with. High Temperature and High Pressure (HTHP) environments that have become increasingly commonplace in today's operations require the petroleum engineer to be savvy in topics as wide ranging as thermo-hydraulics, geo-mechanics, and intelligent systems.

Petroleum engineers must implement high technology plans with the use of manpower, highly coordinated and often in dangerous conditions. The drilling rig crew and machines they use becomes the remote partner of the petroleum engineer in implementing every drilling program. Petroleum engineering has historically been one of the highest paid engineering disciplines; this is offset by a tendency for mass layoffs when oil prices decline. According to a survey published in Dec 2006 the average income was $116,834.Petroleum engineers divide themselves into several types:

- Reservoir engineers work to optimize production of oil and gas via proper well placement, production levels, and enhanced oil recovery techniques.

* www. Wikipedia.ed

• Drilling engineers manage the technical aspects of drilling both production and injection wells.

• Production engineers (also known as completion or subsurface engineers) manage the interface between the reservoir and the well, including perforations, sand control, artificial lift, downhole flow control, and downhole monitoring equipment.

Reservoir engineering is a branch of petroleum engineering, typically concerned with maximizing the economic recovery of hydrocarbons from the subsurface.

Of particular interest to reservoir engineers is generating accurate reserves estimates for use in financial reporting to the SEC and other regulatory bodies. Other job responsibilities include numerical reservoir modeling, production forecasting, well testing, well drilling and workover planning, economic modeling, and PVT analysis of reservoir fluids.

Reservoir engineers also play a central role in field development planning, recommending appropriate and cost effective reservoir depletion schemes such as water flooding or gas injection to maximize hydrocarbon recovery.

Reservoir engineers often specialize in two areas:

• Surveillance (or production) engineering, i.e. monitoring of existing fields and optimization of production and injection rates. Surveillance engineers typically use analytical and empirical techniques to perform their work, including decline curve analysis, material balance modeling, and inflow/outflow analysis.

• Simulation modeling, i.e. the conduct of reservoir simulation studies to determine optimal development plans for oil and gas reservoirs.

Drilling engineering is a subset of petroleum engineering, involved in the design and drilling of production and injection wells. The planning phases of drilling an oil well typically involve estimating the value of sought reserves, estimating the costs to access reserves, acquiring property by a mineral lease, a geologic survey, a wellbore plan, and a layout of the type of equipment depth of the well.

Drilling engineers are engineers in charge of the process of planning and drilling oil wells. Their responsibilities include:

• Designing casing strings in conjunction with drilling fluid plans to prevent blowouts (uncontrolled hydrocarbon release) and formation breakdown.

• Designing or contributing to the design of drill strings, cement plans, directional plans, and bit programs.

• Specifying equipment, material and ratings and grades to be used in the drilling process.

- Providing technical support and audit during the drilling process.
- Performing cost estimates and analysis.
- Developing contracts with vendors.

It is their responsibility to ensure that the well is drilled in a safe, cost-effective, and effective manner.

STATEMENTS	T/F
1. Upstream refers to the process of finding and extracting oil. 2. Petroleum engineering covers a wide range of topics except for knowledge management. 3. New technologies have drastically improved the toolbox of the petroleum engineer in recent decades. 4. According to the text deep water operations cannot be compared to space travel in terms of technical challenges. 5. Petroleum engineers must carry out high technology plans with the use of highly coordinated manpower. 6. Reservoir engineers manage the technical aspects of drilling. 7. Drilling engineers work to optimize production of oil and gas via proper well placement, production levels, and enhanced oil recovery techniques. 8. Production engineers manage the interface between the reservoir and the well. 9. Reservoir engineers also recommend appropriate and cost effective reservoir depletion schemes. 10. Drilling engineers are responsible for the process of planning and drilling oil wells.	

VOCABULARY AND GRAMMAR

3. For each sentence, choose the correct item A, B, C or D.

1. A machine is a device that transmits and changes force or motion into _____.
   A. job
   B. work
   C. energy
   D. power
2. A machine must have _____ parts.
   A. flying
   B. going
   C. crawling
   D. moving

3. As mistakes may be _____ in millions of dollars, petroleum engineers are held to a high standard.
   A. cost
   B. measured
   C. valued
   D. sold

4. The drilling rig crew and machines becomes the _____ partner of the petroleum engineer in implementing every drilling program.
   A. far
   B. farther
   C. remote
   D. further

5. Reservoir engineers often specialize _____ two areas.
   A. in
   B. at
   C. from
   D. on

6. The well _____ drilled in a safe, cost-effective, and effective manner.
   A. will
   B. is
   C. have
   D. are

7. If you use your muscles to lift a box, force on those blades _____ by you.
   A. are exerting
   B. are being exerting
   C. is being exerted
   D. are being exerted

8. Wind, water, steam, and petroleum _____ into natural sources of energy.
   A. is included
   B. are included
   C. include
   D. includes

9. An alternating current of electricity does not exist in nature, _____?
   A. doesn't it
   B. does it
   C. isn't it
   D. do they

10. This phase of drilling an oil well typically involves estimating the value of sought reserves, _____?
    A. does this
    B. doesn't this
    C. doesn't it
    D. does it

TRANSLATION

4. Translate the sentences from English into Russian.

1. A machine is a device that transmits and changes force or motion into work.
2. A machine can be very simple, like a block, or very complex, like a railroad locomotive.
3. A machine receives input from an energy source and transforms it into output in the form of mechanical or electrical energy.
4. Natural sources of energy include wind, water, steam, and petroleum.
5. Work is the combination of the force and the distance through which it is exerted.
6. Upstream refers to the process of finding and extracting oil.
7. Petroleum engineering has become a technical profession that involves extracting oil in increasingly difficult situations.
8. Surveillance engineers typically use analytical and empirical techniques to perform their work.
9. Drilling engineers are engineers in charge of the process of planning and drilling oil wells.
10. Petroleum engineering has historically been one of the highest paid engineering disciplines.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

THE FIRST SEISMOGRAPH

In 1989 millions of people watched on television as a powerful earthquake rocked San Francisco shortly before baseball's World Series. That quake's tremors brought death and destruction around the Bay area. Today we know that the shifting in the earth's crust causes earthquakes. This

movement sends “seismic waves” across the earth’s surface, much as dropping a pebble in a pond sends ripples across water.

People living in Han China believed that angry spirits caused earthquakes to express their displeasure with society. Scholars studied quakes closely, believing they were interpreting a divine message.

In A.D. 132 Zhang Heng invented the world’s first seismograph, an instrument for detecting and measuring earthquakes. Zhang’s device resembled a domed, cylindrical urn. Each of eight dragons around the top held a ball in its jaws. At the base of the urn sat eight toads with upturned heads and open mouths, each directly under a dragon. When a tremor occurred, a mechanism caused one of the balls to fall into a toad’s mouth.

This action showed that somewhere an earthquake was taking place. The side of the seismograph where that toad was sitting indicated the quake’s direction. As the ball popped into the toad’s mouth, the loudness may have indicated the tremor’s strength. Zhang Heng’s seismograph had one quality that today’s instruments lack: it was also a work of art.

SELF-STUDY/KEYS

Ex. 1

Keys: 1a, 2b, 3c, 4c, 5b, 6a, 7a.

Ex. 2

Keys: 1t, 2f, 3t, 4f, 5t, 6f, 7f, 8t, 9t, 10t.

Ex. 3

Keys: 1b, 2d, 3b, 4c, 5a, 6b, 7c, 8b, 9b, 10c.

Ex. 4

Keys:

1. Машина это прибор, который преобразует и изменяет силу или движение в работу.
2. Машина может быть как очень простой, например, блок, так и очень сложной, например, железнодорожный локомотив.
3. Машина получает энергию (подачу) от источника энергии и преобразует ее в продукт в форме механической или электрической энергии.
4. Естественными источниками энергии являются ветер, вода, пар и нефть.
5. Работа представляет собой комбинацию силы и расстояния, через которые она вызывается.
6. Разведка и добыча относятся к процессу нахождения и добычи нефти.
7. Нефтяная промышленность стала технической профессией, которая включает добычу нефти в очень тяжелых условиях.
8. Инженеры технического надзора, как правило, используют аналитические и эмпирические технологии для выполнения своей работы.
9. Буровики – это инженеры, отвечающие за процесс планирования и бурения нефтяных скважин.
10. Нефтяная промышленность является одной из самой высокооплачиваемой инженерной дисциплиной.

CONTROL WORK № 1

Variant 1

READING

Text 1

1. Read the text about different engineering specialties. For questions 1–7, choose the best answer A, B, C or D.

ENGINEERING SPECIALTIES

One result of the rapid expansion of scientific knowledge was an increase in the number of engineering specialties. By the end of the nineteenth century not only were mechanical, civil, and mining and metallurgical engineering established but the newer specialties of chemical and electrical engineering also emerged. This growth in the number of specialties is continuing with the establishment of such disciplines as aerospace, nuclear, petroleum, and electronic engineering. Many of these are subdivisions of earlier specialties – for example, electronic from electrical engineering or petroleum from chemical. Within the field of mechanical engineering the major subdivision is industrial engineering which is concerned with complete mechanical systems for industry rather than individual machines.

Engineers design and make machines, equipment and the like. Such work requires creative ability and a working knowledge of scientific principles. The engineer must also have an understanding of the various processes and materials available to him/her and could be working in any of the following areas: the organization of manufacture, research and development, design, construction, sales and education.

Because of the large number of engineering fields today there are often many different kinds of engineers working on large projects such as the development of nuclear power or new aircraft. In the design of a new aircraft mechanical engineers work not only on the plane's engines but on other mechanical aspects such as the braking system. When the aircraft goes into production, mechanical and industrial engineers are involved in designing the machines necessary to fabricate the different parts as well as the entire system for assembling them. In both phases of such a project mechanical engineers work with specialists in fields such as aerospace and electronic engineering. Each engineer is a member of a team often headed by a systems engineer able to combine the contributions made by all the different disciplines.

Another result of the increase of scientific knowledge is that engineering has become a profession. A profession is an occupation like law or medicine that requires specialized advanced education. Today it requires at least four or five years of university study leading to a Bachelor of Science degree. More and more often engineers, especially those engaged in research, get an advanced master's or doctor's degree. Even those engineers who do not study for advanced degrees must keep up with changes in their profession. A mechanical engineer who does not know about new materials cannot successfully compete with one who does.

1. In this text the rapid expansion of scientific knowledge is connected with _____.
   A. the establishment of such disciplines as aerospace and nuclear engineering
   B. an increase in the number of engineering specialties
   C. subdivisions of earlier specialties
   D. complete mechanical systems
2. According to the text industrial engineering is concerned with _____ .
   A. individual machines
   B. the major subdivisions
   C. the growth in the number of specialties
   D. complete mechanical systems
3. Electronic engineering is a subdivision emerged from _____ engineering.
   A. mechanical
   B. civil
   C. chemical
   D. electrical
4. The area which is *not* of engineers' concern is _____.
   A. research
   B. design
   C. construction
   D. planting trees
5. Engineers are working on the projects connecting with the development of nuclear _____.
   A. source
   B. power
   C. aircraft
   D. unit

6. Mechanical engineers together with other specialists made a great _____ to electronic engineering.
   A. progress
   B. advance
   C. contribution
   D. competition

7. According to the text engineers must keep up with _____ in their profession.
   A. changes
   B. chances
   C. challenges
   D. contributions

Text 2

2. Read the text about engineering in Rome. For questions 1–8, decide if they are true (T) or false (F).

STATEMENTS	T/F
1. The Romans constructed a lot of striking buildings during their history. 2. The Pantheon was rebuilt by Hadrian in 118 and 128 B.C. 3. The Pantheon was built out of stone. 4. Ancient Romans constructed only public buildings with a huge skylight. 5. Neither roads, nor other constructions are still used today. 6. The Romans constructed artificial channels not only in their own country. 7. In their engineering work the Romans used only their own discoveries. 8. Roman scientists borrowed resources information from other cultures.	

ENGINEERING IN ROME

The Romans constructed many impressive buildings besides the Circus Maximus and the Colosseum. Between A.D. 118 and 128, Hadrian rebuilt the Pantheon, a temple for all the gods and goddesses, with a soaring dome and a huge skylight. To build the Pantheon, the Romans mixed concrete, a new building material with various kinds of stone. As they constructed public buildings and a vast network of roads, the Romans engineered aqueducts, or artificial channels for carrying water. These lofty arches built out of stone enabled water to flow into Rome from as far away as 30 miles (about 48 kilometers). One Roman-built aqueduct in Segovia, Spain, was so well constructed that it is still used today nearly 1.900 years after it was completed. The Romans excelled at taking discoveries made by others, combining them, re-

fining them, and using them in new and often more practical ways. They adapted the Etruscan arch and dome to construct aqueducts and the Pantheon, and borrowed the design for columns from the Greek temple to support porches built around Roman city squares. Roman scientists also relied upon foreign resources information that had been collected and organized from other cultures.

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. The growth in the number of specialties in engineering is continuing with the _____ of new disciplines.
   A. choice
   B. exception
   C. advent
   D. challenging
2. The main operational objectives of efficiency demand a range of personal _____ from the engineers.
   A. features
   B. characteristics
   C. skills
   D. duties
3. Mechanical engineers are _____ in their design, building and operation.
   A. involved
   B. included
   C. stimulated
   D. sophisticated
4. The Romans constructed many _____ buildings.
   A. contemporary
   B. unsophisticated
   C. soaring
   D. striking
5. The Romans took discoveries _____ by others scientists.
   A. made
   B. combined
   C. refined
   D. done

6. Industrial engineering _____ with complete mechanical systems.
   A. are concerned
   B. is concerned
   C. is concerning
   D. concerns

7. Engineering _____ a profession.
   A. has been become
   B. is being become
   C. was become
   D. has become

8. Foreign resources information _____ from other cultures.
   A. had been collected
   B. were collected
   C. collected
   D. are collected

9. They constructed public buildings, _____?
   A. don't they
   B. won't they
   C. didn't they
   D. did they

10. These lofty arches were built out of stone, _____?
    A. didn't they
    B. weren't they
    C. weren't these
    D. were they

TRANSLATION

4. Translate the sentences from English into Russian.

1. By the end of the nineteenth century the newer specialties of chemical and electrical engineering emerged.
2. Such disciplines as aerospace, nuclear, petroleum, and electronic engineering were established.
3. Electronic is a subdivision of electrical engineering.
4. Industrial engineering is concerned with complete mechanical systems for industry rather than individual machines.
5. Making machines requires creative ability and a working knowledge of scientific principles.

6. In the design of a new aircraft mechanical engineers work not only on the plane's engines but on other mechanical aspects such as the braking system.
7. A systems engineer is able to combine the contributions made by all the different disciplines.
8. A mechanical engineer who does not know about new materials cannot successfully compete with one who does.
9. One aqueduct built by ancient Romans is still used today nearly 1.900 years after it was completed.
10. The Romans excelled at taking discoveries made by others, combining them, refining them, and using them in new and often more practical ways.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

TOWARDS FLEXIBLE PRODUCTION FACILITIES

Present-day industry, in particular engineering, is defined by the fact that its products – machine-tools, devices, instruments, etc. – are normally produced for a very short period of time and replaced by other more advanced products. The range of products is growing and the size of batches is decreasing. The new production environment has brought about new requirements. Thus, for example, earlier functionally "rigid" automatic production lines require considerable changes to be introduced or the line to be fully dismantled when the factory switches to a new product. Unlike the above lines, flexible production lines can be switched over to a new product virtually instantaneously. When operated on a 24-hour basis, these lines need only a minimal team operators to attend the production.

A set of modules can be combined by a transport-and-storage system and a control system into a production line (or a production area).

The highest level of a flexible production facility, an automatic factory, incorporates several flexible production workshops. Such a factory has both automated equipment and automated services, including computer-aided design of products and processes, and software development for its control systems. Such automated factories are being designed and are expected to become fully operational in the near future. All the industrialized countries are currently making use of flexible modules and workshops.

CONTROL WORK № 1

Variant 2

READING

Text 1

1. Read the text about the main divisions of engineering. For questions 1–5, choose the most suitable headings from the list (A–E).

ENGINEERING

A. Civil engineering.
B. Chemical engineering.
C. Electrical engineering.
D. Mechanical engineering.
E. Structural engineering.

Today machines have to withstand such tremendous stresses and to be able of such complex motions that complicated and specialized calculations taking hundreds of factors into account are needed in the design of even quite a simple machine like a motor-car engine.

So, as engineering progresses, engineers must become ever more scientific and specialized. Today the branches of engineering are so wide that it is impossible to classify them satisfactory. But we may try to divide them into uses. The main divisions of engineering may be listed as follows:

1 _____

Steam engines, internal combustion engines, turbines (steam, gas, water), pumps; compressors; machine-tools; mechanisms.

2_____

a) Power: generators; motors; transformers; transmission (power lines and so on).

b) Electronics: radio, radar, television.

3_____

Dams; tunnels; roads, and so on.

4 _____

The structural details of all large buildings and bridges.

5 _____

Any of these branches of engineering may require the special services of the following specialists: the metallurgist; the strength of materials expert;

the thermodynamics of heat expert, the mechanics or machines experts; the various production engineering experts such as the engineering designer or the tool designer; the mathematician specializing in engineering problems and many more.

The engineer must also deal with the economists to assure himself that he is producing what is wanted, and economically.

Text 2

2. Read the article about the range of job opportunities of mechanical engineers. For questions 1–9, decide if they are true (T) or false (F).

MECHANICAL ENGINEERS' JOB OPPORTUNITIES

Demand for qualified mechanical engineers is high.

Mechanical engineers have a wide range of job opportunities. They may be management, sales, development, research, or design or production engineers in industries such as food, steel, chemicals and heavy and light engineering. They also can work in service industries such as transport and gas, water, and electricity.

Mechanical engineers are vital to the running of plants. Without them production would be impossible. Each plant is likely to be different. Some are large, some are small and most are complex. The main operational objectives of safety, efficiency and profitability are common to them all and demand a range of technical and personal skills from the engineers.

Mechanical engineers are concerned with machines, mechanisms and energy conversion. Mechanical equipment is at the core of the plants. Each plant is different from the next: the machines are particular to the process involved in making the end product and mechanical engineers are involved in their design, building and operation. They are at the forefront of technology: pressing the limits of material capability, developing new materials of construction, specifying complex machines and doing all of this with the most sophisticated design techniques.

Mechanical engineers' jobs are demanding and exciting. Their skills, technical and managerial, are used to the fullest. In plant operation the job is to keep the plant running and stimulate the team to make better use of equipment to improve performance.

Mechanical engineers are at the core of production: they manage plant and equipment, they manage people. In fact, they manage our future.

STATEMENTS	T/F
1. The contemporary world demands greatly for qualified mechanical engineers. 2. Mechanical engineers do nothing with food industry. 3. The running of plants depends on mechanical engineers. 4. Each plant differs from one another. 5. The main operational objectives of safety, efficiency and profitability are also different from one another. 6. Energy conversion is not the spheres of mechanical engineers' concern. 7. Mechanical engineers deal with machines and mechanisms. 8. Mechanical engineers' jobs are demanding but too boring. 9. Mechanical engineers not only manage plants and equipment but they also manage people.	

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. Mechanical engineers should take into _____ specialized calculations in the design of even a simple machine.
   A. part
   B. account
   C. place
   D. advantage

2. We may divide the branches of engineering into the following _____.
   A. parts
   B. constructions
   C. divisions
   D. complexes

3. In particular, mechanical engineers are responsible for work of Steam engines, internal _____ engines.
   A. steam
   B. compressors
   C. pumps
   D. combustion

4. The main operational objectives of efficiency demand a range of personal _____ from the engineers.
   A. features
   B. characteristics
   C. skills
   D. duties

5. Mechanical engineers are _____ in their design, building and operation.
   A. involved
   B. included
   C. stimulated
   D. sophisticated

6. Mechanical engineers _____ with energy conversion.
   A. are concerned
   B. has concerned
   C. will concerned
   D. be concerned

7. Many engineering operations _____ to change things for the better.
   A. has been required
   B. are required
   C. required
   D. require

8. How _____ our engineers work at this problem?
   A. do
   B. does
   C. are
   D. have

9. What _____ mechanical engineers concerned with?
   A. is
   B. are
   C. do
   D. did

10. Mechanical engineers are at the forefront of technology, _____?
    A. don't they
    B. aren't they
    C. aren't mechanical engineers
    D. haven't they

TRANSLATION

4. Translate the sentences from English into Russian.

1. Today machines have to withstand tremendous stresses.
2. Engineers must become ever more scientific and specialized.
3. Each branch of engineering may require the special services of the specialists.

4. The engineer must also deal with the economists to assure himself that he is producing what is wanted, and economically.
5. Mechanical engineers also can work in service industries.
6. Production would be impossible without mechanical engineers.
7. The main operational objectives of safety are likely to be common to each plant.
8. Mechanical equipment is at the core of the plants.
9. Mechanical engineers are at the forefront of technology.
10. In plant operation the job is to keep the plant running and stimulate the team to improve performance.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

AUTOMATED SYSTEMS

We now use the term automation for specific techniques combined to operate automatically in a complete system. These techniques are possible because of electronic devices, most of which have come into use in the last thirty years. They include program, action, sensing or feedback, decision, and control elements as components of a complete system. The program elements determine what the system does and the step-by-step manner in which it works to produce the desired result. A program is a step-by-step sequence that breaks a task into its individual parts. Some steps in an industrial automation program direct other parts of the system when and how to carry out their jobs. The action elements are those which do the actual work. They may carry or convey materials to specific places at specific times or they may perform operations on the materials.

The term mechanical handling device is also used for the action elements. Perhaps the most important part of an automated system is sensing or feedback. Sensing devices automatically check on parts of the manufacturing process such as the thickness of a sheet of steel or paper. This is called feedback because the instruments return or feed back this information to the central system control. The decision element is used to compare what is going on in the system with what should be going on, it receives information from the sensing devices and makes decisions necessary to maintain the system correctly. If some action is necessary the decision element can give instructions or commands to the system. The control element consists of devices to carry out the commands of the decision element. There may be many kinds of de-

vices: valves that open or close, switches that control the flow of electricity, or regulators that change the voltage in various machines; they make the necessary corrections or adjustments to keep the system in conformity with its program.

An industrial engineer working with automated systems is part of a team. Many components of the system, such as computers, are electronic devices so electronic engineers and technicians are also involved. Many of the industries in which automation has proved particularly suitable – chemicals, papermaking, metals processing – involve chemical processes, so there may be chemical engineers at work too. An industrial engineer with expertise in all these fields may become a systems engineer for automation projects thereby coordinating the activities of all the members of the team.

CONTROL WORK № 1

Variant 3

READING

Text 1

1. Read the text about jobs in engineering. For questions 1–10, choose the best answer A, B, C or D.

JOBS IN ENGINEERING

Professional engineers may work as:

Design engineers: They work as part of a team to create new products and extend the life of old products by updating them and finding new applications for them. Their aim is to build quality and reliability into the design and to introduce new components and materials to make the product cheaper, lighter, or stronger.

Production engineers: They ensure that the production process is efficient, that materials are handled safely and correctly, and that faults which occur in production are corrected. The design and development departments consult with them to ensure that any innovations proposed are practicable and cost-effective.

Just below the professional engineers are the technician engineers. They require a detailed knowledge of a particular technology – electrical, mechanical, electronic, etc. Technician engineering technicians may work as:

Test/Laboratory technicians: They test samples of the materials and of the product to ensure quality is maintained.

Installation and service technicians: They ensure that equipment sold by the company is installed correctly and carry out preventative maintenance and essential repairs.

Production planning and control technicians: They produce the manufacturing instructions and organize the work of production so that it can be done as quickly, cheaply, and efficiently, as possible.

Inspection technicians: They check and ensure that incoming and outgoing components and products meet specifications.

Draftsmen/women and designers: They produce the drawings and design documents from which the product is manufactured.

The next grades are craftsmen/women. Their work is highly skilled and practical. Craftsmen and women may work as:

Toolmakers: They make dies and molding tools which are used to punch and form metal components and produce plastic components such as car bumpers.

Fitters: They assemble components into larger products.

Maintenance fitters: They repair machinery.

Welders: They do specialized joining, fabricating, and repair work.

Electricians: They wire and install electrical equipment.

1. Design engineers extend the life of old products by _____ them.
   A. using
   B. updating
   C. assembling
   D. developing
2. The aim of design engineers is to make the product_____.
   A. cheaper
   B. more expensive
   C. newer
   D. older
3. Production engineers ensure that faults which happen in production are _____.
   A. extended
   B. repaired
   C. fitted
   D. corrected
4. Production engineers follow the fact that any innovations proposed are _____.
   A. modernized
   B. sophisticated
   C. cost-effective
   D. new
5. The technician engineers require a detailed knowledge of a _____ technology – electrical, mechanical, electronic, etc.
   A. individual
   B. widespread
   C. traditional
   D. particular

6. _____ test samples of the product to ensure quality is maintained.
   A. Production engineers
   B. Design engineers
   C. Laboratory technicians
   D. Scientists

7. The manufacturing instructions are produced by _____.
   A. laboratory technicians
   B. production planning and control technicians
   C. production engineers
   D. design engineers

8. Inspection technicians ensure that incoming and outgoing products meet _____.
   A. instructions
   B. specifications
   C. conclusions
   D. information

9. The work of craftsmen is highly _____.
   A. skilled
   B. qualified
   C. experienced
   D. developed

10. Craftsmen *may not* work as _____.
    A. toolmakers
    B. fitters
    C. welders
    D. design engineers

Text 2

2. Read the text about the development of mass production techniques. For questions 1–8, decide if they are true (T) or false (F).

INDUSTRIAL ENGINEERING AND AUTOMATION

A major advance in twentieth century manufacturing was the development of mass production techniques. Mass production refers to manufacturing processes in which an assembly line, usually a conveyer belt, moves the product to stations where each worker performs a limited number of operations until the product is assembled. In the automobile assembly plant such systems have reached a highly-developed form. A complex system of con-

veyer belts and chain drives moves car parts to workers who perform the thousands of necessary assembling tasks. Mass production increases efficiency and productivity to a point beyond which the monotony of repeating an operation over and over slows down the workers. Many ways have been tried to increase productivity on assembly lines: some of them are as superficial as piping music into the plant or painting the industrial apparatus in bright colors; others entail giving workers more variety in their tasks and more responsibility for the product. These human factors are important considerations for industrial engineers who must try to balance an efficient system of manufacturing with the complex needs of workers.

Another factor for the industrial engineer to consider is whether each manufacturing process can be automated in whole or in part. Automation is a word coined in the 1940s to describe processes by which machines do tasks previously performed by people. The word was new but the idea was not. We know of the advance in the development of steam engines that produced automatic valves. Long before that, during the Middle Ages, windmills had been made to turn by taking advantage of changes in the wind by means of devices that worked automatically. Automation was first applied to industry in continuous-process manufacturing such as refining petroleum, making petrochemicals, and refining steel. A later development was computer-controlled automation of assembly line manufacturing, especially those in which quality control was an important factor.

STATEMENTS	T/F
1. A major development in manufacturing in the twentieth century was mass production techniques. 2. Each worker in an assembly line in the automobile assembly plant performs an unlimited number of operations until the product is assembled. 3. Industrial engineers have done a lot to increase productivity on assembly lines. 4. Painting the industrial apparatus in bright colors increases productivity on assembly lines. 5. The new word ‘automation’ was created in the twentieth century to describe tasks done by people. 6. The idea of automation in manufacturing processes is rather new. 7. In the Middle Ages no devices were used to make windmills to turn. 8. Computer-controlled automation of assembly line manufacturing was the first to apply to industry.	

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. A conveyer belt moves the product to stations where each worker performs a limited number of operations until the product is _____.
   A. assembled
   B. collected
   C. gathered
   D. combined
2. A complex system of conveyer belts and chain drives moves car _____ to workers who perform the thousands of necessary assembling tasks.
   A. gradients
   B. components
   C. bodies
   D. parts
3. Mass production increases efficiency and productivity to a point beyond which the monotony of repeating an _____ over and over slows down the workers.
   A. procedure
   B. operation
   C. process
   D. work
4. These human factors are important considerations for industrial engineers who must try to balance an _____ system of manufacturing with the complex needs of workers.
   A. important
   B. effective
   C. necessary
   D. efficient
5. We know of the advance in the _____ of steam engines that produced automatic valves.
   A. creating
   B. development
   C. forming
   D. making
6. Electrical equipment _____ and installed by electricians.
   A. are wired
   B. is wired
   C. is wiring
   D. are wiring

7. The industrial apparatus _____ painted in bright colors.
   A. has been
   B. have been
   C. has being
   D. have being
8. Automation was first applied to industry in continuous-process manufacturing, _____?
   A. was it
   B. wasn't it
   C. did it
   D. didn't it
9. Many ways have been tried to increase productivity on assembly lines, _____.
   A. have they
   B. haven't many
   C. haven't they
   D. isn't it
10. This production increases efficiency and productivity, _____?
    A. does this
    B. doesn't it
    C. doesn't this
    D. don't they

TRANSLATION

4. Translate the sentences from English into Russian.

1. The engineers are trying to build quality and reliability into the design.
2. Production engineers ensure that materials are handled safely and correctly.
3. The design and development departments consult with production engineers.
4. Production planning and control technicians organize the work of production so that it can be done as quickly, cheaply, and efficiently, as possible.
5. Toolmakers make molding tools which are used to punch and form metal components.
6. Machinery is repaired by maintenance fitters.
7. Fitters assemble components into larger products.
8. A major advance in twentieth century manufacturing was the development of mass production techniques.
9. Many ways have been tried to increase productivity on assembly lines.
10. Workers on assembly lines perform thousands of necessary assembling tasks.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

EFFICIENCY IN ENGINEERING OPERATION

Unlike the scientist, the engineer is not free to solve problems which interest him. He must solve problems as they arise, his solutions must satisfy conflicting requirements. Efficiency costs money, safety adds complexity, performance increases weight. The engineering solution is the optimum solution, taking into account many factors. It may be the cheapest for a given performance, the most reliable for a given weight, the simplest for a given safety, or the most efficient for a given cost. Engineering is optimizing.

To the engineer, efficiency means output divided by input. His job is to secure a maximum output for a given input or to secure a given output with a maximum input. The ratio may be expressed in terms of energy, materials, money, time or men. Efficiency is achieved by using efficient methods, devices, and personnel organizations.

The need for efficiency leads to the large, complex operations which are characteristic of engineering. The processing of new antibiotics in the test-tube stage belongs to the field of biochemistry. But when great quantities must be produced at low cost, it becomes an engineering problem. It is the need for efficiency and economy that differentiates ceramic engineering from the work of the potter, textile engineering from weaving, and agricultural engineering from farming.

Since output is input minus losses, the engineer must keep losses and waste to a minimum. One way is to develop uses for products which otherwise would be waste. Losses due to friction occur in every machine and in every organization. Efficient functioning depends on good design, careful attention to operating difficulties, and lubrication.

The raw materials with which engineers work seldom are found in useful forms. Engineering of the highest type is required to conceive, design and achieve the conversion of the energy of a mountain stream into the powerful torque of an electric motor. Similarly, many engineering operations are required to change the sands of the seashore into the precise lenses which enable us to observe the microscopic amoeba in a drop of water. In a certain sense, the successful engineer is a person always trying to change things for the better.

CONTROL WORK № 1

Variant 4

READING

Text 1

1. Read the text about the development of engineering education in different countries. For questions 1–6, choose the best answer A, B, C or D.

EDUCATING TOMORROW'S ENGINEERS

Engineering education developed very differently on the Continent and in the UK. On the Continent, engineering and technical sciences were set up in technical universities, while in the UK engineering departments were set up in multi-discipline universities. As a consequence, engineering education developed on the Continent as a more professionally oriented subject, while in the UK the emphasis was on engineering science. Perhaps because of their size and their more professional engineering-oriented courses the Continental technical universities have developed a much closer relationship with industry. In Germany, the Herr Professor is also likely to be a Herr Director and there are many visiting industrial professors, who will spend a day a week in the University. In France much of the lecturing is provided by staff from the appropriate industries. There is nothing similar in UK engineering departments.

The question is what is to be done about engineering education in the UK? In the opinion of Britain's specialists, 70 to 80 engineering faculties in English universities and polytechnics should be condensed down into 20 or so major technical universities. They should become more industrially-oriented.

Lastly, the objective of engineering education and training should be recognized. So what should be the objective of undergraduate education? It is to educate and train people to think and search out knowledge for themselves, and to have the self-assurance to apply it to the job in hand. Many of the courses are now much too intensive and students have too little time or encouragement to read and think for themselves. The solution is to recognize that it is impossible to cover all the subjects which an engineer may find useful in a lifetime, and realize that if he has been correctly educated he can read up on subjects which he may need as he progresses in his career. However, industry must recognize that a graduate will need training in the specific area

in which he is working, and must also be prepared to encourage him to attend continuing education courses and/or seminars and conferences as appropriate. It is clear that there is to be much more interchange of staff between industry and higher education. The education and training of engineers must be a partnership between industry and higher education, which extends from undergraduate education and training through to post-graduate short and long courses and research.

1. Engineering education developed _____ on the Continent and in the UK.
   A. differently
   B. in the same way
   C. in the similar way
   D. in the opposite way

2. In the UK engineering departments were set up in _____ .
   A. technical colleges
   B. multi-discipline universities
   C. technical universities
   D. open universities

3. On the Continent, engineering and technical sciences were set up in _____.
   A. technical colleges
   B. multi-discipline universities
   C. technical universities
   D. open universities

4. On the Continent engineering education _____.
   A. made the emphasis on engineering science
   B. developed as a more professionally oriented subject
   C. developed at universities which were bigger than others
   D. was oriented towards exact sciences

5. In Germany _____.
   A. much of the lecturing is provided by staff from the appropriate industries
   B. there are 70 to 80 engineering faculties in universities
   C. there are 20 or so major technical universities
   D. there are many visiting industrial professors

6. The objective of engineering education and training in UK should _____.
   A. be clear
   B. educate and train people to think
   C. have many courses
   D. be a partnership between industry and higher education

Text 2

2. Read the article about the history of mechanical engineering. For questions 1–10, decide if they are true (T) or false (F).

FOUR INDUSTRIAL REVOLUTIONS

The history of mechanical engineering goes back to the time when the man first tried to make machines. We can call the earlier rollers, levers, and pulleys, for example, the work of mechanical engineering.

Mechanical engineering, as we understand it today, starts from the first Industrial Revolution.

People have labeled as “revolutions” three episodes in the industrial history of the world and now we are entering the fourth.

The first industrial revolution took place in England between 1760 and 1840. Metal became the main material of the engineer instead of wood, and steam gave man great reserves of power. This power could drive not only railway engines and ships but also machines which built them.

In the second revolution, from 1880 to 1920, electricity was the technical driving force. It provided power for factories that was easier and cheaper to control than steam. It was marked also by the growing importance of science-based industries such as chemicals and electrical goods, and the use of scientifically-designed production methods such as semi-automatic assembly lines.

The third industrial revolution coincided with the advent of automation – in its inflexible form. In this revolution, the main features were advances in the control of manufacturing processes so that things could be made more cheaply, with greater precision and (often) with fewer people. And this change, which occurred around the middle of the 20th century also featured a new machine that was to greatly influence the world, the electronic computer.

What is the fourth industrial revolution? The fourth industrial revolution will be characterized by automated machines that are versatile and programmable and can make different things according to different sets of computer instructions. It will be characterized by flexible, automated machinery, the most interesting example of which are robots.

STATEMENTS	T/F
1. The history of world mechanical engineering has passed through four periods. 2. The first industrial revolution took place in America. 3. The first industrial revolution is connected with the advent of metal. 4. Metal became the main material of the engineer along with wood. 5. Steam power could not drive machines which built them. 6. The second industrial revolution took place around the middle of the 18th century. 7. Semi-automatic assembly lines are the features of the second industrial revolution. 8. The third industrial revolution is connected with the advent of automation. 9. Versatile and programmable automated machines are the main features of the fourth industrial revolution. 10. Robots are flexible and automated machinery.	

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. Technical sciences were _____ in technical universities.
   A. set in
   B. set up
   C. set off
   D. set out

2. Much of the lecturing is provided by _____ from the appropriate industries.
   A. staff
   B. crew
   C. team
   D. personnel

3. Students have too little time or encouragement to read and think _____ themselves.
   A. for
   B. about
   C. of
   D. on

4. The first industrial revolution took _____ in England.
   A. part
   B. back
   C. ahead
   D. place

5. This power could _____ railway engines.
   A. drive
   B. manage
   C. handle
   D. conduct

6. An engineering department_____ set up in a multi-discipline university last year.
   A. was
   B. has been
   C. were
   D. have been

7. It provided power for factories, _____?
   A. did it
   B. didn't it
   C. don't it
   D. doesn't it

8. Mechanical engineering starts from the first Industrial Revolution, _____?
   A. isn't it
   B. didn't **it**
   C. don't it
   D. doesn't it

9. _____ should be the objective of undergraduate education?
   A. Who
   B. What
   C. When
   D. How

10. _____ the third industrial revolution coincide with the advent of automation?
    A. did
    B. was
    C. has
    D. have

TRANSLATION

4. Translate the sentences from English into Russian.

1. As a consequence, engineering education developed on the Continent as a more professionally oriented subject.
2. There are many visiting industrial professors in Germany.
3. In the opinion of Britain's specialists, 70 to 80 engineering faculties in English universities and polytechnics should be condensed down into 20.
4. The solution is to recognize that it is impossible to cover all the subjects which an engineer may find useful in a lifetime.
5. However, industry must recognize that a graduate will need training in the specific area in which he is working.
6. People have labeled as "revolutions" three episodes in the industrial history of the world.
7. Metal became the main material of the engineer instead of wood, and steam gave man great reserves of power.
8. Electricity provided power for factories that was easier and cheaper to control than steam.
9. The third industrial revolution coincided with the advent of automation.
10. The fourth industrial revolution will be characterized by flexible, automated machinery, the most interesting example of which are robots.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

THE PIONEERS

Karl Benz (1844–1929), the son of a railway engine-driver who died when Karl was two, studied engineering at the Karlsruhe Polytechnic. After various jobs he set up business, with successive partners in a very small way making two-stroke gas engines of his own design in 1880. Although he is entitled to be called the "inventor of the petrol car", he was reluctant to depart from his original design of belt-driven horseless carriage which sold well in 1890s. Other designers were called in, and after 1902 Benz had little influence on the development of the motor car.

Frederick William Lanchester (1868–1946), the son of an architect, made Britain's first four-wheeled petrol car of wholly native design in 1895 with the help of his brother George. A small company was formed and pro-

duction was begun late in 1899. Lanchester's designs were always unique and ahead of their time; he was responsible for many innovations which became accepted some years later. Those include a vibrationless, fully balanced engine, splined shafts, full-pressure lubrication, lightweight pistons, disk brakes and more. "Doctor Fred" was also a pioneer authority and writer on aerodynamics, and for many years Consultant Engineer to the Daimler Co.

Henry Ford is usually credited with "inventing" mass production, yet the idea originated many years earlier in the Connecticut clock trade and was developed in the America's small-arms industry.

UNIT 3

MATERIAL SCIENCE AND TECHNOLOGY

Text How materials react to external forces. **Grammar Revision**: Conditional sentences.

LEAD-IN

1. Answer the questions.

* Why do you think it is important for engineers to know how materials respond to external forces?
* What are in your opinion external forces?

READING

2. Before reading the text, remember the following words and word combinations.

bar	брусок, прут
compression	сжатие
creep	ползучесть
cross-sectional area	площадь поперечного сечения
cyclic stress	циклическое напряжение
elastic deformation	упругая деформация
elastic limit	предел упругости
fatigue	усталость металла
fracture	перелом, излом
to loosen	ослаблять, расшатывать
shear	срез
to stretch	растягивать
tension	напряженность, растяжение
to propagate	распространять(ся)
to bend	гнуть, согнуть
to extend	расширять, продолжаться
to occur	случаться, происходить
to suffer	страдать
torsion	кручение
twisting	закручивание, изгиб
rupture	разрыв, разрушение

3. You are going to read the text about the reaction of materials to external forces. For questions 1–10, decide if they are true (T) or false (F).

HOW MATERIALS REACT TO EXTERNAL FORCES

Materials science and technology is the study of materials and how they can be fabricated to meet the needs of modern technology. Using the laboratory techniques and knowledge of physics, chemistry, and metallurgy scientists are finding new ways of using materials, plastics and other materials.

Engineers must know how materials respond to external forces, such as tension, compression, torsion, bending, and shear. All materials respond to these forces by elastic deformation. That is, the materials return their original size and form when the external force disappears. The materials may also have permanent deformation or they may fracture. The results of external forces are creep and fatigue.

Compression is a pressure causing a decrease in volume. When a material is subjected to a bending, shearing, or torsion (twisting) force, both tensile and compressive forces are simultaneously at work. When a metal bar is bent, one side of it is stretched and subjected to a tensional force, and the other side is compressed.

Tension is a pulling force; for example, the force in a cable holding a weight. Under tension, a material usually stretches, returning to its original length if the force does not exceed the material's elastic limit. Under larger tensions, the material does not return completely to its original condition, and under greater forces the material ruptures.

Fatigue is the growth of cracks under stress. It occurs when a mechanical part is subjected to a repeated or cyclic stress, such as vibration. Even when the maximum stress never exceeds the elastic limit, failure of the material can occur even after a short time. No deformation is seen during fatigue, but small localized cracks develop and propagate through the material until the remaining cross-sectional area cannot support the maximum stress of the cyclic force. Knowledge of tensile stress, elastic limits, and the resistance of materials to creep and fatigue are of basic importance in engineering.

Creep is a slow, permanent deformation that results from a steady force acting on a material. Materials at high temperatures usually suffer from this deformation. The gradual loosening of bolts and the deformation of components of machines and engines are all the examples of creep. In many cases the slow deformation stops because deformation eliminates the force causing the creep. Creep extended over a long time finally leads to the rupture of the material.

STATEMENTS	T/F
1. Materials science and technology is the study about materials and their ability to be fabricated according to the needs of modern technology. 2. Metallurgy scientists are finding new ways of using materials with the help of theoretical methods. 3. It is very important for engineers to know how materials respond to external forces. 4. Not all materials have any deformation subjected to external forces. 5. A decrease in volume is caused by compression. 6. When a material is subjected to a bending, shearing, or torsion force, neither tensile nor compressive forces are simultaneously at work. 7. The material does not return completely to its original condition under larger tensions. 8. Fatigue occurs when a mechanical part is subjected to vibration. 9. Failure of the material can occur only when the maximum stress exceeds the elastic limit. 10. Creep occurs when a steady force acts a material.	

4. Find the endings (a–j) to the given beginnings (1–10) on the basis of the text. Translate the sentences into Russian.

Example*: *1d
Scientists are finding new ways of using materials.
Ученые находят новые способы использования материалов.

1. Scientists are finding new	a) materials respond to external forces.
2. Engineers must know how	b) a decrease in volume.
3. The results of external forces	c) usually suffer from creep.
4. Compression is a pressure causing	d) ways of using materials.
5. Tension is	e) are creep and fatigue.
6. Fatigue is the growth	f) permanent deformation.
7. No deformation is	g) leads to the rupture of the material.
8. Creep is a slow,	h) a pulling force.
9. Materials at high temperatures	i) of cracks under stress.
10. Creep extended over a long time finally	j) seen during fatigue.

USE OF ENGLISH

5. Match the words on the left (1–9) to the words on the right (a–i) to make the collocations and translate them into Russian.

Example*: *1c
to meet the needs – отвечать требованиям

1) to meet	a) forces
2) external	b) stress
3) elastic	c) the needs
4) their original	d) tension
5) a pulling	e) importance
6) under	f) deformation
7) cyclic	g) loosening
8) are of basic	h) force
9) gradual	i) size

6. Choose the English equivalent (a, b or c) to the given Russian word.

1) реагировать	a) refer	b) respond	c) remain
2) внешний	a) external	b) internal	c) international
3) возвращать	a) remain	b) return	c) recall
4) одновременно	a) simultaneously	b) particularly	c) homogeneously
5) подвергнутый	a) projected	b) subjected	c) objected
6) превышает	a) exceeds	b) succeeds	c) proceeds
7) полностью	a) extremely	b) completely	c) especially
8) через	a) through	b) though	c) thorough
9) ослабление	a) lessening	b) loosening	c) losing

7. Match the words from A to the words from B which are opposite in meaning. Translate them into Russian.

A	B
1. disappears	a) internal
2. permanent	b) above
3. external	c) smaller
4. decrease	d) minimum
5. modern	e) long
6. under	f) temporary
7. larger	h) increase
8. maximum	i) ever
9. never	j) out-of-date
10. short	k) appears

8. Find the following word combinations in the text.

отвечать требованиям; новые способы использования металлов; используя лабораторные методы; сжатие, растяжение, изгиб, кручение, срез; возвращать первоначальный размер и форму; внешняя сила; постоянная деформация; уменьшение объема; растягивающие и сжимающие силы; превышать предел упругости материала; повторяющееся или циклическое напряжение; разрушение материала; развитие и распространение мелких трещин; сопротивление материалов ползучести и усталости

9. Translate the sentences into English on the basis of the text.

1. Когда внешнее воздействие исчезает, материалы возвращают свой первоначальный размер и форму.
2. Инженеры должны знать, как материалы реагируют на внешние воздействия.
3. Упругая деформация – это реакция всех материалов на внешние силы, такие как растяжение, сжатие, скручивание, изгиб и срез.
4. Усталость и ползучесть материалов является результатом внешних сил.
5. Внешние силы вызывают постоянную деформацию и разрушение материала.
6. Растягивающие и сжимающие силы работают одновременно, когда мы изгибаем или скручиваем материал.
7. Растяжение материала выше предела его упругости дает постоянную деформацию или разрушение.
8. Когда деталь работает долгое время под циклическими напряжениями, в ней появляются небольшие растущие трещины из-за усталости металла.
9. Усталость металла происходит тогда, когда механическая часть подвергается постоянному циклическому напряжению.
10. Ползучесть – это медленное изменение размера детали под напряжением.

GRAMMAR REVISION

TYPES OF CONDITIONALS

0	***If/When*** *the sun* ***shines***, *snow* ***melts***.
1	***Unless*** *he* ***pays*** *the fine*, *he* ***will go*** *to prison.* ***If*** *you* ***need help***, ***come*** *and* ***see*** *me.* ***If*** *you* ***have finished*** *your work*, *we* ***can have*** *a break.*
2	***If*** *I* ***had*** *time*, *I* ***would take up*** *a sport.* (*but I don't have time-untrue in the present*) ***If*** *I* ***were*** *you*, *I* ***would talk*** *to your parents about it.* (*giving advice*)
3	***If*** *she* ***had studied*** *harder*, *she* ***would have passed*** *the test.* ***If*** *he* ***hadn't been acting*** *so foolishly*, *he* ***wouldn't have been punished***.

10. Fill in the gaps with *if* or *unless*.

1. _____ you don't study materials science, you won't get to know how the materials can be fabricated to meet the needs of modern technology.
2. _____ scientists use the laboratory techniques, they will find new ways of using materials.
3. Engineers won't find new ways of technology, _____ they will have enough knowledge of physics and chemistry.
4. _____ the external force disappears, the materials return their original size.
5. The materials don't return their original size _____ there isn't an external force.
6. _____ there is an external force, the materials will have permanent deformation.
7. _____ the material is compressed, it will decrease in volume.
8. One side of the material will be subjected to a tensional force _____ a metal bar is bent.
9. _____ the material is under tension, it doesn't usually stretch.
10. The material ruptures _____ it is under greater forces.

11. Put the verbs in brackets into the proper tense. (Type 1, 2, 3 Conditionals)

1. The materials _____ (have) fracture if they are subjected to external forces.
2. The material would have permanent deformation if it _____ (be) under external forces.
3. If the engineers had thoroughly studied the material, they _____ (fail) the experiment.
4. Both sides of the metal bar will be deformed if it _____ (be) bent.
5. If the material is compressed, it _____ (cause) a decrease in volume.
6. If the force _____ (not to exceed) the material's elastic limit, the material will return to its original length.
7. Fatigue _____ (not to occur) if the material had not been subjected to a repeated stress.
8. If a mechanical part was subjected to vibration, small cracks _____ (develop).
9. If there _____ (be) a steady force acting on a material, it will result in creep.
10. Creep would have led to the rupture of the material if it _____ (extend) over a long time.

12. Complete the sentences.

1. If I could change everything, I _____.
2. If I were the chief engineer of the plant, I _____.
3. If there were no machine-tools, there _____.
4. If there were no electricity, there _____.
5. If I worked at the scientific research institute, I _____.
6. If there were no universities, people _____.
7. If there were no prominent scientists, the world _____.
8. If I were very rich, I _____.

SPEAKING

13. Use the words and phrases below to make sentences.

the study of materials, new ways of using materials, respond to external forces, have permanent deformation, creep and fatigue, compression, is subjected to, under tension, failure of the material, creep, loosening of bolts, eliminates

14. Work in pairs. Think of some questions to review the contents of the text about the reaction of materials to external forces and ask each other. Use the words and the word combinations bellow to mention the main aspects.

* materials science and technology	* is subjected to
* new ways of using materials	* under larger tensions
* respond to external forces	* knowledge of tensile stress
* results of external forces	* creep

15. Describe those forces that change the form and size of materials.

WRITING

16. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

THE FUNDAMENTALS OF FORGING

Forging is the oldest known metalworking process. It is believed to have begun when early man discovered he could beat pieces of ore into useful shapes. History tells us that forging was widely practiced at the time when written records first appeared. The blacksmith was one of the first to realize the advantages of forging. Although he did not know why, he knew that

hammering a piece of hot metal not only resulted in a usable shape, it improved its strength. It is this inherent improvement in strength of metal that has placed forgings in the most highly stressed applications in machines. To understand why forging improves the mechanical properties of metal, it is important to recognize that metal is made up of grains. Each grain is an individual crystal, and when the grains are large, cracks can occur and propagate along the grain boundaries. Therefore, it is desirable to minimize the grain size in a metal. Reducing the metal's grain size is one of the things forging does so well. Forging breaks down a coarse-grained structure producing a chemically homogeneous wrought structure with much smaller grains by controlled plastic deformation. In forging, controlled plastic deformation whether at elevated temperature or cold (at room temperature) results in greater metallurgical soundness and improved mechanical properties of the metal. Metal shaping by controlled plastic deformation is the basis for all forging operations. Because of the diversity of forging applications, however, a wide range of processes and equipment have been developed to produce forgings. Some processes are ideally suited to make large parts, others, small parts, and still others, rings. Modern forging is not only carried out in virtually all metals, it is done at temperatures ranging from more than 2500 F to room temperature. Part configuration generally determines the forging method chosen.

UNIT 4

METALS AND METALWORKING

Text Metals. **Grammar Revision**: Conditional sentences.

LEAD-IN

1. Answer the questions.

* Why is it important to study metals?
* What do you know about the properties of metals?

READING

2. Before reading the text, remember the following words.

separation	разделение, интервал, расстояние
failure	повреждение, разрушение, отказ
malleable	ковкий, податливый, способный деформироваться
to bend	сгибать(ся), гнуть(ся), изгибать(ся)
dense	плотный
(to) fracture	ломать(ся), разрушение, излом, перелом
ductile	эластичный, ковкий, пластичный
grain	зерно
(to) shape	форма, формировать
size	размер, величина
treatment	обработка
stress	давление, напряжение
alloy	сплав
brittle	хрупкий, ломкий
to apply	применять
edge	кромка, край, лезвие
to undergo	подвергаться
flaw	недостаток, дефект
coarse	грубый, крупный
wire	проволока
lead	свинец
to hammer	ковать
extrusion	экструзия
rolling	прокатка
metal fatigue	усталость метала
creep	ползучесть
to slide	скользить
vessel	сосуд, котел, судно
to cast	отливать, отлить
mould	форма (для отливки)

3. You are going to read the text about metals and metalworking. For questions 1–7, choose the right letter A, B, C or D.

METALS

Metals are materials most widely used in industry because of their properties. The study of the production and properties of metals is known as metallurgy.

The separation between the atoms in metals is small, so most metals are dense. The atoms are arranged regularly and can slide over each other. That is why metals are malleable (can be deformed and bent without fracture) and ductile (can be drawn into wire). Metals vary greatly in their properties. For example, lead is soft and can be bent by hand, while iron can only be worked by hammering at red heat.

The regular arrangement of atoms in metals gives them a crystalline structure. Irregular crystals are called grains. The properties of the metals depend on the size, shape, orientation, and composition of these grains. In general, a metal with small grains will be harder and stronger than one with coarse grains.

Heat treatment controls the nature of the grains and their size in the metal. Small amounts of other metals (less than 1 per cent) are often added to a pure metal. This is called alloying (легирование) and it changes the grain structure and properties of metals.

All metals can be formed by drawing, rolling, hammering and extrusion, but some require hot-working. Metals are subject to metal fatigue and to creep (the slow increase in length under stress) causing deformation and failure. Both effects are taken into account by engineers when designing, for example, airplanes, gas-turbines, and pressure vessels for high-temperature chemical processes. Metals can be worked using machine-tools.

The ways of working a metal depend on its properties. Many metals can be melted and cast in moulds, but special conditions are required for metals that react with air.

1. Metals are materials which are _____.
   A. ever used in industry
   B. rarely used in industry
   C. never used in industry
   D. widely used in industry

2. Metals are malleable because _____.
   A. the separation between the atoms is small
   B. the atoms are arranged regularly
   C. they vary greatly in their properties
   D. the atoms are arranged irregularly

3. Most metals are dense because _____.
   A. the separation between the atoms is small
   B. they vary greatly in their properties
   C. the atoms are arranged regularly
   D. the atoms are arranged regularly

4. A crystalline structure of a metal is because of _____.
   A. the regular arrangement of atoms
   B. the irregular arrangement of atoms
   C. the small separation between the atoms
   D. the big separation between the atoms

5. The properties of the metals depend on _____.
   A. the size of the grains
   B. the size and shapes of the grains
   C. the size, shape, orientation, and composition of the grains
   D. the composition of the grains

6. The size of grains in metals is controlled by _____.
   A. rolling
   B. hammering
   C. heat treatment
   D. extrusion

7. The ways of working a metal depend on _____.
   A. its malleability
   B. its properties
   C. its fatigue
   D. its structure

4. Find the endings (a–i) to the given beginnings (1–9) on the basis of the text. Translate the sentences into Russian.

Example*: *1h
Metals are materials most widely used in industry. –
Металлы являются материалами, которые широко используются в промышленности.

1. Metals are materials most widely	a) in their properties.
2. Metals vary greatly	b) bent by hand.
3. Lead is soft and can be	c) the nature of the grains.
4. Irregular crystals are	d) to metal fatigue.
5. Heat treatment controls	e) on its properties.
6. Metals are subject	f) taken into account by engineers.
7. Metals can be	g) called grains.
8. The ways of working a metal depend	h) used in industry.
9. Metal fatigue and creep are	i) worked using machine-tools.

USE OF ENGLISH

5. Match the words on the left (1–10) with the words on the right (a–j) to make the collocations and translate them into Russian.

Example*: *1b
regular arrangement – правильная организация

1) regular	a) crystals
2) crystalline	b) arrangement
3) irregular	c) metal
4) heat	d) structure
5) small	e) fatigue
6) pure	f) processes
7) metal	g) treatment
8) to be taken	h) conditions
9) special	i) into account
10) chemical	j) amounts

6. Choose the English equivalent (a, b or c) to the given Russian word.

1) широко	a) widely	b) largely	c) highly
2) свойства	a) qualities	b) properties	c) proprieties
3) разделение	a) quotation	b) emancipation	c) separation
4) скользить	a) tide	b) slide	c) glide
5) свинец	a) lead	b) led	c) thread
6) в общем	a) in main	b) in general	c) in particular
7) тяжелее	a) harder	b) hardest	c) hard
8) зерно	a) harvest	b) grain	c) grape
9) чистый	a) pure	b) poor	c) purl
10) грубый	a) cause	b) course	c) coarse

7. Match the English words to their Russian equivalents on the basis of the text.

1) properties	a) условия
2) vary	b) зависеть (от)
3) depend on	c) принимать во внимание
4) require	d) свойства
5) amount	e) длина
6) bent	f) требовать
7) subject to	g) меняться
8) length	h) количество
9) take into account	i) согнутый
10) conditions	j) подвергнутый (чему-либо)

8. Find the following word combinations in the text.

широко используемые, благодаря их свойствам, свойства металлов, скользить друг о друга, вот почему, можно согнуть рукой, правильное расположение атомов, состав зерен, в общем, небольшое количество, структура зерна, под давлением, вызвать деформацию, высокотемпературные химические процессы, станки, специальные условия, взаимодействовать с воздухом

9. Translate the sentences into English on the basis of the text.

1. Металлы – плотные материалы потому, что между атомами в них малое расстояние.
2. Металлы имеют кристаллическую структуру благодаря правильному расположению атомов.
3. Чем меньше зерна, тем тверже металл.
4. Легирование изменяет структуру зерен и свойства металла.
5. Металлы деформируются и разрушаются из-за усталости и ползучести.
6. Металлы очень отличаются друг от друга по своим свойствам.
7. Свойства металлов зависят от размера, формы и состава зерен.
8. Свинец можно легко согнуть рукой.
9. При проектировании газовых турбин инженерам следует учитывать такие свойства металла, как усталость и ползучесть.
10. Многие металлы можно расплавить.

10. Fill in the gaps with *if* or *unless*.

1. _____ a metal has small grains, it will be harder than one with coarse grains.
2. Metals cannot be bent without fracture _____ they are not malleable.
3. _____ small amounts of other metals are added to a pure metal, this is called alloying.
4. _____ we add small amounts of other metals to a pure metal, it won't change its properties.
5. Metals can be formed _____ we draw, roll and hammer them.
6. _____ metals are subject to metal fatigue, it causes deformation.
7. The engineers won't be a success when designing _____ they take into account these important effects.
8. _____ the engineers don't know the properties of metals, they won't be able to work a metal.
9. _____ there are special conditions, the metals won't react with air.
10. It will cause failure _____ metals are subject to slow increase in length under stress.

11. Put the verbs in brackets into the proper tense. (Type 1, 2, 3 Conditionals)

1. If it were not for their properties, metals _____ widely (not to use) in industry.
2. Most metals wouldn't be dense if the separation between the atoms in them _____ (not to be) small.
3. Unless this basic relationship is understood, difficulties _____ (experience) in the machine shop.
4. If we _____ (increase) strength, it will imply reduced machinability.
5. If metals are subject to metal fatigue, it _____ (cause) deformation.
6. Engineers would employ ceramics if materials withstanding high temperatures _____ (need).
7. If rate of loading _____ (increase) greatly, mechanical properties of the material will vary significantly.
8. If casting processes had been based on more mechanized machines, it _____ (give) reduced waste.
9. These new methods _____ (allow) savings to be made if they were used for assembly.
10. If a new materials technology were not rapidly emerging, there _____ (not to be) any opportunities for more efficient manufacture.

12. Complete the sentences.

1. If you work with new materials, _____.
2. If a metal is with small grains, _____.
3. An engineer would be a good specialist if he _____.
4. If high-tech field of nanotechnology hadn't emerged, _____.
5. If a mechanical engineer does not know about new materials, _____.
6. If there were a close partnership between industry and higher education, _____.
7. The production would be impossible if _____.
8. If I had been involved in the design earlier, _____.
9. If I ran my own business, _____.
10. They would have achieved high productivity if _____.

SPEAKING

13. Use the words and phrases below to make sentences.

metals, properties, malleable, the regular arrangement, depend on, small grains, coarse grains, heat treatment, the grain structure, cause deformation, the ways of working

14. Work in pairs. Think of some questions to review the contents of the text about the properties of metals. Use the words and the word combinations bellow to mention the main aspects.

* properties of metals	* heat treatment
* the atoms in metals	* alloying
* vary greatly	* are subject to metal fatigue
* irregular crystals	* special conditions

15. Say about "The properties of metals".

WRITING

16. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

CASTING

One of the important technological advantages of metals is the ability to corporate a wide variety of secondary elements in a particular metal and thereby create alloys of the metal. Alloying can increase the strength of a metal by several orders of magnitude and permit the strength and ductility to be varied over a wide range by thermal and/or mechanical treatment, resulting in ease of mechanical forming and resistance to deformation.

Several metal phases may exist together in the solid as grains (crystals), or secondary phases may occur as smaller entities on grain (inter-crystal) boundaries or within grains. Often the strengthening phase is submicroscopic and cannot be detected by optical metallography (reflection optical microscopy). The size and distribution of secondary phases is manipulated by thermo-mechanical (thermal and/or mechanical) treatment of the solid metal as well as the original casting procedure.

Casting methods include expendable mold casting (investments/precision, plaster mold, dry sand and wet sand casting), permanent mold casting (ingot, permanent mold, centrifugal, and die casting), and continuous casting (direct chill and "splat" casting). These are listed in approxi-

mate order of cooling rate. As cooling rate increases, the grain (crystal) size tends to be smaller and the strength increases while compositional segregation decreases, providing more uniform properties. At the extremely high casting rates (105 sec to 106 sec) of continuous splat casting, it is possible to produce homogeneous metals not possible in terms of phase diagrams, and many metals have been produced in the amorphous state, yielding unusual metallic glasses. Ingot casting and continuous direct chill casting are primarily used to produce solid metal which will be extensively mechanically formed to final shape. The other casting methods are used to produce shapes near final dimensions, but to varying extends may receive extensive machining, forming, or finishing prior to use. For the latter group, grain refiners are frequently added to reduce solidification grain size. Metal tends to solidify directionally, with grains elongated in the direction of heat flow. This gives rise to directional mechanical properties which should be accounted for in design.

SELF-STUDY

READING

Text 1

1. You are going to read the text about properties of materials. For questions 1–9, decide if they are true (T) or false (F).

PROPERTIES OF MATERIALS

Density (specific weight) is the amount of mass in a unit volume. It is measured in kilograms per cubic meter. The density of water is 1000 kg/m^3 but most materials have a higher density and sink in water. Aluminum alloys, with typical densities around 2800 kg/m^3 are considerably less dense than steels, which have typical densities around 7800 kg/m^3. Density is important in any application where the material must not be heavy.

Stiffness (rigidity) is a measure of the resistance to deformation such as stretching or bending. The Young modulus is a measure of the resistance to simple stretching or compression. It is the ratio of the applied force per unit area (stress) to the fractional elastic deformation (strain). Stiffness is important when a rigid structure is to be made.

Strength is the force per unit area (stress) that a material can support without failing. The units are the same as those of stiffness, MN/m^2, but in this case the deformation is irreversible. The yield strength is the stress at which a material first deforms plastically. For a metal the yield strength may be less than the fracture strength, which is the stress at which it breaks. Many materials have a higher strength in compression than in tension.

Ductility is the ability of a material to deform without breaking. One of the greatest advantages of metals is their ability to be formed into the shape that is needed, such as car body parts. Materials that are not ductile are brittle. Ductile materials can absorb energy by deformation but brittle materials cannot.

Toughness is the resistance of a material to breaking when there is a crack in it. For a material of given toughness, the stress at which it will fail is inversely proportional to the square root of the size of the largest defect present. Toughness is different from strength: the toughest steels, for example, are different from the ones with the highest tensile strength. Brittle materials have low toughness: glass can be broken along a chosen line by first scratching it with a diamond. Composites can be designed to have considerably

greater toughness than their constituent materials. The example of a very tough composite is fiberglass that is very flexible and strong.

Creep resistance is the resistance to a gradual permanent change of shape, and it becomes especially important at higher temperatures. A successful research has been made in materials for machine parts that operate at high temperatures and under high tensile forces without gradually extending, for example, the parts of plane engine.

STATEMENTS	T/F
1. Density of a material is a specific weight of a material. 2. Density is measured in kilograms per cubic cm. 3. The majority of materials sink in water. 4. Stiffness is the ability of a material to deform without breaking. 5. A metal breaks at the fracture strength. 6. Brittle materials cannot absorb energy by deformation. 7. Toughness is the same as strength. 8. Fiberglass is a very tough composite. 9. Creep resistance is especially important at higher temperatures.	

Text 2

2. Read the text about some factors influencing machinability. For questions 1–7, choose the best answer A, B, C or D.

FACTORS AFFECTING MACHINABILITY

Machinability is generally assumed to be a function of tool edge life. The main factors which influence the behavior, and thus the life of the edge of a cutting tool, are: the mechanical characteristics of the material being machined, such as its strength, hardness and metallurgical structure; the state of the casting, involving the skin finish, critical dimensions, machining allowances, slag inclusions, the presence of scabs, rust, dirt, etc.; the nature of the machining techniques being used; the characteristics of the machine-tool being used, such as machine efficiency, available power, and the rigidity of the setup. Other factors aside, it is primarily the structure of the metal which determines its resistance to the cutting action of the tool, i.e. the potential rate of metal removal, and the resulting abrasion on the tool, i.e. the life of the cutting edge. Structure, strength and machinability are interrelated to some extent – in general, increased strength implies reduced machinability. This basic relationship must be understood, otherwise difficulties may be experienced in the machine shop if the designer has specified a material with a higher strength than is necessary. Nevertheless, care should be taken in rating

machinability on the basis of strength. For example, nodular irons are normally considerably stronger than flake-graphite types, but are likely to be easier to machine.

It is therefore recommended that structure, rather than strength, be adopted as the basis for machining practice. Hardness provides a more reliable guide to machinability than does strength, for hardness depends mainly on the matrix structure of the casting. Again, however, the relation is of a general nature only, for it is possible to have a metal which exhibits a low hardness value, but which has a very abrasive action on the cutting tool. For example, the presence of hard phosphide particles embedded in a soft, ferritic matrix reduces tool life considerably.

1. One of the characteristics of the machine-tool being used is machine _____.
   A. effectiveness
   B. efficiency
   C. effeminacy
   D. efficacy
2. Engineers should take into account metallurgical _____ of the material.
   A. situation
   B. position
   C. structure
   D. state
3. Structure, strength and machinability are _____ to some extent.
   A. intersected
   B. interpolated
   C. interrogated
   D. interrelated
4. The structure of the metal determines its _____ to the cutting action of the tool.
   A. resistance
   B. removal
   C. abrasion
   D. machinability
5. Nodular irons are normally considerably _____ than flake-graphite types
   A. fewer
   B. stronger
   C. weaker
   D. less

6. Hardness provides a more _____ guide to machinability.
   A. requiring
   B. responsible
   C. reliable
   D. rewarding

7. Difficulties may be _____ in the machine shop.
   A. experienced
   B. happened
   C. occurred
   D. appeared

VOCABULARY AND GRAMMAR

3. Choose the word (A, B, C or D) that best fits the gap.

1. Density is the _____ of mass in a unit volume.
   A. amount
   B. number
   C. quality
   D. quantity

2. It is the ratio of the applied force _____ unit area to the fractional elastic deformation.
   A. via
   B. for
   C. per
   D. on

3. The yield strength is the stress _____ which a material first deforms plastically.
   A. in
   B. by
   C. at
   D. on

4. Hardness depends mainly _____ the matrix structure of the casting.
   A. on
   B. from
   C. of
   D. at

5. Care should be _____ in rating machinability on the basis of strength.
   A. kept
   B. held
   C. given
   D. taken
6. Structure, strength and machinability are interrelated to some _____.
   A. extent
   B. point
   C. score
   D. dot
7. If a rigid structure is to be made, stiffness _____ important.
   A. will be
   B. are
   C. have been
   D. had been
8. Tool edge life _____ much longer if you had taken into account all the factors of machinability.
   A. will have been
   B. will be
   C. would have been
   D. has been
9. If I were you, I _____ this material in the machine shop.
   A. would experience
   B. experience
   C. experienced
   D. will experience
10. This basic relationship must be understood, _____.
    A. must this
    B. mustn't this
    C. mustn't it
    D. doesn't it

TRANSLATION

4. Translate the sentences from Russian into English.

1. Плотность измеряется в килограммах на кубический метр.
2. Большинство материалов имеют более высокую плотность, чем вода, и тонут в воде.
3. Модуль Юнга – отношение приложенной силы к упругой деформации данного материала.

4. Эластичность – это способность материала деформироваться, не ломаясь.
5. Одним из преимуществ металлов является их способность формироваться в нужную форму.
6. Хрупкие материалы имеют низкую жесткость.
7. Примером очень жесткого состава является стекловолокно, которое очень гибкое и прочное.
8. Было проведено успешное исследование по материалам для частей машины, работающим при высоких температурах.
9. Важным фактором, влияющим на продолжительность работы станка, являются механические характеристики металла.
10. Наличие тяжелых фосфористых частей сильно сокращает продолжительность работы станка.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

MECHANICAL FORMING

Hot working is used when major shape change, cross-section reduction, or texture (directional) properties are desired. Cold working is preferred when close tolerances and fine surface finish are needed. The cold-worked form of a metal typically shows higher yield and tensile strength. Rolling, forging, and extrusion are primarily done hot, while shape drawing, extrusion, deep drawing, stretching, spinning, bending, and high-velocity forming are more formally performed cold. Hot rolling between parallel rollers is used to reduce ingots to plates, sheets, strips, and skelp, as well as structural shapes, rail, bar, round stock (including thick-walled pipe), and wire. Sheet metal and threads on round or wire stock may be rolled to shape cold. Closed die hot forging employs dies with the final part shape, while open die forging (including swaging and roll forging) uses less-shaped dies. Coining, embossing, and hobbing are cold-forging operations used to obtain precision, detailed surface relief or dimensions. Generally, extrusion and die drawing require careful control of die configuration and forming rate and, in the latter case, lubricant system. Impact extrusion, hydrostatic extrusion and deep drawing (thin-walled aluminum cans) permit very large precise dimensional and cross-section changes to be made cold in a single pass. Stretching, spinning, bending are usually used to shape sheet or plate metal and the springback of the metal due to elastic modulus must be accounted for to obtain a precise shape.

SELF-STUDY/KEYS

Ex. 1

Keys: 1t, 2f, 3t, 4f, 5t, 6t, 7f, 8t, 9t.

Ex. 2

Keys: 1b, 2c, 3d, 4a, 5b, 6c, 7a.

Ex. 3

Keys: 1a, 2c, 3c, 4a, 5d, 6a, 7a, 8c, 9a, 10c.

Ex. 4

Keys:

1. Density is measured in kilograms per cubic meter.
2. Most materials have a higher density and sink in water.
3. The Young modulus is a measure of the resistance to simple stretching or compression.
4. Ductility is the ability of a material to deform without breaking.
5. One of the greatest advantages of metals is their ability to be formed into the shape that is needed.
6. Brittle materials have low toughness.
7. The example of a very tough composite is fiberglass that is very flexible and strong.
8. A successful research has been made in materials for machine parts that operate at high temperatures.
9. The main factor which influences the life of the edge of a cutting tool is the mechanical characteristics of the material.
10. The presence of hard phosphide particles reduces tool life considerably.

CONTROL WORK № 2

Variant 1

READING

Text 1

1. Read the text about some properties of engineering materials. For questions 1–10, decide if they are true (T) or false (F).

ENGINEERING MATERIALS

Engineers have to know the best and most economical materials to use. Engineers must also understand the properties of these materials and how they can be worked. There are two kinds of materials used in engineering – metals and non-metals. We can divide metals into ferrous and non-ferrous. The former contain iron and the latter do not contain iron. Cast iron and steel, which are both alloys, or mixtures of iron and carbon, are the two most important ferrous metals. Steel contains a smaller proportion of carbon than cast iron. Certain elements can improve the properties of steel and are therefore added to it. For example, chromium may be included to resist corrosion and tungsten to increase hardness. Aluminum, copper, and the alloys (bronze and brass) are common non-ferrous metals.

Plastics and ceramics are non-metals; however, plastics may be machined like metals. Plastics are classified into two types – thermoplastics and thermosets. Thermoplastics can be shaped and reshaped by heat and pressure but thermosets cannot be reshaped because they undergo chemical changes as they harden. Ceramics are often employed by engineers when materials which can withstand high temperatures are needed.

STATEMENTS	T/F
1. Engineers must know the properties of engineering materials. 2. There are two kinds of engineering materials. 3. All the materials can be classified as metals and non-metals. 4. Ferrous materials do not contain iron. 5. Non-ferrous materials can contain iron. 6. The two most important ferrous metals are cast iron and steel. 7. Cast iron contains a smaller proportion of carbon than steel. 8. Chromium cannot resist corrosion. 9. Both plastics and ceramics are non-metals. 10. Ceramics can resist high temperatures.	

Text 2

2. Read the text about characteristics and mechanical properties of non-ferrous metals. For questions 1–7, choose the best answer A, B, C or D.

NON-FERROUS METALS

Although ferrous alloys are specified for more engineering applications than all non-ferrous metals combined, the large family of non-ferrous metals offers a wider variety of characteristics and mechanical properties. For example, the lightest metal is lithium, 0.53 g/cm^3, the heaviest, osmium, weighs 22.5 g/cm^3 – nearly twice the weight of lead. Mercury melts at around – 38 °F, and tungsten, the metal with the highest melting point, liquefies at 6,170 °F.

Availability, abundance, and the cost of converting the metal into useful forms – all play important parts in selecting a non-ferrous metal. One ton of earth contains about 81,000 g of the most abundant metal of land, aluminum. One ton of sea water, on the other hand, contains more magnesium than any other metal (about 1,272 g). All sources combined, magnesium is the most abundant metal on earth. But because magnesium is difficult to convert to a useful metal, it may cost several times that of the least expensive and most easily produced metal, iron billet.

Although nearly 80 % of all elements are called “metals”, only about two dozen of these are used as structural engineering materials. Of the balance, however, many are used as coatings, in electronic devices, as nuclear materials, and as minor constituents in other systems.

Aluminum is lightweight, strong and readily formable. Aluminum and its alloys, numbering in the hundreds, are available in all common commercial forms. Because of their high thermal conductivity, many aluminum alloys are used as electrical conductors. Commercially pure aluminum has a tensile strength of about 13,000 psi. Cold-working the metal approximately doubles its strength. For greater strength aluminum is alloyed with other elements such as manganese, silicon, copper, magnesium or zink. Some alloys are further strengthened and hardened by heat treatments.

1. Non-ferrous metals are specified for _____.
   A. more engineering applications
   B. the lightest weight
   C. the highest melting point
   D. a wider variety of characteristics and mechanical properties

2. Lithium is a metal which _____.
   A. is the lightest
   B. is the heaviest
   C. has the highest melting point
   D. weighs twice the weight of lead

3. _____ is the most abundant metal of land.
   A. Mercury
   B. Osmium
   C. Aluminum
   D. Lithium

4. One ton of sea water contains about _____ magnesium.
   A. 1,272 g
   B. 81,000 g
   C. 22.5 g
   D. 0.53 g

5. Magnesium is _____ to convert to a useful metal.
   A. easy
   B. difficult
   C. impossible
   D. not difficult

6. About _____ metals are used as structural engineering materials.
   A. 22
   B. 24
   C. 26
   D. 28

7. Many aluminum alloys are used as electrical conductors because of their _____.
   A. high thermal conductivity
   B. light weight
   C. a tensile strength
   D. stiffness

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. All metals can be divided _____ ferrous and non-ferrous.
   A. in
   B. into

C. onto
D. on

2. In text 1 the verb "withstand" means "_____".
A. resist
B. insist
C. demand
D. require

3. "Therefore" is similar to "_____".
A. because
B. because of
C. although
D. that's why

4. _____ the other hand, non-ferrous metals offer a wider variety of characteristics.
A. On
B. In
C. At
D. By

5. "Offers" is similar to "_____".
A. introduces
B. indicates
C. suggests
D. declares

6. If we _____ certain elements to steel, its properties will be improved.
A. add
B. will add
C. added
D. would add

7. If the engineers had understood the properties of these materials, they _____ in the experiment.
A. will succeed
B. would have succeeded
C. have succeeded
D. had succeeded

8. If you convert magnesium to a useful metal, it _____ very difficult.
A. might have been
B. may have been
C. may be
D. might be

9. Ferrous alloys are specified for more engineering applications, _____?
   A. don't they
   B. don't it
   C. aren't they
   D. isn't it

10. These metals _____ as structural engineering materials since then.
   A. are used
   B. have been used
   C. were used
   D. have used

TRANSLATION

4. Translate the sentences from Russian into English.

1. Инженеры должны знать о свойствах самых лучших и самых экономичных материалов.
2. Существует два типа материалов, которые используются в технике – это металлы и не металлы.
3. Все металлы можно разделить на черные и цветные.
4. Черные металлы содержат железо, а цветные металлы нет.
5. Пластмасса и керамика не металлы.
6. Инженеры очень часто используют керамику, когда необходим материал, выдерживающий высокие температуры.
7. Цветные металлы обладают более широким разнообразием характеристик и механических свойств.
8. Чугун и сталь, оба представляющие собой сплавы, являются самыми важными черными металлами.
9. Чтобы улучшить свойство стали, в нее добавляются определенные элементы.
10. На одну тонну морской воды приходится магния больше, чем какого-либо другого металла.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

THE PLASTIC AGE

It's in our homes. It's the most common material in the workplace. Sometimes it's even in our bodies. We may be moving into the Information Age, but it's hard to believe that we are not living in the Plastic Age. The very name "plastic" means versatility. You can bend it, mold it, model it, twist it and ply it in a number of different ways. The finished product can be a soft and airy foam or a hard and strong compound rivaling the sturdiest metal alloys. In its many forms, plastic has forever changed the way we live. The first in the long line of man-made plastics was called Bakelite, after its inventor, Leo Baekeland. Many years of work in his chemistry lab in Yonkers, New York, led him in 1907 to the invention of the first synthetic polymer (plastic), made by linking small molecules together to make large ones. Baekeland made his new material by mixing the carbolic acid (phenol) with the strong-smelling formaldehyde to make a third material that was nothing like the original two. It turned out to be a substance that would change the world. Some of the early uses for plastic were to make things like radio cabinets, buttons, billiard balls, pipe-stems, toilet seats, airplane parts and, the object of Baekeland's research, shellac. Baekeland's trick was to take the resin produced by the two chemicals and heat it under pressure to produce a soft solid that could be molded and hardened or powdered and set under pressure. With this innovation, the plastic revolution was under way.

CONTROL WORK № 2

Variant 2

READING

Text 1

1. Read the text about some properties of materials. For questions 1–10, decide if they are true (T) or false (F).

PROPERTIES OF MATERIALS

The properties of materials are sometimes referred to as structure-sensitive, as compared to structure-insensitive properties. In this case structure-insensitive properties include the traditional physical properties: electrical and thermal conductivity, specific heat, density, and magnetic and optical properties. The structure-sensitive properties include the tensile and yield strength, hardness, and impact, creep, and fatigue resistance. It is recognized that some sources maintain that hardness is not a true mechanical property, because it varies somewhat with the characteristics of the indenter and therefore is a technological test. It is well known that other mechanical properties vary significantly with rate of loading, temperature, geometry of notch in impact testing, and the size and geometry of the test specimen. In that sense all mechanical tests of material properties are technological tests. Furthermore, since reported test values of materials properties are statistical averages, a commercial material frequently has a tolerance band of ±5 percent or more deviation from a given published value.

In the solid state, materials can be classified as metals, polymers, ceramics, and composites. Any particular material can be described by its behavior when subjected to external conditions. Thus, when it is loaded under known conditions of direction, magnitude, rate, and environment, the resulting responses are called mechanical properties. There are many possible complex interrelationships among the internal structure of a material and its service performance. Mechanical properties such as yield strength, impact strength, hardness, creep, and fatigue resistance are strongly structure-sensitive, i.e., they depend upon the arrangement of the atoms in the crystal lattice and on any imperfections in that arrangement, whereas the physical properties are less structure-sensitive. These include electrical, thermal, magnetic, and optical properties and do depend in part upon structure; for example, the resistivity of a metal increases with the amount of cold work.

Physical properties depend primarily upon the relative excess or deficiency of the electrons that establish structural bonds and upon their availability and mobility. Between the conductors with high electron mobility and the insulators with no free electrons, precise control of the atomic architecture has created semiconductors that can have a planned modification of their electron mobility. Similarly, advances in solid-state optics have led to the development of the stimulated emission of electromagnetic energy in the microwave spectrum (masers) and in the visible spectrum (lasers).

STATEMENTS	T/F
1. The structure-sensitive properties include the tensile and yield strength. 2. The structure-insensitive properties don't include electrical and thermal conductivity. 3. Hardness is a true mechanical property. 4. In the solid state, materials cannot be classified as metals. 5. There are a lot of possible complex interrelationships among the internal structure of a material and its service performance. 6. Mechanical properties are strongly structure-sensitive. 7. Physical properties are less structure-sensitive. 8. The resistivity of a metal decreases with the amount of cold work. 9. Physical properties don't depend on the excess of the electrons. 10. Semiconductors can have a planned modification of their electron mobility.	

Text 2

2. Read the text about one of the inventors of the world James Watt. For questions 1–6, choose the best answer A, B, C or D.

JAMES WATT

James Watt was born in Greenock, Scotland, and was taught at home. Later he went to Greenock Grammar School. His technical expertise seems to have been obtained from working in his father's work – shop and from early in life he showed academic promise. His early formal training was as an instrument maker in London and Glasgow. Watt combined the expertise of a scientist with that of practical engineer and later he was not only to improve the heat engine but also to invent new mechanisms. Watt was interested in making experimental models of steam engines and this marks a historical milestone in engineering development, for they were the first experimental apparatus purposely constructed for engineering research. Watt's early interest in steam arose from experience in repairing a model steam engine in

1764, and in 1765 he invented the separate steam condenser. In 1769 he took out a patent on the condenser in which steam came into direct contact with cold water. That was a milestone by which steam engineering reached its practical and usable form. In 1784 he took out another patent for a reaction turbine at a time when continental engineers were only considering similar approaches. An improved centrifugal governor was to follow in 1788 and a design for a pressure gauge in 1790. In the development of the steam engine James Watt represents the perfecting of a sequence of stages beginning with the Newcomen engine and ending with the parallel motion and sun/planet gearing. The latter is said to have been invented by W. Murdock but patented by Watt. In the scientific field Watt's finest memorial, apart from steam engines, is his establishment of the unit of power – the rate of doing work. He introduced the term horsepower (hp), one horse being defined as equivalent to 33,000 ft lb/mm. James Watt died in 1819 in Heathfield, after a life of incomparable technical value. Later, a statue to Watt was placed in Westminster Abbey.

1. James Watt was born in _____.
   A. Scotland
   B. England
   C. Wales
   D. Northern Ireland
2. When a child he went to _____ school.
   A. Comprehensive
   B. Grammar
   C. Technical
   D. Humanitarian
3. James Watt invented the separate steam condenser in _____.
   A. 1764
   B. 1765
   C. 1769
   D. 1784
4. In 1784 he took out another patent for a reaction turbine at a time when _____.
   A. he combined the expertise of a scientist with that of practical engineer
   B. he was repairing a model steam engine
   C. he was making experimental models of steam engines
   D. continental engineers were considering similar approaches

5. Sun/planet gearing was invented by _____.
   A. H. Davy
   B. W. Murdock
   C. J. Watt
   D. I. Newton

6. James Watt died in _____.
   A. Heathfield
   B. Greenock
   C. Westminster
   D. Glasgow

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. Mechanical behavior under load can be explained _____ impurities.
   A. in case of
   B. because of
   C. in terms of
   D. due to

2. The procedures are used to modify the mechanical _____ of particles.
   A. behavior
   B. tendency
   C. direction
   D. position

3. Other engineers have to deal _____ microscopic properties.
   A. in
   B. out
   C. with
   D. up

4. From early in life Watt showed academic _____.
   A. subjects
   B. sciences
   C. promotions
   D. promise

5. Watt was interested in _____ experimental models of steam engines.
   A. collecting
   B. making
   C. doing
   D. gathering

6. If we changed the rate of loading, the mechanical properties _____ vary.
   A. will
   B. would
   C. don't
   D. doesn't

7. The resistivity of a metal _____ unless the amount of cold work is little.
   A. increase
   B. increased
   C. increases
   D. have increased

8. If the engineers _____ new approaches, they wouldn't have taken out another patent for a reaction turbine.
   A. won't consider
   B. don't consider
   C. didn't consider
   D. hadn't considered

9. His interest in steam _____ if he hadn't repaired a model steam engine.
   A. wouldn't have arisen
   B. didn't arise
   C. doesn't arise
   D. won't arise

10. In 1765 he invented the separate steam condenser, _____?
   A. wasn't he
   B. isn't it
   C. didn't he
   D. didn't it

TRANSLATION

4. Translate the sentences from Russian into English.

1. Механические свойства металлов зависят от их структуры.
2. К основным физическим свойствам вещества относится, например, электрическая и термальная проводимость.
3. В этом смысле все механические испытания являются технологическими испытаниями.
4. Вещества, находящиеся в твердом состоянии, классифицируются как металлы, полимеры, керамика.
5. От чего зависят физические свойства материалов?

6. Джеймс Уатт интересовался созданием экспериментальных моделей паровых двигателей.
7. Он не только усовершенствовал тепловой двигатель, но и также изобрел новые механизмы.
8. Джеймс Уатт получил патент на конденсатор, в котором пар вступал в прямой контакт с холодной водой.
9. Это были первые экспериментальные аппараты, специально созданные для инженерных исследований.
10. Кроме паровых двигателей, он установил единицу мощности.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

FIBERS

Fibers are probably the oldest engineering materials used by man. Jute, flax, and hemp have been used for "engineering" products such as rope, cordage, nets, water hose, and containers since antiquity. Other plant and animal fibers have been used for felts, paper, brushes, and heavy structural cloth. The fiber industry is clearly divided between natural fibers (from plant, animal, or mineral sources) and synthetic fibers. Many synthetic fibers have been developed specifically to replace natural fibers, because synthetics often behave more predictably and are usually more uniform in size. For engineering purposes, glass, metallic and organically derived synthetic fibers are most significant. Nylon, for example, is used for belting, nets, hose, rope, parachutes, webbing, ballistic cloths, and as reinforcement in tyres.

Metal fibers are used in high-strength, high-temperature, lightweight composite materials for aerospace applications. Fibers composites improve the strength-to-weight ratio of base materials such as titanium and aluminum. Metal-fiber composites are used in turbine compressor blades, heavy –duty bearings, pressure vessels and spacecraft reentry shields. Boron, carbon, graphite, and refractory oxide fibers are common materials used in high-strength fiber composites.

Glass fibers are probably the most common of all synthetic engineering fibers. These fibers are the finest of all fibers, typically one to four microns in diameter. Glass fibers are used for heat, sound, and electrical insulation; filters; reinforcements for thermoplastics and thermoset resins and for rubber (such as in tyres); fabrics, and fiber optics.

CONTROL WORK № 2

Variant 3

READING

Text 1

1. Read the text about some changes in materials technology. For questions 1–9, decide if they are true (T) or false (F).

CHANGES IN MATERIALS TECHNOLOGY

Since the technology of any age is founded upon the materials of the age, the era of new materials will have a profound effect on engineering of the future.

Not only new materials, but related, and equally important, new and improved and less wasteful processes for the shaping, treating and finishing of both traditional and new materials are continuously being developed. It is important that an engineer should be familiar with them. These include casting, injection molding, and rotational molding of components of ever increasing size, complexity and accuracy; manufacture of more complex components by powder metallurgy techniques; steel forming and casting processes based on new, larger and more mechanized machines, giving reduced waste and closer tolerances; the avoidance of waste in forging by the use of powder metallurgy or cast press forms and new finishing processes for metals and plastics, just to name a few. A high proportion of these processes is aimed at the production of complex, accurate shapes with a much smaller number of operations and with far less waste than the traditional methods of metal manufacture.

Joining techniques have developed to unprecedented level of sophistication and are also providing opportunities for economies. It is necessary to mention that these newer techniques allow the manufacture of complicated parts by welding together simpler sub-units requiring little machining; such assemblies can be made from a variety of materials. The methods can also be used effectively for assembly, allowing savings to be made in both materials and machine utilization.

The brief review of new processes above has indicated that a new materials technology is rapidly emerging, providing new opportunities and challenges for imaginative product design and for more efficient manufacture.

STATEMENTS	T/F
1. The era of new materials will have a great effect on engineering of the future. 2. An engineer must have a thorough knowledge of new technological processes. 3. New technological processes increase productivity. 4. Only a few of these processes are aimed at the production of complex shapes. 5. Only new materials are continuously being developed. 6. The traditional methods of metal manufacture are aimed at the production of complex shapes with far less waste. 7. Joining techniques are providing opportunities for economies. 8. Joining techniques cannot be used effectively for assembly. 9. A new materials technology is providing new opportunities for more efficient manufacture.	

Text 2

2. Read the text about a large group of materials, plastics. For questions 1–5, choose the best answer A, B, C or D.

PLASTICS

Plastics are a large and varied group of materials consisting of combinations of carbon and oxygen, hydrogen, nitrogen, and other organic and inorganic elements. While solid in its finished state, a plastic is at some stage in its manufacture, liquid and capable of being formed into various shapes. Forming is most usually done through the application, either singly or together, of heat and pressure. There are over 40 different families of plastics in commercial use today, and each may have dozens of subtypes and variations.

A successful design in plastics is always a compromise among highest performance, attractive appearance, efficient production, and lower cost. Achieving the best compromise requires satisfying the mechanical requirements of the part, utilizing the most economical resin or compound that will perform satisfactory, and choosing a manufacturing process compatible with the part design and material choice.

Most people have now outgrown the impression that plastics are low-cost substitute materials. Those that still view plastics as cheap and unreliable have not kept up with developments in polymer technology for the past ten years.

Many plastics did indeed evolve as replacements for natural products such as rubber, ivory, silk or wool, which became unavailable or on short supply. But the new materials did not necessarily replace the older ones permanently nor made them obsolete. In many cases, they met an increased demand that could not be met by the natural product alone.

Today's engineering resins and compounds serve in the most demanding environments. Their toughness, lightness, strength, and corrosion resistance have won many significant applications for these materials in transportation, industrial and consumer products. The engineering plastics are now challenging the domains traditionally held by metals: truly load-bearing, structural parts.

1. A plastic in its finished state is _____.
   A. solid
   B. liquid
   C. high-cost
   D. incapable of being formed into various shapes
2. If plastics are of a successful design, they have _____.
   A. highest performance and attractive appearance
   B. efficient production
   C. lower cost
   D. all these combined
3. Plastics *cannot* replace such products as _____.
   A. ivory
   B. silk
   C. rubber
   D. iron
4. The reason for replacements for natural products by many plastics is _____.
   A. to replace them permanently
   B. to make them obsolete
   C. to make them unavailable
   D. to meet the demand that could not be met by the natural product alone
5. Engineering resins are in great demand because of their _____.
   A. toughness
   B. toughness, lightness, strength, and corrosion resistance
   C. lightness
   D. strength and corrosion resistance

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. These materials have a profound effect _____ engineering.
   A. on
   B. at
   C. in
   D. of
2. Engineers must _____ with these processes.
   A. know
   B. be familiar
   C. acquainted
   D. imagine
3. These processes are aimed at the production of complex shapes with far less waste _____ the traditional methods.
   A. that
   B. that of
   C. than
   D. then
4. Joining techniques are providing great _____ for economies.
   A. necessity
   B. challenge
   C. opportunities
   D. demand
5. Unfortunately, some engineers do not keep _____ with developments in polymer technology.
   A. in
   B. on
   C. up
   D. upon
6. Unless the technology _____ founded, application of this material will be impossible.
   A. is
   B. isn't
   C. was
   D. wasn't

7. If the method could allow savings of the material, it _____ used effectively.
   A. will be
   B. would be
   C. would have been
   D. was
8. The material _____ satisfactory if it had satisfied the mechanical requirements.
   A. will perform
   B. had performed
   C. will have performed
   D. would have performed
9. If the engineers didn't achieve the best compromise, the manufacturing process _____ compatible.
   A. weren't
   B. wouldn't be
   C. won't be
   D. won't
10. Engineering resins serve in the most demanding environments, _____?
    A. aren't they
    B. isn't it
    C. don't they
    D. doesn't it

TRANSLATION

4. Translate the sentences from Russian into English.

1. Инженер должен знать о менее затратных процессах обработки материалов.
2. Огромное количество этих процессов направлено на производство более сложных и точных моделей.
3. Современные технологические методы создают новые возможности для более эффективного производства.
4. Технологии по совмещению материалов достигли беспрецедентного уровня сложности.
5. Такие сборки можно осуществлять из множества разнообразных материалов.
6. Пластмасса – это большая группа материалов, состоящих из органических и неорганических элементов.

7. Многие разновидности пластмассы рассматриваются как заменители природных продуктов таких, как резина, слоновая кость, шелк или шерсть.
8. В настоящее время техническая резина используется в самых востребованных областях.
9. Ценность данного материала заключается в его прочности, легкости и сопротивлению коррозии.
10. Те, кто полагают, что пластмасса не надежный материал, не следят за развитием полимерной технологии.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

COMPOSITE MATERIALS

The combinations of two or more different materials are called composite materials. They usually have unique mechanical and physical properties because they combine the best properties of different materials. For example, a fibre-glass reinforced plastic combines the high strength of thin glass fibres with the ductility and chemical resistance of plastic. Nowadays composites are being used for structures such as bridges, boat-building etc.

Composite materials usually consist of synthetic fibres within a matrix, a material that surrounds and is tightly bound to the fibres. The most widely used type of composite material is polymer matrix composites (PMCs). PMCs consist of fibres made of a ceramic material such as carbon or glass embedded in a plastic matrix. Usually the fibres make up about 60 per cent by volume. Composites with metal matrices or ceramic matrices are called metal matrix composites (MMCs) and ceramic matrix composites (CMCs), respectively.

Continuous-fibre composites are generally required for structural applications. The specific strength (strength-to-density ratio) and specific stiffness (elastic modulus-to-density ratio) of continuous carbon fibre PMCs, for example, can be better than metal alloys have. Composites can also have other attractive properties, such as high thermal or electrical conductivity and a low coefficient of thermal expansion.

Although composite materials have certain advantages over conventional materials, composites also have some disadvantages. For example, PMCs and other composite materials tend to be highly anisotropic – that is, their strength, stiffness, and other engineering properties are different depending on the orientation of the composite.

CONTROL WORK № 2

Variant 4

READING

Text 1

1. Read the text about changes in materials technology. For questions 1–8, decide if they are true (T) or false (F).

WORKING WITH NEW MATERIALS

A successful design is almost always a compromise among highest performance, attractive appearance, efficient production, and lowest cost. Achieving the best compromise requires satisfying the mechanical requirements of the part, utilizing the most economical material that will perform satisfactory, and choosing a manufacturing process compatible with the part design and material choice. Stating realistic requirements for each of these areas is of the utmost importance.

The rapidity of change in materials technology is typified by the fact that plastics, a curiosity at the turn of the 20th century, are now being used in volumes which have for many years exceeded those of all the non-ferrous metals put together, and which are beginning to rival steel.

The changes which are taking place are, of course, not only quantitative. They are associated with radical changes in technology – in the range and nature of the materials and processes available to the engineer.

The highest specific strength (i.e. the strength available from unit weight of material) now available comes from non-metals, such as fibreglass, and from metals, such as beryllium and titanium, and new ultra-high strength steels.

Fibre technology, in its modern form, is of more recent origin than plastics, but composites based on glass and/or on carbon fibres are already being applied to pressure vessels, to lorry cabs and to aircraft engines, and may well replace aluminum for the skin and structure of aircraft. An all-plastic car has been exhibited: nearly the whole car, except the engine and transmission is of plastics or reinforced plastics.

It is not only plastics and their reinforcement which are changing the materials scene. Ceramics too are gaining an increasing foothold. Their impact as tooling materials in the form of carbides, nitrides and oxides is also well known – cutting tools made of these materials are allowing machining

rates which had previously been considered quite impossible. Silicon nitride seems to offer particular promise for a wide variety of applications. Among these is liquid metal handling. Pumps for conveying liquid aluminum are now on trial which could revolutionize the foundry industry. Silicon nitride is also being tested for the bearing surfaces of the Wankel rotary engines which are being developed as potential replacements for the conventional piston engines of our motor cars. And ceramic magnets have replaced the traditional steel pole-piece plus copper field coil for providing the engineering field for many electric motors.

It is clear that the number of combinations of all kinds of original trends in the production of new materials is practically unlimited. This, in turn, opens new realms for the designing of still cheaper, effective and unthinkably perfected, compared to that we have today, machines and mechanisms.

STATEMENTS	T/F
1. The compromise among highest performance, attractive appearance, efficient production, and lowest cost makes a successful design of the material. 2. Nowadays the use of plastics in volumes is the same as all the non-ferrous metals put together. 3. The changes in materials technology are rapid. 4. Fibre technology came into being earlier than plastics. 5. Nearly the whole car, including the engine and transmission is of plastics. 6. Both plastics and ceramics are gaining a foothold. 7. Silicon nitride is not considered to be promising in applications. 8. The number of combinations of all kinds of original trends in the production of new materials is not practically limited.	

Text 2

2. Read the text about altering the characteristics of steel. For questions 1–7, choose the best answer A, B, C or D.

HEAT TREATMENT OF STEEL

We can alter the characteristics of steel in various ways. In the first place, steel which contains very little carbon will be milder than steel which contains a higher percentage of carbon, up to the limit of about 1.5 %. Secondly, we can heat the steel above a certain critical temperature, and then allow it to cool at different rates. At this critical temperature, changes begin to take place in the molecular structure of the metal. In the process known as annealing, we heat the steel above the critical temperature and permit it to

cool very slowly. This causes the metal to become softer than before, and much easier to machine. Annealing has a second advantage. It helps to relieve any internal stresses which exist in the metal. These stresses are liable to occur through hammering or working the metal, or through rapid cooling. Metal which we cause to cool rapidly contracts more rapidly on the outside than on the inside. This produces unequal contractions, which may give rise to distortion or cracking. Metal which cools slowly is less liable to have these internal stresses than metals which cool quickly.

On the other hand, we can make steel harder by rapid cooling. We heat it up beyond the critical temperature, and then quench it in water or some other liquid. The rapid temperature drop fixes the structural change in the steel which occurred at the critical temperature, and makes it very hard. But a bar of this hardened steel is more liable to fracture than normal steel. We therefore heat it again to a temperature below the critical temperature, and cool it slowly. This treatment is called tempering. It helps to relieve the internal stresses, and makes the steel less brittle than before. The properties of tempered steel enable us to use it in the manufacture of tools which need a fairly hard steel. High carbon steel is harder than tempered steel, but it is much more difficult to work. These heat treatments take place during the various shaping operations.

1. In the process of annealing, the steel _____.
   A. contains very little carbon
   B. contains a higher percentage of carbon
   C. cools at different rates
   D. becomes softer than before

2. Annealing makes the metal _____.
   A. much easier to machine
   B. cool slowly
   C. cool rapidly
   D. lighter than before

3. Metal which we cause to cool rapidly _____ .
   A. contracts more rapidly on the inside
   B. contracts more rapidly on the outside
   C. relieves any internal stresses
   D. is liable to occur through hammering

4. On the other hand, by rapid cooling, we can make steel _____.
   A. heavier
   B. lighter
   C. milder
   D. harder

5. A bar of the hardened steel is _____ than normal steel.
   A. milder
   B. lighter
   C. harder
   D. more liable to fracture

6. Tempering makes the steel _____ than before.
   A. milder
   B. more brittle
   C. less brittle
   D. lighter

7. High carbon steel is _____.
   A. harder than tempered steel
   B. much easier to work
   C. milder than tempered steel
   D. little easier to machine

VOCABULARY AND GRAMMAR

3. Choose the correct item A, B, C or D.

1. To state realistic requirements for each of the areas is of the _____importance.
   A. utmost
   B. special
   C. especial
   D. efficient

2. A successful design should have an _____ appearance.
   A. beautiful
   B. wonderful
   C. attractive
   D. amazing

3. Nowadays many radical changes take _____ in technology.
   A. a lot
   B. time
   C. part
   D. place

4. Fibre technology is of more _____ origin than plastics.
   A. early
   B. recent

C. late
D. lately

5. These treatments take place _____ the various shaping operations.
A. at
B. during
C. in the time
D. for

6. If a design _____ the best compromise, it will satisfy the mechanical requirements.
A. achieve
B. achieves
C. will achieve
D. would achieve

7. If we heat the steel above a certain critical temperature, and then allow it to cool at different rates, there _____ changes in the molecular structure of the metal.
A. will be
B. would be
C. is
D. has been

8. The steel would have become softer if it _____ above the critical temperature.
A. had heated
B. had been heated
C. would have been heated
D. would be heated

9. Unless we heat the steel above a certain temperature, the metal _____ become softer.
A. wouldn't
B. isn't
C. doesn't
D. don't

10. This produces unequal contractions, _____?
A. don't it
B. doesn't it
C. don't this
D. doesn't this

TRANSLATION

4. Translate the sentences from Russian into English.

1. Пластик начинает конкурировать со сталью.
2. Изменения, которые сейчас происходят, связаны с радикальными изменениями в технологии.
3. Фибра технология имеет более раннее происхождение, чем пластмасса.
4. Почти весь автомобиль, кроме двигателя и коробки передач, состоит из пластика.
5. Керамика также утверждает свои позиции.
6. Трубы для транспортировки жидкого алюминия находятся в процессе испытаний.
7. Становится очевидным, что число комбинаций всех видов оригинальных направлений в производстве новых материалов, практически безгранично.
8. Характеристики стали можно изменить различными способами.
9. При такой температуре происходят изменения в молекулярной структуре металла.
10. С другой стороны, можно сделать сталь более твердой путем быстрого охлаждения.

WRITING

5. Write an abstract to the following text. The length of the abstract is 100–120 words (see Appendix).

NEW STEEL MEETS CHANGING NEEDS

As a structural material, steel has two drawbacks: its weight and its susceptibility to rust. However, due to its advantages, steel has long been used, and in great quantities, in structural applications from bridges and buildings to ships, automobiles and household appliances. Steel is superior to other structural materials in strength, toughness, workability and other properties that are critical for such applications, and it is mass-produced with uniform, reliable quality and at a low cost. Since steel is the most popular structural material available, steel-makers make every effort to meet the changing needs of these markets. New, more sophisticated processes for steel-making and treatment have led to steel products of higher grade and a greater variety. Yet, it can no longer be said that a steel product is satisfactory if it is simply a good structural material.

Today's market needs can be classified broadly as: 1) the need for lighter weight; 2) the need for new properties; 3) the need for maximum performance; and 4) the need for cost reduction. The need for lighter weight is really a requirement for materials having higher specific strength (strength/specific gravity). Materials offering new properties not found in conventional materials will include new breeds of steel, hybrid materials and truly novel materials such as amorphous metal. The need for maximum performance calls for materials approaching the limits of durability, toughness and the like. Finally, the need to reduce costs is leading to materials diversification in which steel materials precisely suited to a specific application are developed. New families of steel products are steadily emerging to meet these needs.

Let's look now at how steel needs have changed in automotive industry and how steelmakers have met these needs. What is needed in new steels by automotive industry. Changes in auto industry's environment New requirements for steel by auto industry Steels which meet auto industry's requirements Fuel efficiency Durability Exhaust gas restriction Noise restriction Safety requirements Weight reduction, lighter gauge of steel Corrosion resistance Heat resistance Noise reduction Rigid structure High-strength sheets with good formability (dual-phase steel) Coated sheets (one – side galvanized sheets) Heat-resistant stainless sheets, aluminized sheets Vibration-damping sheets High-strength low-alloy steel some properties of metals. Every engineering material possesses material certain properties, or characteristics or qualities which we can find by experiment; these properties may make the material suitable or unsuitable for any particular purpose.

GRAMMAR REFERENCE

THE PASSIVE VOICE

1.1. The Formation of the Passive Voice

to be + V_3

Tense/Verb Form	Active	Passive
Present Simple	They **develop** films here.	Films **are developed** here.
Present Continuous	They **are developing** a film now.	A film **is being developed** now.
Past Simple	They **developed** this film yesterday.	This film **was developed** yesterday.
Past Continuous	They **were developing** a film when I arrived.	A film **was being developed** when arrived.
Present Perfect	They **have already developed** ten films.	Ten films **have already been developed.**
Past Perfect	They **had developed** fifty films by that year.	Fifty films **had been developed** by that year.
Future Simple	They **will develop** the film tomorrow.	The film **will be developed** tomorrow.
Conditionals	They **would develop** the film if they had time.	The film **would be developed** if they had time.
Modals	They **must develop** the film by noon.	The film **must be developed** by noon.

1.2. The Use of the Passive Voice

* when the person who carries out the action (the agent) is unknown, unimportant or obvious from the context.

My car was stolen last night, (*unknown agent*)

The plants are watered every evening, (*unimportant agent*)

The house was burgled, (*by a burglar-obvious agent*)

* when the action itself is more important than the agent, especially in news headlines, newspaper articles, formal notices, instructions, advertisements, etc.

The new wing of the hospital was opened by the President yesterday morning.

* when we want to emphasize the agent.

The town library was built by my great-great-grandfather in 1874.

* when we want to make statements more polite or formal.

My new CD player is broken, (more polite than *You've broken my new CD player*).

EXERCISES

1. Form the Passive from the verbs.

***Example*:** to take – to be taken

to ask, to read, to write, to invite, to drink, to eat, to smoke, to drive, to see, to send, to inform, to build, to publish, to help, to advise, to give, to bring, to speak.

2. Translate the sentences paying attention to the Present Simple Passive.

1. Many books are published in Russia. 2. The machines are tested by the police. 3. I am always driven to work by my neighbor. 4. The machines are tested before use. 5. The car is polished once every three months. 6. Concrete is made of cement, sand and gravel. 7. A picnic is arranged once a month by our club. 8. These gates aren't painted every year. 9. I'm not invited to my uncle's every weekend. 10. He isn't asked at every lesson.

3. Translate into English using the Present Simple Active or Passive.

1. Я приглашаю – Меня приглашают.
2. Он присылает – Ему присылают.
3. Она рассказывает – Ей рассказывают.
4. Они сообщают – Им сообщают.
5. Рабочий строит – Дом строится.
6. Писатель пишет книгу – Книга публикуется.
7. Студент пишет упражнение – Упражнение выполняется.
8. Студенты помогают – Студентам помогают.
9. Мы задаем вопросы – Нам задают вопросы.
10. Я советую – Мне советуют.

4. Translate the sentences paying attention to the Past Simple Passive.

1. The best machine was chosen. 2. My bike was stolen last week. 3. The police were called. 4. The book was finished yesterday. 5. The meeting was held on Monday. 6. He was not invited to the party. 7. They were introduced to my friend. 8. I was visited by the teacher last week. 9. Many questions were given to us at the lesson. 10. The letters were brought by the postman.

5. Put the verbs in brackets into the Future Simple Passive.

***Example*:** The delegation … *will be met* ... (meet) tomorrow.

1. This program … (show) again tomorrow. 2. Your room … (clean) in a week. 3. I … (introduce) to the director soon. 4. The gates … (paint) again next year. 5. My pets … (not feed) until six o'clock. 6. You … (not bother) by that man again. 7. You … (invite) to Betty's party? 8. I … (allow) to go to Europe. 9. Many questions … (ask) to the lecturer. 10. The letter … (write) next week.

6. Put the verbs in brackets into the Present, Past or Future Simple Passive.

1. Moscow … (found) in 1147. 2. Football … (play) in summer. 3. Her new article … (finish) next year. 4. The letter … (receive) tomorrow. 5. That bone … (give) to the dog today. 6. The chair … (break) two days ago. 7. An interesting fairy-tale … (tell) tonight. 8. The boy … (take) to the zoo last month. 9. The book … (publish) in three months. 10. Many letters and telegrams … (send) every day.

7. Put the verbs in brackets into the Continuous Passive.

1. This question still … (discuss). 2. The theatre … (build) when we came to this town. 3. My friend … (ask) when the dean entered the classroom. 4. A new grammar rule … (explain) by the teacher now. 5. While the experiment … (make) we were not allowed to enter. 6. Who … (examine) now? 7. Don't switch off the TV-set. An interesting quiz program … (broadcast) now. 8. The lecture … (listen) to attentively. 9. The flowers … (water) from 2 till 3 tomorrow. 10. The glasses … (look) for everywhere now.

8. Translate the sentences paying attention to the passive forms. Identify the tense.

1. A new underground station is being constructed in our street. 2. The device was being tested when you entered the laboratory. 3. This question is not connected with the problem which is being discussed now. 4. Many various machines are being produced for our industry by this plant. 5. The art exhibition of young artists is being widely commented by the press. 6. The machines produced by this plant are being used in agriculture. 7. Masterpieces from our museum were being exhibited in different cities in June last year. 8. He is being waited for. 9. While the experiment was being carried out, nobody left the laboratory. 10. The speaker was being listened to with great interest.

9. Put the verbs in brackets into the Simple or Continuous Passive.

1. He … (ask) now. 2. We received the telegram when the letter … (type). 3. The article … (translate) into Russian in a few days. 4. A new grammar rule … usually … (illustrate) by some examples. 5. She … (laugh) at if she says it. 6. The new project … still … (work) at. 7. The document … still … (look) for. 8. Books by this writer … always much … (speak) about. 9. The meeting won't be over soon as the report … (follow) by a discussion. 10. The doctor … (send) for a minute ago.

10. Translate the sentences paying attention to the Perfect Passive forms.

1. An opening speech has been made by Mr. Brown. 2. Tom said that the conditions of work had been greatly improved. 3. The project has already been submitted to the commission. 4. He asked me if I had been invited to the party. 5. The project will have been finished by Tuesday. 6. Much attention has been paid to the further improvement of the living conditions of the people. 7. She said that her poems had been devoted to the youth. 8. Good art training has been received by these young artists. 9. She has been listened to with great attention. 10. The house will have been built by the end of the year.

11. Change from active into passive.

1. I took him for a walk. 2. She won't forget your telephone number. 3. We'll book tickets tomorrow. 4. We met her at the corner of the street. 5. We discussed such problems at our meetings. 6. They are building a new cinema in his street. 7. A young architect designed that beautiful building. 8. I rang my friend up. 9. I have just done the translation. 10. They will have passed the examinations by February.

12. Write sentences in the passive. Mind the tense form.

***Example*:** (The floor/not clean/yet) *The floor hasn't been cleaned yet.*

1. (The politician/interview/now). …….
2. (The Mona Lisa/paint/Leonardo da Vinci)……
3. (My flat/burgle/last night)…….
4. (All tickets/sell/before we got there)…….
5. (The dog/not feed/yet)……...
6. (The presents/wrap/now) ……..
7. (The prizes/award/President/tomorrow)……
8. (Tea/grow/India)……
9. (The prisoners/take/to prison/now)…….
10. (The book/read/by next week) ……

13. Fill in *by* or *with*.

1. Most children are strongly influenced …*by* …they parents.
2. The jam sandwiches were made …*with* …white bread.
3. Jake was dismissed … his boss.
4. The meal was eaten … chopsticks.
5. The lock was broken … a hammer.
6. The football fans were observed … the police.
7. My hair was cut … a top stylist.
8. My camera was loaded … a black and white film.
9. The beds were made up … clean sheets.
10. This awful mess was made … Carol's dog.

14. Put the verbs in brackets into the correct passive form.

Last week a new leisure centre 1) …*was opened*… (open) in the town of Halden. The centre 2) … (believe) to be the largest in Europe and it 3) … (hope) that it 4) … (visit) by over 40,000 people a month. The centre 5) … (plan) for over ten years, but it 6) … (only/make) possible by a large government grant. Unfortunately, it 7) … (not/finish) yet, but it 8) … (think) that it 9) … (complete) by next month. The centre includes an Olympic-size swimming pool and fifty tennis courts which 10) … (can/book) by phone. The gym 11) … (claim) to be the most modern in the country. The equipment 12) … (buy) in Germany and training 13) … (provide) by five top instructors. Entrance fees are cheap because half the cost 14) … (pay) by the local council, so many local people will be able to afford them.

PROGRESS CHECK TEST 1 (***The Passive forms***)

15. Choose the correct item.

1. Chocolate can ... or ... .
   a) eat, drink b) be eating, drinking c) be eaten, drunk
2. The cocoa plant ... by the Mayas, Toltecs and Aztecs more than 3,000 years ago.
   a) was first growing b) was first grown c) was first being grown
3. A suspicious-looking man … running away from the scene of the crime.
   a) was seen b) is seeing c) saw
4. The salad was made … lettuce, onions and cucumber.
   a) of b) by c) with

5. The curtains … by Marie.
a) are making b) are being made c) made

6. The pool must be … on Sunday.
a) cleans b) cleaning c) cleaned

7. These cakes are made … cherries.
a) by b) of c) with

8. The goods … recently.
a) has been delivered b) have been delivered c) delivered

9. The picture … to me for my birthday.
a) was given b) gave c) is given

10. My dress … by my mother now.
a) is being made b) is made c) made

11. The book … in a month.
a) is publishing b) was published c) will be published

12. The cats …once a day.
a) are being fed b) are feeding c) are fed

13. I … how to swim when I was five.
a) will be taught b) was taught c) have been taught

14. The jewellery … in the safe.
a) is kept b) are kept c) is keeping

15. "What is happening over there?" – "Oh, a new cinema … ."
a) is built b) is being built c) was is built

16. Paul's car … last night.
a) is stolen b) has been stolen c) was stolen

17. Claire's phone number … on this piece of paper.
a) written b) be written c) is written

18. This tree … in the 19th century.
a) plant b) was planted c) is planting

19. This piece of music … yet.
a) has not recorded b) have not recorded c) has not been recorded

20. Not much … about this complicated subject.
a) is known b) known c) knows

21. The new night club … by the council last week.
a) closed b) was closed c) is closed

22. I have a beautiful jumper which … by my grandmother.
a) knitted b) had been knitted c) was knitted

23. The instructions must … very carefully.
a) was followed b) be followed c) is followed

24. Tickets … before we arrived.
a) had been sold b) have been sold c) will be sold

25. The new bridge … already.
a) is being built b) has been built c) had been built

26. Breakfast … at eight in the morning.
a) was served b) had been served c) has been served

27. Designer clothes … in this shop.
a) is sold b) was sold c) are sold

28. The exam … by all the children by three o'clock.
a) was taking b) was being taken c) had been taken

29. Chinese … by more than one billion people.
a) has spoken b) is spoken c) speak

30. The house … by the time we arrived.
a) wasn't cleaned b) isn't cleaned c) hadn't been cleaned

TYPES OF QUESTIONS

There are five types of questions in the English language:
1. General questions.
2. Special questions.
3. Questions to the subject.
4. Tag questions.
5. Alternative questions.

1. GENERAL QUESTIONS (or YES/NO QUESTIONS)

A General question is one of the main questions in the English language. It is made up to the whole sentence and requires only "yes" or "no" answers.

The word order in a general question is indirect, i.e.

An auxiliary verb or a modal verb → subject → verb…?

There are some auxiliary verbs the choice of which depends on the tense of the verb. These are:

am/is/are/was/were/do/does/did/have/has/had/shall/will.

There are some modal verbs. These are:

an/could/may/might/must/should/ought.

Examples of general questions:

1. Is he a student? – Yes, he is / No, he isn't.
2. Are they pilots? – Yes, they are / No, they aren't.
3. Was your brother in the cinema yesterday? – Yes, he was / No, he wasn't.
4. Does she know English well? – Yes, she does / No, she doesn't.
5. Do your cats eat a lot? – Yes, they do / No, they don't.
6. Did you buy that picture? – Yes, I did / No, I didn't.
7. Has he arranged the party yet? – Yes, he has / No, he hasn't.
8. Have you got Claire's phone number? – Yes, I have / No, I haven't.
9. Had they travelled a lot before they visited London? – Yes, they had / No, they hadn't.
10. Will you show me the way to the underground? – Yes, I will / No, I won't.
11. Can you swim? – Yes, I can / No, I can't.
12. Could you see that ship? – Yes, I could / No, I couldn't.

2. SPECIAL QUESTIONS (or WH - QUESTIONS)

A special question is made up to any part of the sentence to find out particular detailed information and requires a full answer.

The word order in a special question is:

Wh → an auxiliary verb or a modal verb → subject → verb…?

Remember the following interrogative words (Wh – вопросительные слова):

Interrogative words	Translation
What…?	Что, какой…?
Where…?	Где, куда…?
When…?	Когда…?
Why…?	Почему, зачем…?
Who…?	Кто…?
Which…?	Который…?
Whose…?	Чей…?
Whom…?	Кого, кому…?
How…?	Как…?

The most widespread interrogative words are *what*, *where*, *when*.

Besides, there are some interrogative combinations made up of two words. These are:

Interrogative combinations	Translation
What kind…?	Какой…?
What time…?	Во сколько…?
How many…?	Сколько…? (с исчисляемыми существительными)
How much…?	Сколько…? (с неисчисляемыми существительными)
How long…?	Как долго…?
How often…?	Как часто…?
How far…?	Как далеко…?
How old…?	Сколько лет…?

While asking a special question, it is a general question which is taken into account. For example, a general question to the sentence “She passed her exams successfully” is “Did she pass her exams successfully?” In order to turn this general question into a special question, just add any interrogative word to the beginning of the sentence: “**How** did she pass her exams?” or “**What** did she pass successfully?”

Examples of special questions:

1. Where does that lady keep her jewellery?
2. What should you do if you are lost?
3. How is Kevin?
4. When were you born?
5. Whose book is this?
6. What subject do you like?
7. How far from the university do you live?
8. How long have you been studying English?
9. How old is your little sister?
10. How often can you visit your grandparents?

3. QUESTIONS TO THE SUBJECT

A question to the subject deserves a special attention. It is different from special questions because **no auxiliary verb** is used in this type of questions. You should just change the subject of the sentence into *what* or *who*.

So, the word order in a question to the subject is:

Wh → verb → other parts of the sentence?

It is important here not to confuse a question to the subject with a special question beginning with *what* or *who*.

Examples of questions to the subject:

1. What happened to you?
2. Who went to the zoo?

Compare with those of special questions:

1. Who are you seeing now?
2. What are you doing?

Check yourself

Put the words in the correct order.

1. Who / about / you / it / ? / told /
2. ? / called / Who / yesterday / her /
3. tell / about / Who / ? him / can / her /
4. yet / hasn't / book / read / this / Who / ? /
5. ? / has / to / What / happened / you /

Keys:

1. Who told you about it?
2. Who called her yesterday?
3. Who can tell him about her? Who can tell her about him?
4. Who hasn't read this book yet?
5. What has happened to you?

4. TAG QUESTIONS (or DISJUNCTIVE QUESTIONS or TAIL QUESTIONS)

A tag question is made up of two parts: the first part is an affirmative or a negative sentence, the second part is a short question (tag) either positive or negative. The second part is separated from the first part with a comma (запятая). These types of questions are very popular in everyday English. They are not asked directly still they encourage an interlocutor (собеседник) to an answer. The "tags" are usually translated into Russian as "не так ли", "не правда ли", "да", "правильно".

Examples of tag questions:

1. He looks after his sister, doesn't he?
2. A girl fell into the river, didn't she?
3. The guests will come tomorrow, won't they?
4. An army officer must wear a uniform, mustn't he?
5. The secretary has been typing the letters for two hours, hasn't she?
6. Paul doesn't like his new job, does he?
7. John isn't paying for his lessons, is he?
8. These girls cannot speak French, can they?

As we can see from the examples that in the "tag" there is an auxiliary or a modal verb which we use in the first part and a pronoun which is the subject of the first part. It is also important to know that if the first part is positive, then the second part is negative and vice versa (наоборот).

The tag questions of some verbs/expressions are formed differently. Study the following examples:

I **am** →aren't I?
Open the windows, will/won't you?
Let me say, will/won't you?

Check yourself

Choose the correct letter.

1. The children are happy, …?
   a) aren't they b) don't they c) are they
2. She is your best friend, ... ?
   a) isn't she b) won't she c) doesn't she
3. There are many plates in the cupboard, …?
   a) isn't it b) aren't there c) are there

4. They could read the notice, …?
   a) could they b) couldn't they c) can't they
5. Open the book at page 20, ….?
   a) will you b) wasn't he c) didn't you
6. Each parent worries about their children, …?
   a) don't they b) doesn't he c) isn't he
7. She hasn't put an advertisement in a paper, …?
   a) hasn't she b) does she c) has she
8. Many people don't know about this new shop, …?
   a) don't they b) do they c) are they
9. Nobody will come to the beach tomorrow, …?
   a) won't they b) will they c) will he
10. He never wakes up before 10 0'clock, …?
   a) does he b) doesn't c) isn't he

Keys: 1a, 2a, 3b, 4b, 5a, 6b, 7c, 8b, 9b, 10a.

5. ALTERNATIVE QUESTIONS

An alternative question implies a choice between two people, things, actions, etc. This question can be asked to any part of the sentence. It is made up of two parts: the first part is a general question, the second part contains "or" and the word of choice.

Examples of alternative questions:

1. Do you live in Tomsk *or Moscow*?
2. Is she a student *or a school girl*?
3. Did you wake up at 6 *or at 7 o'clock*?

Check yourself

Identify the type of questions. Choose the correct letter (A–E).

1. Does she like to ride a bicycle in the evening?
   A) a general question
   B) a special question
   C) a question to the subject
   D) a tag question
   E) an alternative question
2. Who can help us to wash the car?
   A) a general question
   B) a special question

C) a question to the subject
D) a tag question
E) an alternative question

3. This sportsman is very fast, isn't he?
A) a general question
B) a special question
C) a question to the subject
D) a tag question
E) an alternative question

4. Do they speak English or German?
A) a general question
B) a special question
C) a question to the subject
D) a tag question
E) an alternative question

5. Who are we waiting for?
A) a general question
B) a special question
C) a question to the subject
D) a tag question
E) an alternative question

6. Why are you late?
A) a general question
B) a special question
C) a question to the subject
D) a tag question
E) an alternative question

7. That house is under construction, isn't it?
A) a general question
B) a special question
C) a question to the subject
D) a tag question
E) an alternative question

8. What was the weather like all the time?
A) a general question
B) a special question
C) a question to the subject
D) a tag question
E) an alternative question

9. Who doesn't understand the rule?
   A) a general question
   B) a special question
   C) a question to the subject
   D) a tag question
   E) an alternative question

10. Who will meet the foreign delegation?
   A) a general question
   B) a special question
   C) a question to the subject
   D) a tag question
   E) an alternative question

Keys: 1a, 2c, 3d, 4e, 5b, 6b, 7d, 8b, 9c, 10c.

CONDITIONALS

*** Conditionals** are clauses introduced with ***if***.

* The main types of conditionals are: **Type 0, Type 1, Type 2 and Type 3**.

*** Type 0 Conditionals** are used to express a general truth or scientific fact. We can use ***when*** instead of ***if*** in this case.

*** Type 1 Conditionals** (real present) are used to express real or very probable situations in the present or future. We can use ***when*** instead of ***if***. If means that something may happen. ***When*** means that something will definitely happen.

If he calls, I'll tell him the news. (*but he might not call*)

When he calls, I'll tell him the news. (*he will definitely call*)

*** Type 2 Conditionals** (unreal present) are used to express imaginary situations which are contrary to facts in the present and, therefore, are unlikely to happen in the present or future. We can use ***were*** instead of ***was*** for all persons in the if-clauses.

*** Type 3 Conditionals** (unreal present) are used to express imaginary situations which are contrary to facts in the past. They are also used to express regrets or criticism.

* We can form conditionals by using words or expressions such as ***unless* (*=if not*)** (Type 1 conditionals), ***providing/provided that, so/as long as, suppose/supposing, on condition that***, etc.

TYPES OF CONDITIONALS

Type	If-clause	Main clause
0	**If + present simple**	**present simple**
***If/When** the sun **shines**, snow **melts**.*		
1	**If + present simple/present cont./present perfect/ present perfect cont.**	**future/imperative/can/may/might/ must/should/could present bare infinitive**
***If** he **doesn't pay** the fine, he **will go** to prison.* ***If** you **need help**, **come** and **see** me.* ***If** you **have finished** your work, we **can have** a break.*		
2	**If + past simple or past Continuous**	**would/could/might + bare infinitive**
***If** I **had** time, I **would take up** a sport.* (*but I don't have time-untrue in the present*) ***If** I **were** you, I **would talk** to your parents about it.* (*giving advice*)		
3	**If + past perfect or past perfect continuous**	**would/could/might + have + past participle**
***If** she **had studied** harder, she **would have passed** the test.* ***If** he **hadn't been acting** so foolishly, he **wouldn't have been punished**.*		

EXERCISES

1. Make sentences with if (Type 1 conditional).

Example: I'm afraid the bus will be late.
→ get to work late again *If the bus is late, I'll get to work late again.*
→ lose my job *If I get to work late again, I'll lose my job.*

1. → not find another job ……
2. → lose my flat ……
3. → move back to my parents' house ……
4. → get very bored ……
5. → go swimming every day ……..
6. → look very good ……
7. → meet interesting people ……
8. → go to lots of parties ……...
9. → have a wonderful time ……..
10. → be happy ……

2. Fill in the gaps with *if* or *unless*.

1. … the weather is bad, we'll be late for the meeting.
2. … you hurry up, you will miss the train.
3. … you go there by plane, you won't reach the destination in time.
4. Your holiday on board the ship will be truly adventurous and enjoyable … you have any sailing skills.
5. … you phone me on the arrival day, I'll get upset.
6. It will take you less time … you sail from Hong Kong to England via Singapore.
7. … you look at their company's website, you won't get relevant information.
8. You'll have to pay a fine … you're caught without a ticket.
9. Children can't go in … they are with an adult.
10. You can't park here … you don't live in this street.

3. Put the verbs in brackets into the proper tense. (Type 1 Conditional)

1. You will get the feel of Sydney if you … (go) about on foot.
2. If you go abroad, you … (need) to change your money into local currency.
3. Unless the accommodation … (be) reasonably-priced, we won't afford it.
4. The town will accommodate more holiday makers if they … (construct) a new hotel.

5. If you … (not/wear) a dress or skirt, you won't be let into the temple.
6. If you come to New York, you … (experience) the excitement of one of the busiest cities in the world.
7. Unless cars … (be allowed) in the city centre, I'll have to look for a car park in the suburbs.
8. If there … (not be) any seats available, we'll stay here.
9. If it rains, we … (have) the party inside.
10. If I … (not be) free tomorrow evening, I'll see you on Friday.

4. Put the verbs in brackets into the proper tense. (Type 2 Conditional)

1. We … (need) a car if we lived in the country.
2. If we had a choice, we … (go) on a sailing tour.
3. I wouldn't mind going abroad if I … (have) enough money.
4. I think there are too many cars. If there … (not/be) so many cars, there … (not/be) traffic congestions.
5. If you … (live) nearer, we would visit you more often.
6. We … (go) on a tour by plane, if we could afford it.
7. If I were you, I … (not/buy) that car.
8. We wouldn't reach this area, if we … (not/go) by boat.
9. If dogs … (can talk), they would tell some interesting stories.
10. If he … (not travel) so much, he'd have more money.

5. Choose the correct form of the verbs.

1. If I visited Brazil, I definitely *will see/would see* the Carnival show.
2. We *will go/would go* to a campsite if the weather *is/will be* nice.
3. Unless there *were/is* a large hole in the tent, we *won't feel/will feel* comfortable.
4. If she *didn't take/doesn't take* any food along, she *is/will be* very hungry.
5. The trip *will be/would be* far more enjoyable for everyone unless the weather *is/weren't disgusting*.
6. If they *will go/go* on the "all-in" package tour, it *includes/will include* everything from food and drinks to entertainment and excursions.
7. If they *take traveller's cheques/will take traveller's cheques*, they *will be able to exchange/will can exchange* them for local money when they *arrive/will arrive* in the foreign country.
8. Unless you exceed the maximum luggage allowance, you *will pay/won't pay* an extra charge.
9. If I could find my camera, I *will take/would take* your photo.
10. Unless Pete *comes/will* come, we *won't play/wouldn't play* this game.

6. Write these sentences, putting the verbs in brackets into the correct form and adding *will* or *would*.

***Example*:** If you give me your phone number, I ...*will call*. (call) you.
I …*would drive*. (drive) to work if I had a car.

1. If I … (lose) my job, I'd go back to university.
2. If it … (rain) tomorrow, we'll cancel the barbecue.
3. Where would you live if you … (can) choose?
4. If the weather … (be) good, we often have lunch outside.
5. My mother … (worry) about me if I didn't phone her every week.
6. If you finish before 5 o'clock, I … (come) and pick you up.
7. If we … (hurry), we'll get to the shops before they close.
8. I don't know what she … (do) if she couldn't go on working.
9. What would you do if he … (ask) you to marry him?
10. He always … (complain) if I'm late.

7. Match the two halves of these sentences.

1. If the car broke down in the mountains, ...*g* …	a) we would turn back.
2. If we forgot our passports, …	b) you would catch up with me.
3. If we set off at dawn, …	c) we will catch the early train.
4. If you rode the bike faster, …	d) you would enjoy camping.
5. If you could put up with the insects,	e) we'll have to go home soon.
6. If we run out of money after a week, …	f) there'll be plenty of opportunities to take photos of wild animals.
7. If I checked in my luggage quickly,	g) I wouldn't be able to repair it.
8. If you go on a safari tour, …	h) I would have some coffee then.

8. Fill the gaps in the sentences, using the words given.

1. If I had more money, … (I/stay) at a luxurious hotel.
2. If you wanted to buy someone a really good present, what sort of things … (you/look for)?
3. How … (you/feel) if you were in my position?
4. If I were you, … (I/spend) the holiday in the countryside.
5. If you stay at one of these suites, … (it/cost) you thousands of pounds per a single night.
6. If … (you/go) on a seaside holiday, it would value for money.
7. If we went by air-conditioned coach, … (we/feel) much more relaxed.
8. If … (hitchhiking/not/be) so dangerous, it would be widely spread among young people.
9. Alex will finish his work on time if … (he/not talk) so much.
10. If the programs … (be) better, I'd watch more TV.

9. Complete the following sentences with your own ideas.

1. What will you do if you ***miss your plane***?
2. If I didn't arrive in time, they ……..
3. What would happen if I ……. …….
4. If he listened to my advice, he …….
5. Would you sell your car if ……
6. If I knew where to go, I ……
7. They wouldn't mind if we ……
8. If I were late for the appointment, I …….
9. If Alice were here, we ……..
10. If we had bikes, ……

10. Put the correct verb form (Type 3 Conditional).

***Example*:**
If I … (be) here yesterday, I would have come to see you.
If I *had been* here yesterday, I would have come to see you.

1. If Joe … (work) harder, he would have passed the exams.
2. If you … (take) a map with you, you wouldn't have got lost.
3. We would have won the game if we … (not play) so badly.
4. … you … (crash) if you had driven more slowly?
5. You … (not sleep) badly if you hadn't drunk all that coffee.
6. If you … (come) on holiday with us, you … (have) a wonderful time.
7. If my car … (not break down), I … (be) here at 8 o'clock.
8. … you … (study) harder at school last year if you … (like) the teachers?
9. She … (not get) married if she … (not want) to leave home.
10. … you … (help) me if I … (ask) you?

11. Put the correct verb form (Type 1, 2, 3 Conditionals).

1. What would you do if you … (see) a vandal destroying a painting?
2. I … (go) out if unless I'm so tired.
3. You'll miss the train if you … (wake up) late.
4. If I were you, I … (change) the route of travelling.
5. If I had been more careful, you … (visit) your old granny then.
6. You won't find the accommodation if you … (not/reserve) it in advance.
7. Unless you take an umbrella, you … (get) wet.
8. If … you, I would call the receptionist.
9. If you … (not/fly) via Novosibirsk, it would have taken you more time.
10. If he … (not/leave) immediately, he'll miss his flight.

WISHES

	Form	Use
I wish (If only) (wish/regret about the present)	**+ Past tense**	Wish/regret about a present situation we want to be different
*I wish **you worked** harder this term. (It's a pity you don't work hard).*		
I wish (If only) (wish/regret about the present)	**+ could + bare Infinitive**	Wish/regret in the present concerning lack of ability
*I wish **I could speak** English fluently. (But I can't)*		
I wish (If only) (wish/regret about the past)	**+ Past Perfect**	regret that something happened or didn't
*I wish **I had visited** my parents last holidays. (But I didn't. It's a pity I didn't visit them).*		
I wish (If only) (impossible wish for a future change)	**+subject+would+ bare Inf.** ('wish' and 'would' should have different subjects)	wish for a future change unlikely to happen or wish to express dissatisfaction; polite request implying lack of hope
*I wish **he would drive** more carefully. (But I don't think he will).* *I wish **the children would be** more co-operative. (The children have refused to co-operate. – dissatisfaction)* *I wish **you would be** more patient with Jim. (Please be more patient with him! – request implying lack of hope)*		

*** In wishes, we go one tense back. This means that we use the Past Simple in the present or the Past Perfect in the past.**

*He's ill. He wishes he **weren't** ill. (present)*

I overslept yesterday. I wish I hadn't overslept yesterday. (past)

*** After *I wish* we can use *were* instead of *was* in all persons.**

*I wish I **was/were** richer.*

*** *If only* means the same as *I wish* but it is more dramatic.**

*If only I **was/were** richer.*

12. Fill in the gaps with an appropriate auxiliary verb.

***Example*:** She can't type but she wishes she … *could* … .

1. They didn't buy the antique vase but they wish they … .
2. I'm not going to the concert but I wish I … .
3. I'm not very tall but I wish I … .

4. I didn't go to the meeting but I wish I … .
5. I can't tell him the truth but I wish I … .
6. I don't earn much money but I wish I … .
7. She won't accept help but I wish she … .
8. They haven't got any children but they wish they … .
9. I didn't see the program but I wish I … .
10. I don't live close to the University but I wish I … .

13. Complete these sentences with the correct form of the verb in brackets. Some sentences require a negative.

1. Bruce wishes he … (have) more money so he could buy a new sweater.
2. I wish it … (snow) now that it's Christmas.
3. I wish I … (be) taller so that I could be in the basketball team.
4. I wish you … (stop) watching television while I am talking to you.
5. I wish you … (do) that. It annoys me.
6. I wish the holidays … (come) so we could go off to the seaside.
7. I wish they … (build) that block of flats right in front of our window.
8. Of course Tom wishes he … (come) with us to Paris, but he has to stay here and work.
9. I wish we … (go) to the match on Saturday but we are visiting my uncle instead.
10. If only I … (lose) all my money. Now I'm broke.

14. Here are some problems in the brackets. How could they have been avoided? Use the words and phrases to help you write two sentences about each problem using *I wish* and *If only*.

a) keep mouth shut, b) eat less, c) tell the news, d) waste water, e) drive carefully, f) keep calm, g) lose temper, h) use bins, i) take more exercise, j) take rubbish, k) recycle more paper, l) come earlier, m) save water, n) protect the forests, o) let someone else drive, p) use cars less often, q) be more disciplined for a change, r) walked more, v) play fewer computer games, w) watch less TV

1. (I've gained a lot of weight). *I wish* ……. *If only* ……. 2. (The rivers and reservoirs have dried up). *I wish* ……. *If only* ……. 3. (He crashed his car). *I wish* ……. *If only* …….	6. (We are cutting down too many trees). *I wish* …… *If only* …… 7. (People use their cars when they don't need to). *I wish* …… *If only* ……

4. (He had a row with his best friend). *I wish* ……. *If only* ……. 5. (People drop litter in the street). *I wish* ……. *If only* …….	8. (Children don't read enough nowadays). *I wish* …… *If only* …… 9. (Now Mary knows everything). *I wish* …… *If only* …… 10. (Peter is always late). *I wish* …… *If only* ……

PROGRESS CHECK TEST 2 (*Conditionals*)

15. Choose the correct item.

1. The children always … frightened if they watch horror films.
   a) would get b) will get c) get
2. I don't know what I'd do if John … in an accident.
   a) were b) is c) will be
3. There … trouble if they try to stop him leaving.
   a) would be b) is c) will be
4. Can I take the typewriter if you … with it?
   a) will finish b) would finish c) finish
5. Shout if you … anything unusual.
   a) see b) would see c) will see
6. If you … the car, it will never break down.
   a) will look after b) look after c) would look after
7. If you … that program, you would have enjoyed it.
   a) watched b) had watched c) would watch
8. If he weren't so bad-tempered, his wife … him so soon after the marriage.
   a) won't leave b) didn't leave c) wouldn't leave
9. I … if I'd known he was so ill.
   a) won't go out b) wouldn't have gone out c) wouldn't go out
10. What … you … if I offered you a job?
    a) will …say b) would … say c) would have said
11. Tell me if there … anything wrong.
    a) is b) will be c) would be

12. The engine will start if you … this key.
    a) will turn b) turn c) would turn
13. If John had come to the football match, he … it.
    a) would have liked b) will like c) would like
14. I'll go home as soon as I … my work.
    a) carry out b) will carry out c) would carry out
15. We won't have the meeting tomorrow unless everybody … .
    a) will agree b) agree c) agrees

Keys to grammar exercises

THE PASSIVE VOICE

1 Keys: to be asked, to be read, to be written, to be invited, to be drunk, to be eaten, to be smoked, to be driven, to be seen, to be sent, to be informed, to be built, to be published, to be helped, to be advised, to be given, to be brought, to be spoken.

2 Keys: 1. Много книг публикуются в России. 2. Машины проверяются полицией. 3. Меня всегда подвозит на работу мой сосед. 4. Машины проверяют перед их использованием. 5. Машину полируют раз в три месяца. 6. Бетон готовят из цемента, песка и гравия. 7. Пикник проводится один раз в месяц нашим клубом. 8. Эти ворота не красят каждый год. 9. Меня не приглашают к дяде каждые выходные. 10. Его не спрашивают на каждом уроке.

3 Keys: 1. I invite – I am invited. 2. He sends – He is sent. 3. She tells – She is told. 4. They inform – They are informed. 5. A worker builds – The house is built. 6. The writer writes a book – The book is published. 7. The student writes an exercise – The exercise is written. 8. The students help – The students are helped. 9. We ask questions – We are asked the questions. 10. I give some advice – I am given some advice.

4 Keys: 1. Выбрали лучшую машину. 2. На прошлой неделе украли мой велосипед. 3. Вызвали полицию. 4. Книгу закончили читать вчера. 5. Митинг проводился в понедельник. 6. Его не пригласили на вечеринку. 7. Их представили моему другу. 8. Меня посетил учитель на прошлой неделе. 9. Много вопросов было задано нам на уроке. 10. Письма были принесены почтальоном.

5 Keys: 1) will be shown; 2) will be cleaned; 3) will be introduced; 4) will be painted; 5) won't be fed; 6) won't be bothered; 7) will be invited; 8) will be allowed; 9) will be asked; 10) will be written.

6 Keys: 1) was founded; 2) is played; 3) will be finished; 4) will be received; 5) was given; 6) was broken; 7) will be told; 8) was taken; 9) will be published; 10) are sent.

7 Keys: 1) is still being discussed; 2) was being built; 3) was being asked; 4) is being explained; 5) was being made; 6) is being examined; 7) is being broadcast; 8) is/was being listened; 9) will be watered; 10) are being looked.

8 Keys:1. Новая станция метро строится на нашей улице. 2. Когда вы вошли в лабораторию, испытывали прибор. 3. Этот вопрос не связан

с проблемой, которая обсуждается сейчас. 4. Много разнообразных машин для промышленности производится на нашем заводе. 5. Художественная выставка молодых художников широко комментируется прессой. 6. Машины, выпускаемые на этом заводе, используются в сельском хозяйстве. 7. Шедевры из нашего музея экспонировались в разных городах в июле прошлого года. 8. Его ждут. 9. Пока выполнялся эксперимент, никто не покидал лабораторию. 10. Оратора слушали с огромным вниманием.

9 Keys: 1) is being asked; 2) was being typed; 3) will be translated; 4) is … illustrated; 5) will be laughed; 6) is … being worked; 7) is … being looked; 8) are spoken; 9) will be followed; 10) was sent.

10 Keys: 1. Вступительная речь была произнесена мистером Брауном. 2. Том сказал, что условия работы намного улучшились. 3. Проект был представлен на комиссию. 4. Он спросил меня, был ли я приглашен на вечеринку. 5. Проект подготовят ко вторнику. 6. Огромное внимание было уделено дальнейшему улучшению жизненных условий людей. 7. Она сказала, что ее поэмы посвящены молодежи. 8. Этими молодыми художниками была получена хорошая художественная подготовка. 9. Ее прослушали с огромным вниманием.

11 Keys: 1. I was taken by him for a walk. 2. Your telephone number won't be forgotten by her. 3. Tickets will be booked by us tomorrow. 4. She was met by us at the corner of the street. 5. Such problems were discussed at our meetings. 6. A new cinema is being built in his street. 7. That beautiful building was designed by a young architect. 8. My friend was rung up by me. 9. The translation has just been done by me. 10. The examinations will have been passed by February.

12 Keys: 1. The politician is being interviewed now. 2. The Mona Lisa was painted by Leonardo da Vinci. 3. My flat was burgled last night. 4. All tickets had been sold before we got there. 5. The dog hasn't been fed yet. 6. The presents are being wrapped now. 7. The prizes will be awarded by President tomorrow. 8. Tea is grown in India. 9. The prisoners are being taken to prison now. 10. The book will have been read by next week.

13 Keys: 2) with; 3) by; 4) with; 5) with; 6) by; 7) by; 8) with; 9) with; 10) by.

14 Keys: 2) is believed; 3) is hoped; 4) will be visited; 5) has been planned; 6) has only been made; 7) hasn't been finished; 8) is thought; 9) will have been completed; 10) can be booked; 11) is claimed; 12) was bought; 13) is provided; 14) is paid.

PROGRESS CHECK TEST 1 (The Passive forms)

15 Keys: 1) c; 2) b; 3) a; 4) c; 5) b; 6) c; 7) c; 8) b; 9) a; 10) a; 11) c ;12) c; 13) b; 14) a; 15) b; 16) c; 17) c; 18) b; 19) c; 20) a; 21) b; 22) c; 23) b; 24) a; 25) b; 26) a; 27) c; 28) c; 29) b; 30) c.

CONDITIONALS

1 Keys: 1. If I lose my job, I won't find another job. 2. If I don't find another job, I'll lose my flat. 3. If I lose my flat, I'll move back to my parents' house. 4. If I move back to my parents' house, I'll get bored. 5. If I get bored, I'll go swimming every day. 6. If I go swimming every day, I'll look very good. 7. If I look very good, I'll meet interesting people. 8. If I meet interesting people, I'll go to lots of parties. 9. If I go to lots of parties, I'll have a wonderful time. 10. If I have a wonderful time, I'll be happy.

2 Keys: 1) If; 2) Unless; 3) Unless; 4) if; 5) Unless; 6) if ; 7) Unless; 8) if; 9) unless; 10) if.

3 Keys: 1) go; 2) will need; 3) is; 4) construct; 5) don't wear; 6) will experience; 7) are allowed; 8) aren't; 9) will have; 10) am not .

4 Keys: 1) would need; 2) would go; 3) had; 4) weren't, wouldn't be; 5) lived; 6) would go; 7) wouldn't buy; 8) didn't go; 9) could talk; 10) didn't travel.

5 Keys: 1) would see; 2) will go, is; 3) are, will feel; 4) doesn't take, will be; 5) will be, is; 6) go, will include; 7) take traveller's cheques, will be able to exchange; 8) won't pay; 9) would take; 10) comes, won't play.

6 Keys: 1) lost; 2) rains; 3) could; 4) is; 5) would worry; 6) will come; 7) hurry; 8) would do; 9) asked; 10) complains; 11) would tell; 12) will meet; 13) have; 14) am/'m ; 15) spoke; 16) won; 17) closed; 18) comes; 19) is; 20) was/were.

7 Keys: 2) a; 3) c; 4) b; 5) d; 6) e; 7) h; 8) f.

8 Keys: 1) I would stay; 2) would you look for; 3) would you feel; 4) I would spend; 5) it will cost; 6) you went; 7) we would feel; 8) hitchhiking weren't; 9) doesn't talk; 10) were.

9 Student's individual answer

10 Keys: 1) had worked; 2) had taken; 3) hadn't played; 4) would you have crashed; 5) wouldn't have slept; 6) had come, would have had; 7) hadn't

broken down, would have been; 8) Would you have studied, had liked; 9) wouldn't have got, hadn't wanted; 10) Would you have helped, had asked.

11 Keys:
1. I would go out unless I were so tired. 2. Why don't change the route of travelling? 3. You'll miss the train if you wake up late. 4. If I were you I would visit your old granny. 5. You won't find the accommodation unless you reserve it in advance. 6. If you don't take an umbrella, you will get wet.
7. If I were you, I would call the receptionist. 8. Unless you fly via Novosibirsk, it will take you more time. 9. It's the last time I've used that travel agent. 10. You'll miss your flight unless you leave right away. 11. I'll have a hot shower as soon as I get to the hotel. 12. Children can visit the gallery as long as they are accompanied by an adult. 13. The museum will only be able to buy that sculpture provided that the government makes a contribution. 14. I'm sure I'll never understand this painting, however much you keep explaining it to me. 15. Whatever exhibition is on in that gallery, she always goes.

WISHES

12 Keys: 1) had; 2) were/was; 3) was/were; 4) had; 5) could; 6) did; 7) would; 8) had; 9) had; 10) did.

13 Keys: 1) had; 2) would snow; 3) was/were; 4) would stop; 5) wouldn't do; 6) would come; 7) wouldn't build; weren't building; 8) could come; 9) could go; 10) hadn't lost.

14 Keys: 1. I wish I ate less. If only I had taken more exercise.
2. I wish people wouldn't waste water. If only people would save water. 3. I wish he would drive carefully. If only he had let someone else drive. 4. I wish he would keep calm. If only he hadn't lost his temper. 5. I wish people would use bins. If only they would take rubbish home. 6. I wish he would recycle more paper. If only we protected (would protect) the forests. 7. I wish people would use their cars less often. If only people would walked more. 8. I wish children would play fewer computer games. If only children would watch less TV. 9. I wish you would keep your mouth shut. If only I hadn't told her the news.

PROGRESS CHECK TEST 2 (*Conditionals*)

15 Keys: 1) c; 2) a; 3) c; 4) c; 5) a; 6) b; 7) b; 8) c; 9) b; 10) b; 11) b; 12) b; 13) a; 14) c; 15) c.

APPENDIX

Рекомендации по написанию аннотации английского текста

(Abstract)

Рекомендуемый объем аннотации — 150–200 слов.

Аннотация к тексту включает только самые основные положения и выводы, которые даются в сжатой форме.

Аннотация выполняет следующие функции:

– позволяет определить основное содержание текста (или статьи), его релевантность и решить, следует ли обращаться к полному тексту;

– предоставляет информацию о тексте (статье) и устраняет необходимость чтения его полного текста в случае, если он представляет для читателя второстепенный интерес;

В аннотации не должны повторяться предложения из текста (нельзя брать предложения из текста и переносить их в аннотацию), а также ее название.

В аннотации должны излагаться существенные факты, приведенные в тексте, и не должен содержаться материал, который отсутствует в самом тексте.

В тексте аннотации следует избегать слишком длинных предложений, а также сложных грамматических конструкций. Он должен быть лаконичен и четок.

Аннотация (abstract) состоит из:

1. Вводная часть – главная идея текста и основная информация (Кто? Что? Где? Когда?).
2. Основная часть – перечень затронутых в тексте проблем.
3. Заключительная часть, в которой пишущий высказывает свое мнение.

При написании аннотации следует использовать клишированные вводные слова:

Вводная часть:
The text deals with …
As the title implies the text describes …
The text is concerned with…

Основная часть
It is known that …
It should be noted about/that …

It is spoken in detail about…
It is reported that …
The text gives valuable information on/about…
Much attention is given to…
It is shown that…
The main idea of the text is…
It gives a detailed analysis of…
It draws our attention to…
It is stressed that…

Заключение: оценка:
The following conclusions are drawn…
The text gives valuable information about…
рекомендация:
The main idea of the text is …
The text is of great help to …
The text is of interest to …

Пример составления аннотации:

Subwavelength Plasmonic Waveguides and Plasmonic Materials

This text is concerned with surface plasmon based photonics materials to show possibility of creation such plasmonic device as plasmonic waveguide with new properties.

It should be noted that such process is still kind of obscure and requires precise investigation and research. **It is spoken in detail about** formation of plasmon-polariton metal surface as a result of extreme light irradiation and transmission through these layers. **It is shown that** free-electron model could be used for describing plasmon system inside the glass and light distribution through the plasmonic waveguide made of metal nanolayers.

The main idea of the text is to study surface plasmons and show opportunity to fabricate standalone devices to plasmonics, assisted by advanced simulation and fabrication tools, emphasizes the integration of plasmonic features into subsystems for all sorts of optical communications and information exchange.

This text is of great help to researchers involved into waveguide technologies and plasmonic waveguides devices formation.

GLOSSARY

Условные обозначения:

(v) – verb – глагол
(n) – noun – существительное
(adj.) – adjective – прилагательное
(adv.) – adverb – наречие

A
abrasive (n) – абразив
abrasion (n) – истирание, абразивный износ
accomplish (v) – усовершенствовать, выполнять
accuracy (n) – точность, правильность
account (v) – оценивать
acid (n) – кислота
advance (n) – успех
advent (n) – приход, появление
alloy (n,v) – сплав; сплавлять, легировать
altitude (n) – высота
anneal (v) – отжигать, прокаливать
application (n) – применение, приложение (силы)
artificial lift (n) – механизированная добыча
assembly (n) – монтаж, сборка; узел
axle (n) – ось, полуось (механическая)
B
bar (n) – брусок, прут
bear (v) – выдерживать
bend (v) – гнуть, согнуть
bit program (n) – программа использования буровых долотам
blowout (n) – прорыв (дамбы)
braking system (n) – система торможения
breakdown (n) – поломка, авария
brittle (adj.) – хрупкий, ломкий
C
capability (n) – способность
carbon (n) – углерод, угольный электрод (эл)
cast (v) – отливать, отлить
casting (n) – отливка
cast iron (n) – чугун
chromium (n) – хром

coarse (adj.) – грубый, крупный
coat (n, v) – грунтовка; грунтовать
coin (v) – чеканить, выбивать; штамповать
coincide (v) – совпадать
complexity (n) – сложность
compression (n) – сжатие
concrete (n) – бетон
conductivity (n) – удельная проводимость
conductor (n) – проводник
cope with (v) – справиться, совладать
corrosion (n) – коррозия
crack (n, v) – трещина; трескаться
creep (n) – ползучесть
cross-sectional area (n) – площадь поперечного сечения
cutting tool (n) – режущий станок
cyclic stress (n) – циклическое напряжение
D
damage (n) – повреждение, порча, разрушение
deficiency (n) – недостаток, отсутствие, дефицит
dense (adj.) – плотный
density (n) – плотность
deplete (v) – истощать, исчерпывать
depletion – истощение, выработка
detect (v) – обнаруживать
device (n) – прибор
die (n) – матрица; штамп; винторезная головка
die casting (n) – кокильное литье
dismantle (v) – разбирать (машину), демонтировать
dimension (n) – размер, величина; измерение
discovery (n) – открытие
distortion (n) – искривление
downhole flow control (n) – регулирование дебита скважины
downstream (n) – переработка и сбыт
drilling (n) – бурение
ductile (adj.) – эластичный, ковкий, пластичный
ductility (n) – эластичность, ковкость

E
earth's crust (n) – земная кора
elastic deformation (n) – упругая деформация
elastic limit (n) – предел упругости
elongate (adj.) – вытянутый
embed (v) – вставлять, врезать, вделывать; внедрять
emboss (n) – выбивать, чеканит
emission (n) – выброс
engine (n) – двигатель
enhanced oil recovery (n) – добыча нефти с искусственным поддержанием энергии пласта
entity (n) – существо
equipment (n) – оборудование
exceed (v) – превышать, превосходить
excel (v) – превосходить
excess (n) – избыток
expendable (adj.) – потребляемый, расходуемый
extend (v) – расширять, продолжаться
extensive (adj.) – обширный
extrusion (n) – экструзия
F
fabricate (v) – производить, изготовлять, собирать из готовых частей
failure (n) – повреждение, разрушение, отказ
fatigue (n) – усталость металла
facilitate (v) – облегчать, содействовать
fault (n) – недостаток, дефект
ferrous (adj.) – железистый
fix (v) – укреплять, устанавливать
flaw (n) – трещина, щель
flake (adj.) – слоистый
flexible (adj.) – гибкий
flow (n) – расход; поток; текучесть; течь
fluxion (n) – дифференциация
foam (n) – пена
foothold (n) – опора, плацдарм
forge (v) – ковать
formation breakdown (n) – разрыв пласта
foundry (n, adj.) – литье; литейный
fracture (n) – перелом, излом

freezing point (n) – точка замерзания
fuel consumption (n) – потребление топлива
G
gain (v) – приобретать, достигать
gear (n) – шестерня, привод, механизм
grain (n) – зерно
H
hammer (v) – ковать
handle (v) – управлять, ухаживать (за машиной)
harden (v) – закаливать(ся), твердеть
hardness (n) – твердость, крепость
heat (n) – теплота, плавка; нагревать
hydrogen (n) – водород
hydrocarbon recovery (n) – добыча, отбор (нефти, газа из коллектора)
I
implement (v) – внедрять, вводить в действие
indispensable (adj.) – необходимый
inflexible (adj.) – негибкий, негнущийся
inflow/outflow (n) – приток/выход
influence (n, v) – влияние; влиять
ingot (n) – слиток, болванка; брусок
input (n) – входная величина
install (v) – размещать, устанавливать
insulator (n) – изолятор, непроводник
insulation (n) – изоляция, изоляционный материал
interface (n) – поверхность раздела (двух фаз или слоёв жидкости)
internal combustion engine (n) – двигатель внутреннего сгорания
invent (v) – изобретать
iron (n) – железо
irreversible (adj.) – необратимый
ivory (n) – слоновая кость
L
layoff (n) – приостановка
layout (n) – план/схема
lead (n) – свинец
lease (n) – контракт на аренду нефтеносного участка
lever (n) – рычаг, рукоятка

liquid (n) – жидкость
load (n, v) – груз, нагрузка; грузить
loosen (v) – ослаблять, расшатывать
losses (n) – потери
lubricant (n) – смазочный материал, смазка
M
machine (n, v) – машина, станок; обрабатывать на станке
maintenance (n) – техническое обслуживание
magnitude (adj.) – величина, размер; значение
malleable (adj.) – ковкий, податливый, способный деформироваться
manual (adj.) – ручной; с ручным управлением
measure (n, v) – мера; измерять
mild (adj.) – мягкий
mold (v) – отливать в форму; делать по шаблону
mould (n) – форма (для отливки)
N
nitrous (adj.) – азотистый
nitrogen (n) – азот
nodular iron (n) – почковидное железо
non-ferrous metal (n) – цветной металл
notch (n, v) – зарубка; зарубать, делать метку
O
obsolete (adj.) – устарелый
occur (v) – случаться, происходить
offset (n) – компенсация, возмещение
output (n) – выходная величина
oxide (n) – окись
oxygen (n) – кислород
P
performance (n) – рабочие характеристики
permanent (adj.) – постоянный, неизменный, перманентный
petroleum (n) – нефть
petroleum engineering (n) – нефтяная промышленность
pipe (n) – труба, трубка, трубопровод
ply (v) – эксплуатировать
potter (n) – гончар
power (n) – сила, мощность

precision (n) – точность
pressure (n) – давление
probability analysis (n) – анализ вероятности
profitability (n) – прибыльность
property (n) – свойство
propagate (v) – распространяться
pulley (n) – шкиф, блок
pump (n) – насос
punch (n, v) – штамп; штамповать
Q quench (n, v) – закалка; закаливать
R rate (n) – степень, пропорция, коэффициент
ratio (n) – соотношение
reinforce (v) – усиливать, армировать (бетон)
reinforcement (n) – укрепление, арматура (железобетона)
refiner (n) – рафинировочная печь
regulatory body (n) – контролирующий орган
release (n) – выделение
reliability (n) – надежность
relieve (v) – ослаблять, (напряжение), уменьшать
repair (v) – ремонтировать
requirement (n) – требование
reserves (n) – экономические запасы
resist (v) – сопротивляться
resistance (n) – сопротивление
resistivity (n) – удельное сопротивление
respond (v) – реагировать
responsiveness (n) – ответственность
rigid (adj.) – жесткий; стойкий
rigidity (n) – жесткость, твердость
rival (adj.) – соперник, конкурент
rivaling (adj.) – конкурирующий
rolling (n) – прокатка
rubber (n) – резина
rupture (n) – разрыв, разрушение
rust (n, v) – ржавчина; ржаветь

S
sample (n) – образец
savvy (n) – сообразительность; смекалка
scab (n) – раковина
scratch (n, v) – царапина; царапать
screw (n, v) – винт; завинчивать
separation (n) – разделение, интервал, расстояние
setup (n) – устройство, структура
shape (n, v) – форма, формировать
shear (n) – срез
simulation modeling (n) – (имитационное) моделирование
slide (v) – скользить
solid (adj.) – твердый
solidify (v) – затвердевать, твердеть
spin (v) – крутить(ся), вертеть(ся)
steam (n) – пар
steel (n) – сталь
stiffness (n) – жесткость, прочность
strengthen (v) – укреплять, усиливать
stress (n) – давление, напряжение
stretch (v) – растягивать
sturdy (adj.) – стойкий, твердый
surveillance (n) – осмотр; обследование; технический надзор; контроль
susceptibility (n) – чувствительность, восприимчивость
swag (v) – штамповать в горячем виде
T
temper (v) – отпускать (после закалки стали)
tensile (adj.) – прочный на разрыв
tension (n) – напряженность, растяжение
tolerance (n) – выносливость
toolbox (n) – инструментарий
torque (n) – крутящий момент
torsion (n) – кручение
toughness (n) – жесткость
transmit (v) – посылать, отправлять
treat (v) – обрабатывать
treatment (n) – обработка
tungsten (n) – вольфрам
twisting (n) – закручивание, изгиб

U
undergo (v) – подвергаться
update (v) – модернизировать
upstream (n) – разведка и добыча
utilize (v) – использовать, утилизировать
V
velocity (n) – скорость, быстрота
vendor (n) – поставщик
verify (v) – проверять; подтверждать
versatile (adj.) – многосторонний, гибкий
versatility (n) – многосторонность
vessel (n) – сосуд, котел, судно
via (prep) – посредством чего-л.
W
water flooding (n) – заводнение
weave (v) – ткать
wedge (n, v) – клин; закреплять клином
weld (v) – сваривать(ся)
welding (n) – сварка
well completion (n) – заканчивание скважины
well placement (n) – размещение (скважины)
wire (n) – проволока
withstand (v) – выдерживать, противостоять
workover (n) – капитальный ремонт
workshop (n) – цех, мастерская

SUPPLEMENTARY 1

Engineering Specialties

advisory engineer – инженер-консультант
assistant engineer – младший инженер
automatic-control engineer – инженер по автоматическим системам управления
automotive engineer – инженер-автомобилист, инженер по двигателям внутреннего сгорания
building engineer – инженер-строитель
chief engineer – главный инженер, главный механик
combustion engineer – инженер-теплотехник

civil engineer – инженер-строитель
computer engineer – инженер по вычислительной технике
design engineer – конструктор
efficiency engineer – инженер по рационализации производства
equipment engineer – инженер по оборудованию
ground engineer – инженер по эксплуатации
hydraulic engineer – инженер-гидротехник
industrial engineer – инженер-технолог, инженер по организации производства
industrial-relations engineer – инженер по промышленным связям
installation engineer – инженер-монтажник
management engineer – ведущий инженер
maintenance engineer – инженер по ремонту оборудования
marine engineer – корабельный инженер-механик
mechanical engineer – инженер-механик, инженер-машиностроитель
metallurgical engineer – инженер-металлург
methods engineer – инженер по рационализации методов работы
operation engineer – инженер по эксплуатации
patent engineer – патентовед
planning engineer – инженер-конструктор; инженер-проектировщик
plant engineer – инженер-технолог; инженер по оборудованию
power engineer – инженер-энергетик
process engineer – инженер-технолог
refrigerating engineer – инженер по холодильному делу
safety engineer – инженер по технике безопасности
shift engineer – дежурный техник, сменный инженер
steelmaking engineer – инженер-сталеплавильщик
systems engineer – инженер по системному конструированию
test(ing) engineer – инженер-испытатель
thermal engineer – инженер-термист
tool(ing) engineer – технолог
vacuum engineer – технолог по вакууму
water engineer – инженер-гидротехник
weight-and-balance engineer – специалист, занимающийся центровкой самолетов и определением их весовых характеристик

SUPPLEMENTARY 2

Engineering Spheres

engineering – a) техника, конструирование; технический, инженерный; b) машиностроение; машиностроительный; c) технология; d) строительство
advanced production engineering – разработка опытного образца
agricultural engineering – агротехника
architectural engineering – строительная техника
atomic power engineering – атомная энергетика
automotive engineering – автотракторная техника
chemical engineering – химическая технология
civil engineering – гражданское строительство
construction engineering – строительная техника
control engineering – техника контроля; техника автоматического регулирования
design engineering – конструирование
development engineering – инженерное проектирование
electrical engineering – электротехника
fuel engineering – технология топлива
high-frequency engineering – высокочастотная техника
hydraulic engineering – гидротехника
industrial engineering – организация производства
management engineering – техника управления
marine engineering – судостроительная техника
mechanical engineering – машиностроение
methods engineering – технологическая разработка
military engineering – военно-инженерное дело
nuclear engineering – ядерная техника
plant engineering – промышленная эксплуатация, промышленная технология
power engineering – энергетика
process engineering – разработка технологического процесса, организация производства, технология
production engineering – организация производственного процесса, технологическое проектирование
radio engineering – радиотехника
research engineering – технические исследования
structural engineering – строительная техника
systems engineering – системный метод разработки, системотехника,

системное конструирование
water-power engineering – гидротехника
engineering-oriented – при помощи технических мероприятий

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