А. Г. Широколобова

TECHNICAL ENGLISH IN USE
(Технический английский)

Учебное пособие для практических занятий
и самостоятельной работы студентов

Кемерово 2017

Министерство образования и науки Российской Федерации
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«Кузбасский государственный технический университет
имени Т. Ф. Горбачева»

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и самостоятельной работы студентов**

Кемерово 2017

УДК 811.111(075.8)

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Предлагаются тексты из современных источников и упражнения, содержащие необходимую лексику для использования в рамках профессионального общения. Задания к текстам дают возможность организовать дискуссию по обсуждаемой теме, используя при этом лексику текста, стимулируют обучающихся к обмену мнениями, комментированию и высказыванию своего личного отношения относительно полученной информации. Каждый раздел завершается серией упражнений, нацеливающих на диалог и ролевой игрой, которая требует использования лексики и информации из текстов.

Подготовлено для студентов направлений подготовки 15.03.01 «Машиностроение», 15.04.05 «Конструкторско-технологическое обеспечение машиностроительных производств».

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Содержание

Предисловие

Учебное пособие «**TECHNICAL ENGLISH IN USE (Технический английский)**» для студентов направлений подготовки 15.03.01 «Машиностроение», 15.04.05 «Конструкторско-технологическое обеспечение машиностроительных производств» составлено в соответствии с рабочими программами дисциплины «Иностранный язык». Пособие предназначено для практических занятий и самостоятельной работы студентов.

Целью данного учебного пособия является обучение практическому владению иностранным языком для его применения в профессиональной сфере.

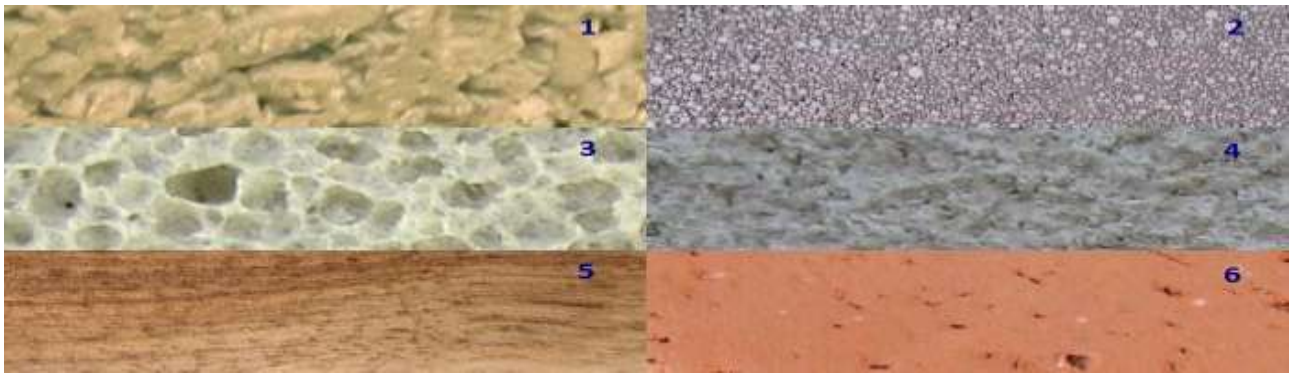
В пособие включены задания и упражнения на основе профессионально-ориентированных текстов, содержащих лексику, характерную для данной отрасли знаний.

Каждый раздел учебного пособия сопровождается системой коммуникативных и лексико-грамматических заданий в соответствии с требованиями итогового контроля: умение воспринимать речь на слух и воспроизводить основное содержание услышанного, формирование навыков устной речи для общения в профессиональной сфере.

UNIT 1
General overview of materials and their structure

Warming up

Ex. 1. What comes to your mind when you look at this picture? How does it refer to the topic?



Ex. 2. What materials do you know, what types of structure do they have? Think of some examples of material structures in our life.

Ex. 3. Words to be remembered.

structure – структура
sensitive – чувствительный
electrical – электрический
thermal – тепловой, термический
conductivity – проводимость
hardness – твердость
impact – удар, воздействие
resistance – сопротивление, стойкость
indentor – индентор
technological – технологический
specimen – образец
statistical – статистический
band – диапазон
deviation – отклонение
polymer – полимер
ceramic – керамика
conductor – проводник
density – плотность
tensile – растяжимый
yield strength – предел текучести
creep – ползучесть
fatigue – усталость
test – испытание
impact strength – ударная прочность
loading – нагружение
notch – выточка, выемка
average – средний
tolerance – допуск
solid state – твердое состояние
metal – металл, металлический
composites – композиты
interrelationship – взаимосвязь

rate – скорость
arrangement – расположение
imperfections – несовершенства
resistivity – удельное сопротивление
amount – объем, количество
cold work – холодная обработка
structural – структурный
bond – связь
availability – наличие
mobility – подвижность
semiconductor – полупроводник
excess – избыток
relative – относительный
crystal lattice – кристаллическая решетка
deficiency – недостаток
electron – электрон
insulator – изолятор
solid-state – твердотельный
emission – излучение
specific heat – удельная теплоемкость

Ex. 4. Match the two parts to make correct sentences.

1. If a material is stiff…	a) it is malleable and/or ductile.
2. If a material is brittle…	b) it has low elasticity and low tensile strength.
3. If a material is plastic…	c) it has low elasticity and high tensile strength.
4. If a material yields…	d) it has been extended to a point before its elastic limit.
5. If a material fractures…	e) it has been loaded beyond its ultimate tensile strength.
6. If a material is elastically deformed…	f) it has been significantly plastically deformed, but not broken.

Ex. 5. Complete the sentences using the words in the box. You will need to use one word twice.

compression deformation elongation extension tension

1. A stretching force is called ..... .
2. A crushing force is called ..... .
3. Extension is also called ..... .
4. Tension causes ..... or ..... .
5. Tension or compression cause ..... .

Ex. 6. Fill in the gaps using the words below.

technological, solid, properties, structure-sensitive

1. The … of materials are sometimes referred to as structure-sensitive, as compared to structure-insensitive properties.
2. The … properties include the tensile and yield strength, hardness, and impact, creep, and fatigue resistance.
3. All mechanical tests of material properties are … tests.
4. In the … state, materials can be classified as metals, polymers, ceramics, and composites.

Reading

Ex. 7. Read and translate the text using the dictionary. Analyze the sentences you find difficult to understand, try to make them easier.

General Overview of Materials and their Structure

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 indentor 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).

Ex. 8. Work in pairs. Translate questions and let your group mates answer them.

1. Зависят ли механические свойства материалов от их структуры? 2. Каковы основные традиционные физические свойства веществ? 3. В какой степени физические свойства зависят от структуры материала? 4. Что такое механические свойства? 5. Каков уровень статистического отклонения для промышленных материалов? 6. Как классифицируются вещества, находящиеся в твёрдом состоянии? 7. Дайте определение механических свойств материалов. 8. Какие свойства материалов в большей степени зависят от структуры: физические или механические? 9. От чего зависят физические свойства материалов? 10. Как зависит удельное сопротивление от обработки давлением?

Writing

Ex. 9. Summarize what is said on *Engineering helps to improve life standards.*

Speaking

Ex. 10. Study the table and speak about different material properties

Describe the structure and bonding of materials	• a physical process is used to separate mixtures – filtration, • distillation, evaporation • alloys are mixtures of a metal with other elements • mixtures can be a mixture of several compounds (such as concrete, glass)
Describe properties and uses of solid materials	Describe the characteristics of solid materials and match the properties to their uses in the commercial world. Coverage of: • the wide range of specialist uses of manufactured materials (for example in building, transport, furniture and flooring, clothing, sport) • natural fibres (such as wool, silk, cotton) • polymers (such as nylon, polyester, poly(ethene), lycra) • ceramics (such as glass, pottery, china) • metals and alloys (such as aluminium, copper, iron, steel) • composites (such as fibreglass, plywood, laminate flooring) • "smart materials" (such as carbon nanotubes, organic electronic chips)
Carry out tests to determine whether materials are fit for purpose	Choose and carry out at least three appropriate tests on materials Tests: • density • hardness • brittleness • stiffness • tensile strength • electrical resistance • thermal conductivity • optical properties

Ex. 11. Think about a device, vehicle or structure you're familiar with, and the materials used to make it. What properties do the materials have? Which properties are strengths in this situation? Which properties are weaknesses, and how are these weaknesses overcome?

Ex. 12. You are going to debate with your groupmates. Read the debates rules and algorithm.

Debate participants: affirmative team (AT) and negative team (NT), a starter (members of AT and NT) and a moderator.

Regulations: Firstly, starters state the position taken by the team and make a kind of introduction. Two teams take part. AT affirms the debate position, NT denies the debate position. In turns, two teams lead the arguments against one another providing examples, probing the opposite team for weaknesses in their reasoning. Finally, the moderator summarizes the main points of both teams and makes the conclusion.

Principles: RESPECT, HONESTY AND NO DEFEATED PARTIES.

The problem debated: The problem of improving life standards through engineering technologies.

<u>While talking use the following expressions:</u>

I'm afraid I disagree.
I completely/entirely/totally agree …
I wouldn't say so …
Yes, definitely …
It's my firm belief that …
As regards to me …
That is out of the question **...**
To my way of thinking …
I feel quite sure that …
I suppose that …

UNIT 2

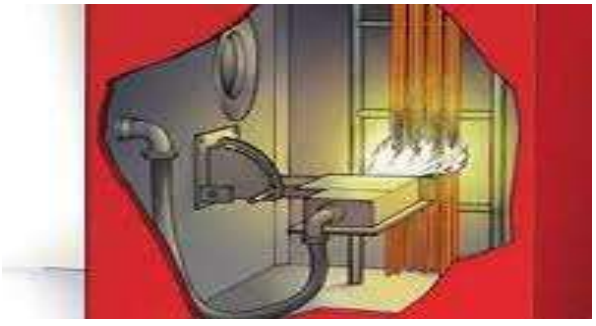
Physical Properties of Materials

Warming up

Ex. 1. What do you know about physical properties of materials? Answer the questions.

1. How are transitions from one solid to another solid form, from solid to liquid, from liquid to vapor, from vapor to solid etc. called?
2. What happens with a typical substance when temperature rises, at a constant pressure?
3. How is the (phase) transition temperature from solid to liquid called, and how is the temperature at which the vapor pressure of a liquid equals 1 atm. (101.3 kPa) called ?
4. Is there any theoretical way to predict the behavior of a mixture from its components, even if its exact composition is known?
5. Does the volume of a gas change as the pressure changes even if temperature remains the same?
6. Do transmissions of energy and electric charge across a body of material give rise to heat and electric conductance respectively?
7. How is the reciprocal of electric conductance called?

Ex. 2. What comes to your mind when you look at this picture? How does it correspond to the topic?



Ex. 3. Words to be remembered.

bonding – связывающий	variation – изменение
force – сила	macroscopic – макроскопический
specific удельный, специфичный	to pertain to принадлежать, относиться

heat – тепло
magnetism – магнетизм
impurities – примеси
imperfections – несовершенства
lattice – решетка
fluctuation – флуктуация
applicability – приложимость
concept – концепция
average средний
property – свойство
awareness – знание, осведомленность
realm – область, сфера
quantum – квантовый
mechanics – механика
relativity – теория относительности
matter – вещество; материал
bulk – объём, объемный
flaw – трещина, щель
aggregation – скопление, концентрация
density – плотность
manufacturing – изготовление
microscopic – микроскопический
contradictory – противоречивый
velocity – скорость
commonplace – общеизвестный факт
relationship – отношение, зависимость
light – свет, легкий
subatomic – субатомный
tool box – инструментарий
accelerator – ускоритель

Ex. 4. Complete the design brief for a cutting machine part using four of the words in the box.

abrasion durability durable hard indentation scratch soft

The cutting wheel will be surrounded by transparent guards. These will allow the operator to see the cutting wheel at all times, and will shield the operator from flying metal fragments. The guards must therefore be constructed from material with a high degree of (1) ..... hardness, to protect it from impacts. As the guards will require regular cleaning, the action of wiping away metal fragments will result in (2) ..... The guards must, therefore, have sufficient (3) ..... hardness in order to retain their transparency and ensure adequate (4) ..... .

Ex. 5. Match the descriptions (1-4) to the technical terms (a-d).

1)the cause of fatigue a creep; 2)the consequence of fatigue ; 3)a material property that helps to slow down cracking; 4) permanent changes in shape due to the action of loads over time.	a) creep b) cyclic loads c) micro-cracking d) fracture toughness

Reading

Ex. 6. Read and translate the text using the dictionary. Analyze the sentences you find difficult to understand, try to make them easier.

Properties of Materials

In studying the general structure of materials, one may consider three groupings: first, atomic structure, electronic configuration, bonding forces, and the arrangement of the aggregations of atoms; second, the physical aspect of materials, including properties such as electrical and thermal conductivity, specific heat, and magnetism; and third, their macroscopic properties, such as their mechanical behavior under load, which can be explained in terms of impurities and imperfections in the lattice structure and the procedures used to modify that behavior.

In the selection of materials for industrial applications, many engineers normally refer to their average macroscopic properties, as determined by engineering tests, and are seldom concerned with microscopic considerations.

Others, because of their specialty or the nature of their positions, have to deal with microscopic properties. The average properties of materials are those involving matter in bulk with its flaws, variations in composition, and variations in density that are caused by manufacturing fluctuations. Microscopic properties pertain to atoms, molecules, and their interactions. These aspects of materials are studied for their direct applicability to industrial problems and also so that possible properties in the development of new materials can be estimated.

In order not to become confused by apparently contradictory concepts when dealing with the relationships between the microscopic aspects of matter and the average properties of materials, it is wise to

consider the principles that account for the nature of matter at the different levels of our awareness. These levels are the commonplace, the extremely small, and the extremely large. The commonplace level deals with the average properties already mentioned, and the principles involved are those set forth by classical physics. The realm of the extremely small is largely explained by means of quantum mechanics, whereas that of the extremely large is dealt with by relativity.

Relativity is concerned with very large masses, such as planets or stars, and large velocities that may approach the velocity of light. It is also applicable to smaller masses, ranging down to subatomic particles, when they move at high velocities. Relativity has a definite place in the tool boxes of nuclear engineers and electrical engineers who deal with particle accelerators. For production engineers, relativity is of only academic interest and is mentioned here for the sake of completeness.

Ex. 7. Work in pairs. Translate questions and let your class mates answer them.

1. Какие группы понятий можно выделить при изучении общей структуры материалов? 2. Укажите четыре компонента в первой группе понятий. 3. Какие свойства материалов можно отнести к физическим свойствам? 4. Что такое макроскопические свойства? 5. Каким образом обычно определяют макроскопические параметры материала? 6. Чем определяются микроскопические свойства материалов? 7. Какие уровни познания можно выделить с целью соотнесения микро- и макропараметров? 8. Какая дисциплина объясняет поведение микрочастиц? 9. Поведение каких объектов описывает теория относительности? 10. Приложима ли теория относительности к малым частицам и при каких условиях?

Ex. 8. Give the summery of the text in English

Все материалы, в том числе строительные, содержат набор определенных физических и химических свойств, которые человечество, сумев выделить, применяет с пользой для себя. При этом, определенными физическими свойствами обладают, как природные, натуральные, так и созданные искусственно руками человека материалы. К их физическим характеристикам относятся следующие свойства: средняя плотность и электропроводность,

пористость и теплопроводность, огнестойкость и гигроскопичность, морозостойкость, теплоемкость и термостойкость.

Являясь величиной прямо пропорциональной массе вещества, средняя плотность материала обратно пропорциональна его объему. Эта важная физическая величина оказывает непосредственное влияние на выбор того или иного строительного материала. В каких-то случаях необходимо применять материалы с большой плотностью, в каких то, наоборот, с меньшей, что обусловлено тем, где он будет применяться. Непосредственно от этой величины зависит и пористость материала.

Отражая количество пор в конкретном объеме материала, величина пористости влияет на прочность. Увеличение этого физического параметра, значительно понижает способность противостояния механических воздействий на него. Однако материалы с большой пористостью хорошо проводят теплоту, звук, хорошо поглощают воду.

Теплопроводность – это свойство, характеризующее возможность материала нагреваться и соответственно пропускать сквозь себя тепловой поток. Теплоемкость – качество материала, позволяющее сохранять полученную теплоту. Это физическое качество аккумулировать тепло, учитывается в момент необходимость выбора материала для возведения пола, стен, перегородок и других частей помещения.

Огнестойкость – это способность или свойство материала, которое проявляется в возможности выдерживать более большие или высокие температуры в определенный промежуток времени. Материалы, отличающиеся огнеупорными качествами, под воздействием высоких температур не горят, а также не деформируются, к примеру, кирпич и черепица, что с успехом применяется при возведении фундамента и крыши. Однако, человечество научилось увеличивать огнестойкость материала пропитывая его огнестойкой пропиткой, что с успехом применяется при возведении домов из различных пород древесины.

Термостойкость – возможность выдерживать чередование низких и высоких температур материалом, который не деформируется и не разрушается. Гигроскопичностью обладают материала, способные поглощать влагу из воздуха. Водостойкость же напротив – это способность материала сохранять свои характеристики при увлажнении.

Writing

Ex. 9. Summarize what is said on *Properties of materials improve everyday life.*

Speaking

Ex. 10. Study the scheme and speak about material properties

Name	properties
Metals	are usually solid, good conductors of electricity and heat, shiny when clean, strong and malleable (meaning they can be bent and shaped).
Metals	are strong and are useful for making tools, buildings, bridges and other structures where strength is important.
Gold	is shiny and doesn't corrode, this means it is a great metal for making jewelry.
The chemical symbol used	for silver is Ag, this comes from the Latin word for silver, argentum.
While aluminum	is the most common metal found in the Earth's crust, the most common metal found on Earth is iron, mostly because it makes up such a large part of the Earth's core.
Copper	is a good conductor of electricity and is often used for making wires.
At room temperature mercury	is the only metal that is in liquid form.
Aluminum	is a good conductor of heat and is often used to make cooking pots.
Alkali metals such as sodium, potassium, rubidium	are extremely reactive elements, just putting them in water can result in an explosion! They are carefully stored in oil to prevent this happening.
Tungsten	has a very high melting point, after carbon it has the second highest melting point of all elements.
Steel	is an important alloy (combination of metals) that is

	created from a mixture of metals, mostly iron. There are many different types of steel including stainless steel, galvanized steel and carbon steel. Steel is commonly used to make a number of products including knives, machines, train rails, cars, motors and wires.
Bronze	is a metal alloy made from copper and tin. Copper makes up the larger amount, usually between 80 to 95%.

Ex. 11. Express your opinion on statements below. Have a talk with your group mate, prove your answers by providing arguments.

- Knowledge of material properties has great prospects for future.
- Study of material properties may help to solve the overpopulation problem concerning food supply.
- Farmers should take into consideration material properties while working with fertilizers.
- Improving the quality of products (changes in material properties) with the help of food chemistry we are taking risks to do harm to our health.

Ex. 12. For a product you know about, say what the designer needed to consider with regard to:

• abrasion • indentations • fatigue • creep • thermal issues.

Say what materials were chosen as a result of these considerations?

Ex. 13. You are going to debate with your group mates. Read the debates rules and algorithm.

Debate participants: affirmative team (AT) and negative team (NT), a starter (members of AT and NT) and a moderator.

Regulations: Firstly, starters state the position taken by the team and make a kind of introduction. Two teams take part. AT affirms the debate position, NT denies the debate position. In turns, two teams lead the arguments against one another providing examples, probing the opposite team for weaknesses in their reasoning. Finally, the moderator summarizes the main points of both teams and makes the conclusion.

Principles: RESPECT, HONESTY AND NO DEFEATED PARTIES.

The problem debated: The problem of changing life conditions through investigations in material properties.

UNIT 3
Mechanical Properties of Materials

Warming up

Ex. 1. What do you know about mechanical properties of materials? Answer the questions.

1. Why are designers and engineers usually more interested in the behavior of materials under load or when in a magnetic field than in why they behave as they do?
2. Why does better understanding of the nature of materials and the reasons for their physical and mechanical properties give opportunity for more quickly and wisely understanding of choice of the proper material for a design project?

Ex. 2. What comes to your mind when you look at this picture? How does it correspond to the topic?

TOUGNESS	BRITTLINESS	DUCTILITY	MALLESBILITY	CORROSION RESISTANGE
Copper	White Cast Iron	Gold	Gold	Gold
Nickel	Gray Cast Iron	Silver	Silver	Platinum
Iron	Hardened Steel	Platinum	Aluminum	Silver
Magnezium	Bismuth	Iron	Copper	Mercury
Zinc	Bronzes	Nickel	Tin	Copper
Aluminum	Aluminum	Copper	Lead	Lead
Lead	Brass	Aluminum	Zinc	Tin
Tin	Structural Steels	Tungsten	Iron	Nickel
Cobalt	Zinc	Zinc		Iron
Bismuth	Monel	Tin		Zinc
	Tin	Lead		Magnezium
	Copper			Aluminum
	Copper			
Metals/alloys are ranked in descending order of having the property named in the columm heading				

Ex. 3. Words to be remembered.

load – нагрузка
design – конструкция
magnitude – величина
handbook – справочник
available – доступный
supplier – поставщик
hammering – ковка
breaking – разрыв, обрыв
wire – проволока, провод
die – матрица
brittleness – хрупкость
rolled – катаный
hardness – твердость
dent – зуб, зубец
malleability – ковкость, пластичность
malleable – ковкий, тягучий
elasticity – упругость
stretched – растянутый
environment – внешние условия
elevated – повышенный
ductility – ковкость, тягучесть
softness – мягкость
stretching – растяжение
drawing – вытяжка
brittle – хрупкий, ломкий
cast iron – чугун
harden – упрочнять
steel – сталь
resistant – стойкий
dented – зубчатый
toughness – ударная вязкость
cracking – разрушение, растрескивание
shape – форма
bent – изогнутый, гнутый
subfreezing – ниже точки замерзания

Ex. 4. Match the word with its definition.

1. Compressive strength	a) Mass per unit volume
2. Density	b) Maximum stress a material can withstand before compressive failure
3. Ductility	c) Maximum stress a material can withstand under repeated loading
4. Fatigue limit	d) Ability of a material to deform under tensile load (% elongation)
5. Fracture toughness	e) Ability to withstand surface indentation (e.g. Brinell hardness number)
6. Hardness	f) Energy absorbed by unit area before the fracture of material
7. Plasticity (physics)	g) Ratio of lateral strain to axial strain (no units)

8. Poisson's ratio	h) Ability of a material to undergo irreversible deformations
9. Shear modulus	i) Modulus per unit volume
10. Shear strain	j) Maximum shear stress a material can withstand
11. Shear strength	k) Change in the angle between two perpendicular lines in a plane
12. Specific modulus	l) Ratio of shear stress to shear strain
13. Specific weight	m) Maximum tensile stress a material can withstand before failure
14. Tensile strength	n) Weight per unit volume
15. Yield strength	o) Ratio of linear stress to linear strain
16. Young's modulus	p) The stress at which a material starts to yield

Ex. 5. Decide whether the sentences below are true or false, and correct the false sentences.

1. Metal must always be heated before it can be forged.
2. When referring to metals, the terms working and forging mean the same.
3. A common reason for forging metal is to increase its hardness.
4. One way of forging metal is by heating it and then rolling it.
5. Metal can only be rolled after it has been heated to a high temperature.
6. When metal is drop forged, it is subjected to compression.
7. Metal can only be work hardened by the process of hot forging.
8. Shot-peening is a hot forging technique used to work harden metal.

Reading

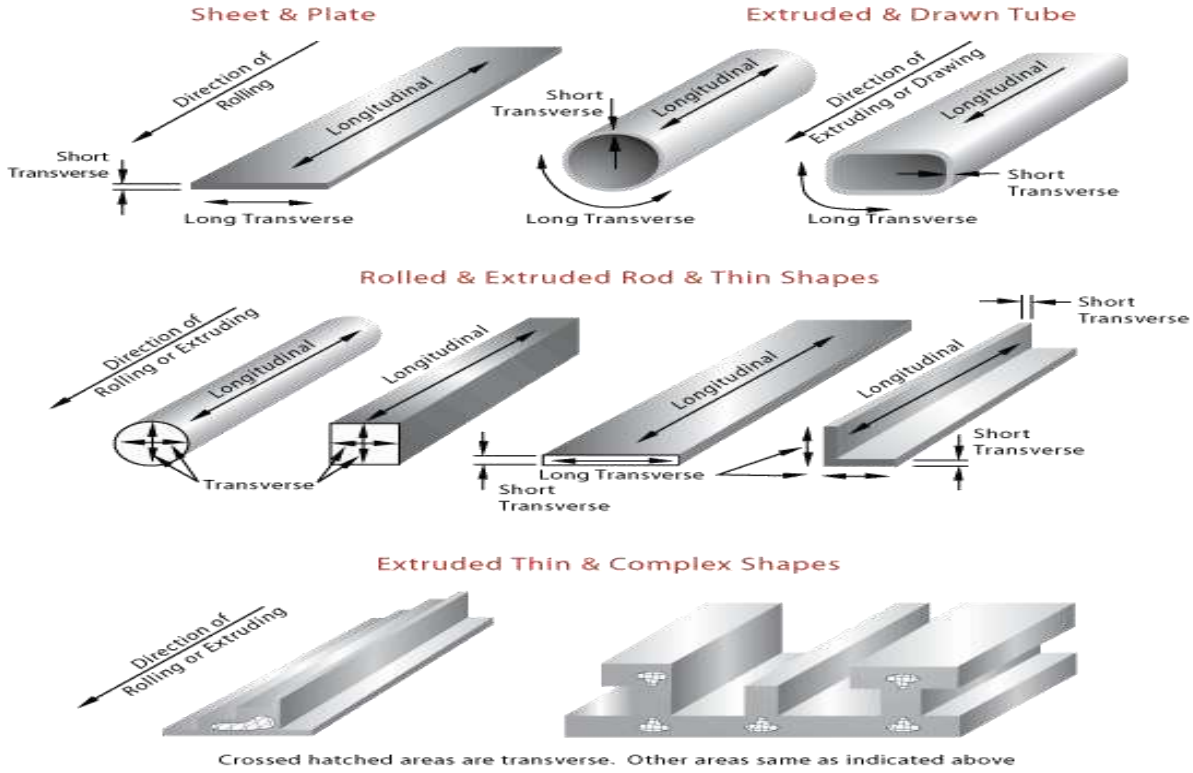
Ex. 6. Read the text and translate it. While reading, write out key sentences, make up a plan and retell the text.

Mechanical Properties

The mechanical properties of a material are those properties that involve a reaction to an applied load. The mechanical properties of metals determine the range of usefulness of a material and establish the service life that can be expected. Mechanical properties are also used to help

classify and identify material. The most common properties considered are strength, ductility, hardness, impact resistance, and fracture toughness.

Most structural materials are anisotropic, which means that their material properties vary with orientation. The variation in properties can be due to directionality in the microstructure (texture) from forming or cold working operation, the controlled alignment of fiber reinforcement and a variety of other causes. Mechanical properties are generally specific to product form such as sheet, plate, extrusion, casting, forging, and etc. Additionally, it is common to see mechanical property listed by the directional grain structure of the material. In products such as sheet and plate, the rolling direction is called the longitudinal direction, the width of the product is called the transverse direction, and the thickness is called the short transverse direction. The grain orientations in standard wrought forms of metallic products are shown the image.



Crossed hatched areas are transverse. Other areas same as indicated above

The mechanical properties of a material are not constants and often change as a function of temperature, rate of loading, and other conditions. For example, temperatures below room temperature generally cause an increase in strength properties of metallic alloys; while ductility, fracture toughness, and elongation usually decrease. Temperatures above room temperature usually cause a decrease in the strength properties of metallic alloys. Ductility may increase or decrease with increasing temperature depending on the same variables

It should also be noted that there is often significant variability in the values obtained when measuring mechanical properties. Seemingly identical test specimen from the same lot of material will often produce considerable different results. Therefore, multiple tests are commonly conducted to determine mechanical properties and values reported can be an average value or calculated statistical minimum value. Also, a range of values are sometimes reported in order to show variability.

Ex. 7. Work in pairs. Translate questions and let your class mates answer them.

1.Что в материалах интересует конструкторов и инженеров в первую очередь? 2. Важно ли для инженеров знание природы материалов и причин их поведения, почему? 3. Что в сущности представляет собой то или иное свойство материала? 4. Из каких источников можно получить те или иные характеристики материалов? 5. Являются ли справочные свойства материалов абсолютными или относительными, почему? 6. Дайте определение ударной вязкости. 7. Как получают проволоку? 8. Дайте определение хрупкости и назовите материалы, которые могут быть отнесены к хрупким материалам. 9. Что такое ковкость? 10. Как можно дать определение твердости металла? 11. Что такое пластичность? 12. Дайте определение упругости материала.

Ex. 8. Give the summery of the text in English

Механические свойства определяются способностью материала противостоять различным внешним физическим воздействиям: прочность при сжатии, изгибе, ударе, кручении; твердость, пластичность, упругость, истираемость и другие.

Прочность – способность материала сохранять свою структуру и свойства под действием сжимающих, растягивающих, скручивающих, изгибающих, ударных и других сил. Прочность материала зависит от его плотности, влажности, структуры и направления приложения нагрузки. Каменные материалы хорошо сопротивляются силам сжатия, другим видам (растяжению, удару и изгибу) они сопротивляются хуже в несколько раз (в 5–50 раз). Другие материалы, например древесина лучше сопротивляются

силам растягивания, поэтому и используются там, где эти качества необходимы.

Твердость определяется величиной сопротивления материала при вдавливании в него более твердого тела. Твердость определяется по шкале Мооса, таким образом, что один из материалов чертит, а другой чертится испытуемым образцом.

Истираемость – потерянная масса материала с одного квадратного метра площади.

Износ – разрушение материала при одновременном действии ударных и истирающих сил. Износ оценивается в процентном отношении потерянной массы к общей массе материала.

Сопротивление удару определяется работой, затраченной на разрушение единицы объема материала.

Деформацией называется изменение геометрических форм и линейных размеров материала под действием внешних сил. Разделяют упругую и пластическую деформацию.

Упругость – свойство материала восстанавливать первоначальную форму после снятия действия внешних сил. Пределом упругости считается величина силы, после которой исходная форма уже не может полностью восстановиться. В зависимости от типа материала, при расчете его предела упругости допускается различная величина остаточной деформации.

Пластичность материала определяет его способность изменять форму при действии внешних сил, не трескаясь и не разрушаясь. По свойству пластичности разделяют хрупкие (при давлении материал разрушается уже при очень малых деформациях) и пластичные материалы. К хрупким материалам относят камень, к пластичным – металл.

Writing

Ex. 9. Summarize what is said on *All materials have properties that designers must use to their best advantage.*

Speaking

Ex. 10. Read some definitions, say if they are true or false.

1. Ductility is not a softness presented in some materials, such as copper and aluminum, that permits them to be formed by stretching (drawing) or hammering without breaking.
2. Wire is made of ductile materials that can be drawn through a die.
3. Brittleness is a characteristic of alloys that will not stretch without breaking, such as cast irons and hardened steels.
4. Malleability is the ability of an atom to be rolled or hammered without breaking.
5. Hardness is the ability of a metal to melt being dented when it receives a blow.
6. Toughness is the feature of being resistant to cracking and breaking while remaining malleable.
7. Elasticity is the ability of a metal to return to its original shape after being bent or stretched.

Ex. 11. Comment on the following quotation: "Engineers and scientists have different objectives, they follow different processes in their work. Scientists perform experiments using the scientific method; whereas, engineers follow the creativity-based engineering design process".

Try to use the phrases expressing opinions:

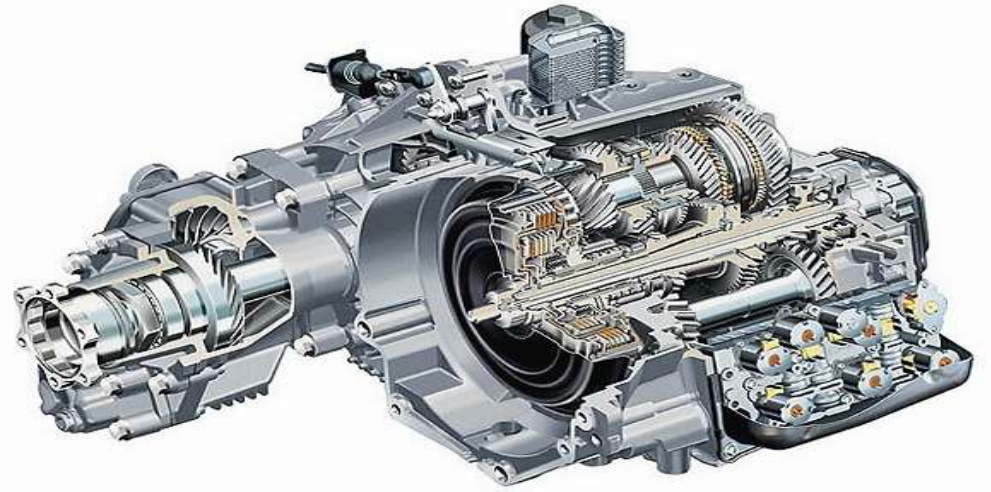
- I suppose
- In my opinion
- To my mind
- I personally think

Ex. 13. Role play. You are the representative of scientific society and you task is to attract another members. Ask your group mates about advantages and disadvantages of scientific work?

UNIT 4
Structural and kinematic analysis of mechanisms

Warming up

Ex. 1. Think of the words associated with. Say why you associate them with the topic discussed. How can analyses of mechanisms be related to other fields of science?



Ex. 2. Think about a specific metal component made by machining. What machine tools and machining techniques do you think were used to make it?

Ex. 3. Match the words in column A with those in column B.

A	B
1) machine elements	a) замещать
2) branches of engineering	b) средства
3) automatic counts	c) взаимоотношение
4) converter	d) автоматический приборный механизм
5) transmission	e) сортировочное устройство
6) replace	f) детали машин
7) automatic - machine - device	g) отрасли инженерии
8) sorter of machined objects	h) коробка передач
9) means	i) автоматический подсчет
10) interrelation	j) преобразователь

Ex. 4. Words to be remembered.

dynamic analyses – динамический анализ
mechanism – механизм
kinematic – кинематический
jointly – совместно
resistance of materials – сопротивление материалов
consider – рассматривать
productivity – производительность
device – механизм, прибор
automatic transfer line – автоматическая линия
power machine – энергетическая машина
information machine – информационные машины
cybernetic machine – кибернетическая машина
location – размещение
inherent – присущий
transmission – передача, коробка передач
machine unit – машинный агрегат
working machine – станок
feeder – питатель, подающий механизм
liquid body – жидкое тело
deal with – иметь дело с чем-либо
branch – отрасль
dynamic method – динамический метод
apply – применять
conversion – превращение
therefore – поэтому; следовательно
theory of elasticity – теория упругости
gaseous body – газообразное тело
manual labour – физический труд
carry out – выполнять
automatic-machine device – машина-автомат
material working machine – технологическая машина
supervisory control machine – контрольно-управляющая машина
computation – применение, вычисление
property – свойство
animate nature – живая природа
executive mechanism – исполнительный механизм
actuator – исполнительный механизм
converter – преобразователь
producing engineering – технология производства
thermal physics – тепловая физика
structural analyses – структурный анализ

Ex. 5. Complete the descriptions below the photos using the words in the box.

abrasive bit blade circular cores diamond drill drilling grinder hacksaw holesaw saw toothed wheel

1 a .... for metal

3 a ..... for a .....

5 a thick .... on a .....

2 a .....

4 a ..... blade for a ....

6 ..... of concrete being removed by ....

Reading

Ex. 6. Read and translate the text using the dictionary.

Mechanics of machines and their basic sections

Mechanisms are widely used in all branches of modern technology. The same types of mechanisms having the same computation and design methods are used in machines of various branches. The Theory of Machines and Mechanisms (TMM) develops general kinematic and dynamic methods of design applied to mechanisms of various branches of engineering. The special disciplines studying the theory and methods of mechanisms and machines' design, used in separate branches of engineering, widely use general methods developed in TMM, therefore TMM is a general-engineering discipline.

Base for TMM is physics, mathematics and theoretical mechanics. The TMM jointly with sciences "Strength of Materials and Theory of Elasticity", "Machine Elements" and "Production Engineering" is theoretical basis for current engineering industry.

The Theory of Machines and Mechanisms considers the scientific basis of machine design and their investigation methods. It is a science studying machines both as a complex unit and as separate links having the purpose of their analysis and providing people with knowledge for creation of new ones.

The purpose of creating of machines is to increase the productivity and to make worker's manual labour easier or to extend his or hers physical and intellectual opportunities. The term "machine" covers a great number and variety of objects used by a man for labour and physiological functions.

The following definition is common: the machine is a device intended for transformation of energy, materials and information.

The machines are means of production that use the forces nature of to facilitate work.

From the point of view of functions, carried out by machines, it is possible to classify all machines into the following groups:

a) Power machines;

b) Material-working machines;

c) Information (supervisory control) machines;

d) Cybernetic.

The power machine is a machine intended for conversion of energy from one form to another (transforming any kind of energy into mechanical one – the machine-engine, and vice versa – machine-generator).

The material-working machine is a machine for conversion of materials. The working machines are subdivided into transport and technological ones.

The transport machine is a working machine, in which conversion of materials consists only in changes of their position in space.

The technological machine is a working machine, in which the conversion of a material consists in changes of the form, location or properties of a material or machined object.

The information machine is a machine for conversion of information. These machines are subdivided into supervisory control machines and computing ones.

The cybernetic machine is a machine replacing or simulating various mechanical, physiological or biological processes, inherent to a man and animate nature.

If the processes of energy or materials conversion are carried out without direct participation of man, the machines performing such operations are named automatic-machine devices.

The set of the automatic-machine devices connected with each other and intended for performance of certain technological processes, is called an automatic transfer line.

The set of the machine-engine, transmission, working machine and supervisory control machine is called a machine unit.

Ex.7. Say if the statement is true or false

1. The purpose of machine creation is to increase the productivity.
2. It is not possible to classify all machines into several groups.
3. The machines are means of production which use the forces of nature to facilitate work.
4. It seems to be convenient to divide all problems of mechanisms' analysis into six parts.
5. Mechanisms are used seldom in all branches of modern technology.
6. The machine is a device intended for transmission of energy, materials and money.
7. The working machines are multiplied into transport and technological ones.
8. The mechanisms which are included in the structure of a machine can incorporate firm, liquid, gaseous bodies.
9. All problems of the theory of mechanisms can be divided into three groups.

Ex. 8. Read the text and translate it. While reading, make up a plan write out key sentences and retell the text.

Basic concepts and definitions

All problems of the theory of mechanisms can be divided into two groups. The first group of problems is connected with the research of structural, kinematic and dynamic properties of mechanisms, i.e. with their analysis. The second group of problems deals with the design of mechanisms with the predetermined structural, kinematic and dynamic properties for realization of required movements, i.e. with the synthesis of mechanisms.

The mechanism's movement depends on their structure and applied forces. Therefore, in the study of the theory of mechanisms, it seems to be convenient to divide all problems of mechanisms' analysis into two parts:

1. Structural and kinematic analysis.
2. Dynamic analysis of mechanisms.

The purpose of structural and kinematic analysis of mechanisms is to study the mechanism's structural theory and research the motion of mechanisms from the geometrical point of view, without the consideration of the forces causing this motion.

The purpose of dynamic analysis is to study the methods of force definition, acting on the elements, forming a mechanism during their motion, and to study the interrelation between the motion of the elements, their masses and acting forces.

Writing

Ex. 9. Summarize what is said on *Different types of mechanisms in our life.*

Speaking

Ex. 10. Match the two parts of the sentences about possible technical issues during the installation of cable saddles on a new suspension bridge.

1. These bolts are slightly too thick, so
2. Some of the saddles don't fit tightly enough- there's a slight gap between the saddle and the cable, so
3. The holes in the top of this saddle don't line up exactly with the holes in the bottom part, so
4. The wire that's wrapped around the outside of the main cable isn't sealed against the edge of some of the saddles, so
5. The saddles are all different – they're manufactured to correspond with the angle of the main cable at the point where they're fixed, so

a) they won't fit together properly.
b) the joints aren't properly protected against rainwater.
c) they're not designed for adjustment.
d) they won't slot through the holes in the saddles.
e) even when they're fully tightened there's too much play.

Ex. 11. Working in pairs make up dialogues using the following words and combinations.

practical problems, scientific knowledge, engineers, solve, apply, different types of engineering jobs.

Ex. 12. Think of a device or structure you're familiar with. Describe how it fits together, and how different components are fixed and/or supported.

Ex. 13. Fill in the gaps.

1. The machine is a ... intended for transformation of energy, ... and information.
2. The power machine is a machine ... for conversion of energy from one form to ... (transforming any kind of energy into mechanical – the machine-engine, and vice versa – machine -generator).
3. The material-working machine is a machine for conversion of ... .
4. The working machines are ... transport and ... ones.
5. The transport machine is a ... machine, in which conversion of materials consists only in ... of its position in space.
6. The technological machine is a working machine, in which the conversion of a material consists in changes of the ..., location or ... of a material or machined object.
7. The information machine is a machine for conversion of ... . These machines are subdivided into ... and computing ones.
8. The cybernetic machine is the machine replacing or ... various mechanical, physiological or ... processes, inherent to the man and ... nature.
9. If the processes of energy or materials conversion are carried out without ... participation of ..., the machines performing such operations are named ... – machine devices.
10. The set of the automatic-machine devices connected with each other and intended for ... of certain technological process, is called an ... transfer line.
11. The set of the machine-engine, transmission, ... machine and supervisory control machine is called a machine.

Ex. 14. Role play.

1. Imagine that you are at the exam in TMM. One of you is a student, the other one is a teacher. The teacher asks you about the main concepts of TMM.
2. You are a group of students visiting the plant. The mechanical engineer shows you different types of machines. You are interested in them and ask him detailed questions about each machine.

UNIT 5
Machines and their parts

Warming up

Ex. 1. Think of the words associated with the picture. Say why you associate them with the topic discussed. How can machine parts be related to other fields of science? Answer the following questions:

1. What are the main requirements to a part?
2. What are the principal criteria of a part's efficiency?
3. Why do machines fail to work?
4. What is the task of mechanical engineering?
5. What is the most important stage in design?

Ex. 2. Match the terms and their definitions.

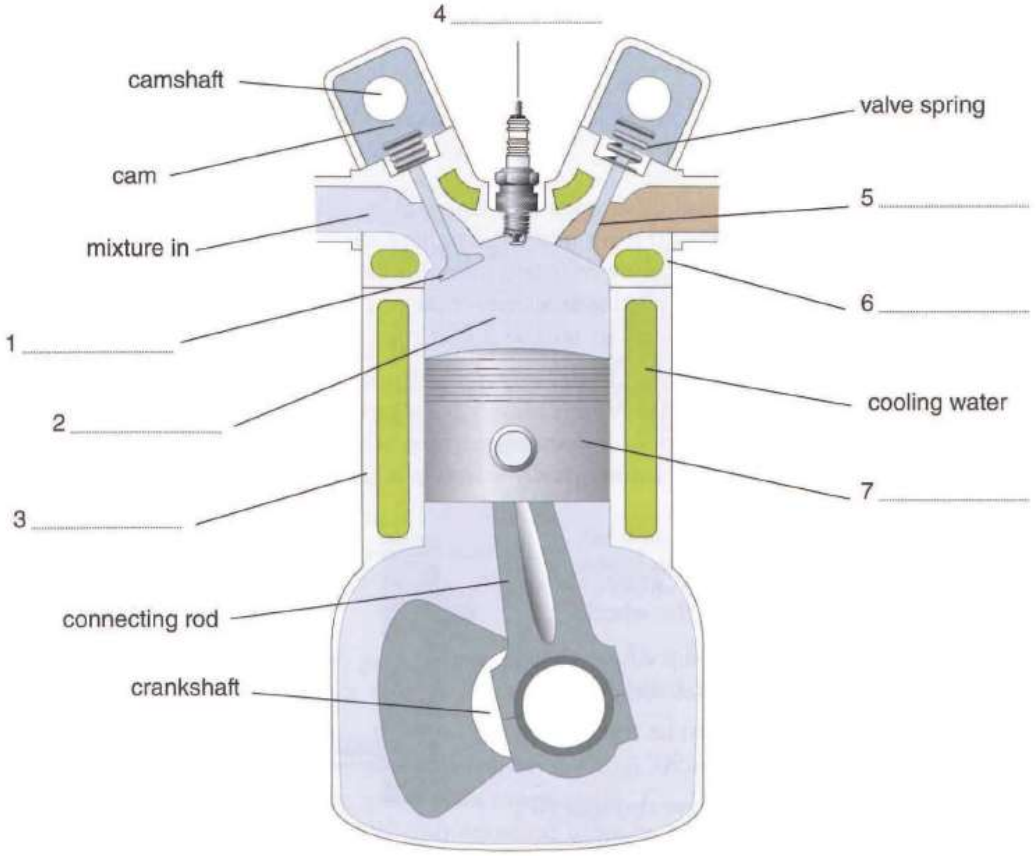
1. Rigidity	a) is the property to resist failures connected with temperature difference (heating and cooling)
2. Unification	b) is changing mechanical and physical properties under the influence of loads and stresses
3. Wear /deterioration resistance	c) is the property to resist failures under the effect of different loads
4. Thermal resistance	d) is the process of a gradual change in size (dimensions), shape, and mass as a result of wear or friction
5. Vibration resistance	e) is the reduction of all kinds of products to a rational minimum in terms of their types, forms, properties, etc.
6. Strength	f) is the property to resist the development of deformations because of acting loads
7. Fatigue	g) is the ability to withstand the negative effect of excessive vibrations

Ex. 3. Words to be remembered.

assemble – собирать
assembly – сборка
axle – ось
bearing – подшипник; опора
ball – шарикоподшипник
frictionless – подшипник качения
roller – роликоподшипник
belt – ремень; лента
body – корпус
case – корпус, кожух
clutch – муфта; соединение
safety – предохранительная муфта
coupling – соединение; муфта
flexible – гибкое соединение
rigid – жесткое соединение
drive – привод; передача
friction – трение
gear – механизм; шестерня
screw – винтовая передача
gear – зубчатая передача
housing корпус; кожух
articulated – шарнирное соединение
joint – соединение
bolt(ed) – болтовое соединение
screw(ed) – винтовое соединение
threaded – резьбовое соединение
welded – сварное соединение
machine – машина; станок; обрабатывать (на станке)
part – деталь; элемент
basic – корпусная деталь
pulley – шкив
shaft – вал

belt (-and-pulley) – ременная передача
chain – цепная передача
unit – узел, блок
shafting – валопровод
structure – конструкция
support – опора; поддерживать

Ex. 4. Look at the cross-section of an engine, and label it using words and expressions from the text below.



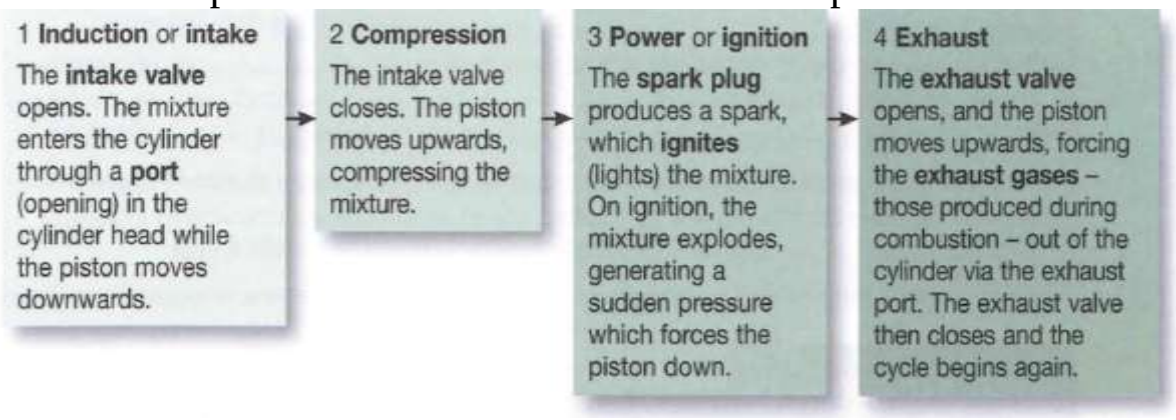
Reading

Ex. 5. a) Read text and study the table below.

Internal combustion engines

Petrol and diesel engines are internal combustion engines. This means they are driven by the combustion (burning) of fuel in enclosed, sealed spaces called combustion chambers. In petrol and diesel engines, the combustion chambers are cylinders surrounded by a cylinder block and closed at the top by a cylinder head. Each cylinder contains a piston. The number of piston cylinders in an engine varies – engines in small motorcycles have only one, while sports car engines may have twelve.

Fuel is supplied to each cylinder from a tank. In most engines, the flow of fuel is generated by a pump, which forces it- at high pressure – through fuel injectors. These vaporize the fuel, allowing it to mix with air. Using this mixture (of fuel and air), most engines function as four-stroke engines. This means they work on a cycle of four stages – or four strokes. A stroke is an upward or downward movement of a piston.



b) Which of the above machine parts are used: a) to join, b) to support, c) to protect, d) to drive some other elements?

c) Say, without looking at the table, what machine parts and units you know and what functions they perform in a machine.

Ex. 6. Read the text paying attention to the terms.

Types and functions of engines and motors

The term engine usually refers to petrol engines, diesel engines and jet engines (or jets). In engineering, motor usually means electric motor – but in general language, 'motor' can also refer to petrol and diesel engines. Engines and motors power (or drive) machines by generating rotary motion- for example, to drive wheels. In jet engines, compressors and turbines rotate to generate thrust – pushing force, produced by forcing air from the back of the engine at high velocity.

As an engine produces a couple – rotary force – the moving parts of the machine it is driving will produce resistance, due to friction and other forces. As a result, torque (twisting force) is exerted on the output shaft of the engine. Torque, calculated as a turning moment in newton metres – is therefore a measure of how much rotational force an engine can exert.

The rate at which an engine can work to exert torque is the power of the engine, measured in watts. Although engineers normally calculate engine power in watts, the power of vehicle engines is often given in brake

horsepower (bhp). This is the power of an engine's output shaft measured in horsepower (hp) – a historic measurement of power.

Ex. 7. Complete the text about diesel engines using words from Ex. 5 and Ex. 6.

Diesel engines differ from (1) ... engines in one key respect: they are not fitted with a (2) ... , in each cylinder, to ignite the fuel. This is because when a (3) ... of diesel and air is compressed inside a hot (4) ..., it will explode spontaneously, without the need for a spark to provide (5) .... A diesel engine must therefore work in a way which prevents the diesel from exploding before the piston is at the top of the cylinder. To achieve this, the engine takes in only air during the (6) ... stage of the cycle. Therefore, during the (7) ... stage, only air- and not an air-fuel mixture – is pressurized. It is only at that last instant, when full compression has occurred, that the (8) ... above each cylinder forces vaporized diesel into the combustion chamber, where it ignites.

Diesel engines operate at lower speeds than petrol engines, making them less suitable for high-speed applications. However, they are more able to (9) ... heavy vehicles, as they can produce greater amounts of (10) ... than petrol engines.

Ex. 8. Read the text and choose the appropriate headings for "A", "B" and "C" passages. There is one extra letter that you don’t need to use:

1) A worn gear
2) A chain drive
3) The limiting factors of its application
4) Types of rivets

A

A rivet is a permanent joint. Depending on the structure there are different kinds of rivet joints: single-rivet (однорядные), multiple-rivet and others. Rivets are widely used when the materials to be connected cannot be welded and when it is necessary to **slow down the failure process.** For example, an airplane's wing has thousands of rivets, thus the failure of one or several rivets will not result in its failure. The defect can be detected in time and the rivet can be changed.

B

A chain drive is based on the engagement of sprockets (звездочка). The principle of engagement (not friction) leads to an increased strength of a steel chain as well as to the absence of frictional sliding (пробуксовка).

Among the disadvantages of a chain drive there is the wear of hinges in the chain, noise, additional dynamic loads, and the necessity of greasing. Chain drives are widely used in mining and transport equipment as well as in agricultural, and chemical machine-building.

C

A worm gear provides high reduction ratio and is characterized by smooth and noiseless operation, as well as self-braking (самоторможение) in case of low efficiency.

On the other hand, a worn gear has rather low efficiency and rather high wear as well as the necessity of costly antifriction materials (bronze). A lower reduction ratio and a higher cost in comparison with toothed gears are the limiting factors of its application.

Ex. 9. Give the summary of this text in English.

Не существует абсолютной, полной и завершённой классификации всех существующих деталей машин, т.к. конструкции их многообразны и, к тому же, постоянно разрабатываются новые. Для ориентирования в бесконечном многообразии детали машин классифицируют на типовые группы по характеру их использования:

– передачи предназначены для передачи и преобразования движения, энергии в машинах. Их разделяют на передачи зацеплением, передающие энергию посредством взаимного зацепления зубьев (зубчатые, червячные и цепные), и передачи трением, передающие энергию посредством сил трения, вызываемых начальным натяжением ремня (ременные передачи) или прижатием одного катка к другому (фрикционные передачи).

– валы и оси. Валы служат для передачи вращающего момента вдоль своей оси и для поддержания вращающихся деталей передач (зубчатые колёса, шкивы звёздочки), устанавливаемых на валах, оси служат для поддержания вращающихся, деталей без передачи полезных вращающих моментов;

– опоры служат для установки валов и осей;

– подшипники. Они предназначены для закрепления валов и осей в пространстве. оставляют валам и осям только одну степень

свободы – вращение вокруг собственной оси, подшипники делятся на две группы в зависимости от вида трения в них: а) качения; б) скольжения;

– муфты предназначены для передачи крутящего момента с одного вала на другой. Муфты бывают постоянными, не допускающие разъединения валов при работе машин, и сцепные, допускающие сцепление и расцепление валов;

– соединительные детали (соединения) соединяют детали между собой. Они бывают двух видов:

а) разъемные – их можно разобрать без разрушения, к ним относятся резьбовые, штифтовые, шпоночные, шлицевые, клеммовые;

б) неразъемные – разъединение деталей невозможно без их разрушения или связано с опасностью их повреждения к ним относятся сварочное, клеевое, заклепочное, прессовое соединения.

– упругие элементы. Их применяют: а) для защиты от вибраций и ударов; б) для совершения в течение длительного времени полезной работы путем предварительного аккумулирования или накопления энергии (пружины в часах); в) для создания натяга, осуществления обратного хода в кулачковых и других механизмах и т.д.;

– корпусные детали организуют внутри себя пространство для размещения всех остальных деталей, обеспечивают их защиту;

– детали специфические. К ним можно отнести механизмы управления, устройства для защиты от загрязнений, для смазывания и т.д.

Writing

Ex. 10. Summarize what is said on *Machine parts and their classification*

Speaking

Ex. 11. Think about the engine in a vehicle you're familiar with. Describe specific aspects of it – the type of fuel it uses, the number of cylinders it has, and how much power and torque it produces.

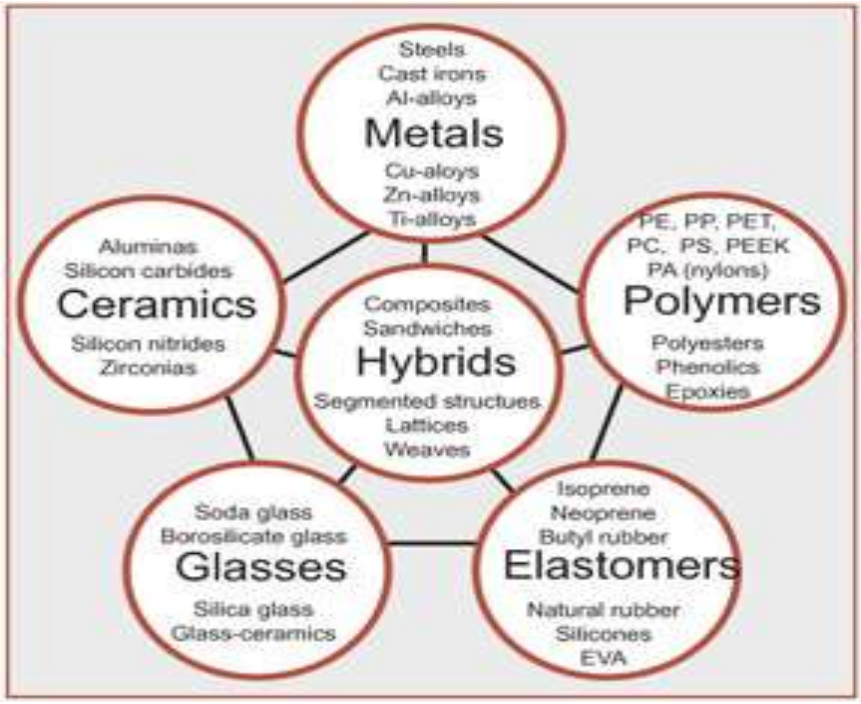
Ex. 12. Give any examples of machines or household appliances subject to excessive wear, vibrations, or changes in temperature and pressure?

Ex. 13. Role play. You are going to plan your career as a future design engineer, you have a meeting with a well-known expert in machine parts. Make up 3-5 questions you would like him or her to answer. What is necessary to do at first, second and so on? Discuss the steps with your classmates.

UNIT 6
Engineering materials

Warming up

Ex. 1. a) What comes to your mind when you see such a picture?



b) Can you think of any engineering material? Which one? Have you ever seen it?

Ex. 2. These are some examples of engineering materials. Answer the questions. Support your ideas with examples.

a) What materials, in your opinion, are

1. rigid	4. light-weight	7. dense
2. flexible	5. heavy	8. thermal resistant
3. strong	6. brittle	9. environmentally stable

b) What materials are or can be used for making

1. belts	4. chains	7. worm gears
2. screws	5. welded joints	8. clutches
3. bodies	6. ball bearings	9. housings

Ex. 3. Complete the following sentences with a form of the word in brackets.

1. In the … industry, … develop processes for producing plastics, fibres, medicines, etc. from simple chemicals. (chemistry)
2. Producing steel using the Bessemer process is one of the best-known… processes. (industry)
3. Most … devices need oil as a lubricant. (mechanics)
4. Following the earthquake every building had to be inspected to see whether it had suffered any …. damage. (structure)
5. Certain chemicals are added to glue to … it. (hard)
6. Excavators and power shovels are two types of … equipment used by … when they are removing rocks from the ground. (mine)

Ex. 4. Words to be remembered.

alloy – сплав
bond связь; связывать
Brittle – ломкий, хрупкий; ломаться
engineering material – конструкционный материал
blast furnace – доменная печь
cast – литье; отливка; лить
precipitate – осадок; выпадать в осадок
grade – марка, сорт
frame – рама, каркас, остов
process – обрабатывать
wheel – колесо
flaky – хлопьевидный
ductile – пластичный; ковкий
crack – трещина
constituent компонент, составная часть
alloying element – легирующий элемент
insulator – изолятор
lining – обшивка, облицовка
materials science – материаловедение
matrix – основной материал
reinforce – укреплять, усиливать
iron casting – чугунная отливка
stain – пятно
stainless – нержавеющая сталь

Ex. 5. Match English and Russian terms.

1. strength	a. проводник; (электро)провод
2. matrix	b. пластичный сплав
3. flexible	c. атомная связь
4. heat conductor	d. твёрдость, прочность
5. brittle alloy	e. прочность; сила
6. hardness	f. обычно, как правило
7. electrical conductor	g. основной материал
8. ductile alloy	h. плохой проводник
9. generally	i. гибкий
10. poor conductor	j. проводник тепла
11. atomic bond	k. хрупкий сплав

Reading

Ex. 6. a) Read and translate the text using the dictionary. Try to guess possible title to it.

It has been estimated that there are between 40,000 and 80,000 materials which are used or can be used in today's technology. The choice of a proper material is of critical importance in the development of failure of structural and mechanical equipment. Failures causing loss of life have occurred for over 100 years. Throughout the 1800s bridges fell, and in the late 1800s railroad accidents in the United Kingdom were continually reported as "The most serious railroad accident of the week"! In the USA there also were the hair-raising stories of the ships built during World War II. Of 4,694 ships considered in the final investigation, 24 had a complete crack in the deck, and 12 ships were either lost or broken in two. In this case, improved, stronger structural steel was needed because welded construction was used in shipbuilding instead of riveted one.

There are the two sciences dealing with structural materials: 'materials science' and 'materials engineering'.

Materials science is primarily concerned with the study of the basic knowledge of materials: the relationships between the composition/structure, properties and processing of materials.

Materials engineering is mainly concerned with the use of this fundamental knowledge to the design and production of materials with properties that will meet certain requirements.

As the two sciences study engineering materials they are often called as one subject – "materials science and engineering", which combines both a basic knowledge and application, and forms a bridge between the basic sciences (physics, chemistry and mathematics) and the various engineering disciplines, including electrical, mechanical, chemical, civil and aerospace engineering.

b) Answer the questions.

1. Do you know any structural materials? If yes, name them.
2. What is the difference between 'Materials science' and 'Materials engineering'? What do the two subjects have in common?
3. Why should you know the fundamentals of these subjects?
4. Do you know any recent structural failures in our country or abroad? What was or could be the reason for that failure?

Ex. 7. Read text. Get ready to discuss its information.

Classification of engineering materials

1. *Metals and alloys* are inorganic materials composed of one or more metallic elements. They may also contain a small number of non-metallic elements. Metals are good thermal and electrical conductors. Many metals are strong and ductile at room temperature and maintain good strength at high and low temperatures.

2. *Ceramics* are inorganic materials consisting of both metallic and non-metallic elements bonded together chemically. Generally, ceramics they have high melting points and high chemical stabilities. They also have high hardness and high temperature strengths, but tend to brittle. Ceramics are usually poor electrical conductors.

3. *Polymers* are organic materials. They typically have low densities and are mechanically flexible. Their mechanical properties may vary considerably. Most polymers are poor electrical conductors due to the nature of atomic bonding.

4. *Composites* are mixtures of two or more types of materials. Usually, they consist of a matrix and a reinforcing material. They are designed to ensure a combination of the best properties of each of the component material.

Ex. 8. a) Translate the following text in writing without a dictionary. Try to do it within 10 minutes.

Classification of Engineering Materials

There is also an increasing trend to classify engineering materials into two further categories: *structural materials* and *functional materials*.

Structural materials, as the name indicates, are materials used to build structures, bodies and components. For instance, in a car the body, frame, wheels, seats, inside lining, engine and various mechanical transmission parts are all constructed from structural materials. The most important consideration for this type of application is the mechanical properties.

Functional materials, on the other hand, are used for special purposes in equipment such as conductors and insulators or in devices used to generate light, to convert optical, mechanical or thermal signals into electrical voltages, or to provide a strong magnetic field. The electronic devices in the control systems of a car, for instance, are built with semiconductors, an important type of functional material.

b) Make a plan and retell the text according to it.

Ex. 9. Agree or disagree with the statements, prove your point of view.

1. Metals and alloys are organic materials composed of one or more metallic elements.
2. Many metals are not strong and ductile at room temperature and maintain good strength at high and low temperatures.
3. Ceramics are usually poor electrical conductors.
4. There is also an increasing trend to classify engineering materials into three further categories.

Writing

Ex. 10. Summarize what is said on *Engineering materials*

Speaking

Ex. 11. In pairs, discuss the information of the following table.

Here are the examples of choosing the materials depending on working conditions.

Working conditions	Structural Material	Machine parts/units
High (steady or live) load	structurally improved, hardened steel, high-strength cast iron	gears shafts, etc.
Elastic deformation	hardened steel, rubber, special plastics	springs, etc.
Contact (rolling and sliding) stresses	hardened or structurally improved steel, cast iron, nonmetallic materials	ball and roller bearings, stressed toothed gears, etc.
Mating parts; sliding contact	the surface of mating parts: in friction units – a friction material, in bearing units – an antifriction material	bearings, clutches, slideways, brakes, friction drives, etc.

Ex. 12. Say true or false.

1. The properties of engineering materials can not be classified into two main groups: physical and chemical.
2. Depending on the application, the physical properties can be further grouped into five categories, corresponding either to structural or functional materials.
3. Mechanical properties include Young's modulus, tensile and shear strengths, hardness, toughness, ductility, deformation and fracture behaviors, fatigue and creep strengths, wear resistance, etc.
4. Physical properties does not include electrical and electronic properties, magnetic properties, optical and thermal properties, etc.
5. The physical properties of engineering materials generally include corrosion, oxidation, catalysis properties and chemical stabilities.
6. There are four essential elements in materials science and engineering:
   a) processing or synthesis;
   b) structure or composition;
   c) properties;
   d) performance or application.

There is a growing opinion among scientists and engineers that in order to develop new materials and provide materials efficiency, all four elements should be considered.

Ex. 14. Role-play. Imagine that you are a reporter of a local newspaper and your group-mate is an engineer and you should interview him concerning the properties of engineering materials. Think over possible questions and dramatize the dialogue.

UNIT 7
Innovation and invention

Warming up

Ex. 1. Which is the most important invention of the last 100 years? Which one do you wish had not been invented? Why?

Ex. 2. Study the chart and complete the table after it.

Verb	Noun: concept (uncountable)	Noun: thing (countable)	Noun: Person
design: to make plans or drawings for how something is to be made	design	a design	a designer
develop: to make a new idea successful, for example by making or improving a product	development	a development	a developer
innovate: to think of new ideas, methods, products, etc.	innovation	an innovation	an innovator
invent: to design and make something for the first time	invention	an invention	an inventor
–	technology: the practical or industrial use of scientific discoveries	a technology	a technologist

Verb	Noun	Person
(1) ……..	invention	inventor
produce	(2) ……..	producer
observe	(3) ……..	observer
design	design	(4) ……..
develop	(5) ……..	developer
discover	(6) ……..	discoverer
research	(7) ……..	(8) ……..
program	program	(9) ……..
(10) ……..	engine	engineer
build	(11) ……..	builder
conserve	(12) ……..	(13) ……..
create	(14) ……..	(15) ……..

Ex. 3. Complete the following sentences with the appropriate word from the chart above.

1 The same civil ……. who built the roads is now building the new bridge.
2 They called in a ……. to knock down the wall between the two rooms.
3 Scientists have been carrying out ……. to find a cure for the disease.
4 The company which ……. the drug has had to pay a lot of money to the victims.
5 Lewis and Clark were the first to ……. the new territory.
6 Penicillin was one of the most important ……. of the twentieth century.
7 Walt Disney, the ……. of Mickey Mouse, died a very rich man.
8 You'll need to go to university if you want to become a computer ……. .
9 A property ……. buys land and builds offices or homes on it.
10 The theory is based on detailed ……. of many patients/

Ex. 4. Words to be remembered.

innovation – инновация	invention – изобретение
develop – развивать	development – развитие
research – исследовать	conserve – сохранять
dimension – измерение	reduce – снижать, уменьшать
substance – вещество	property – свойство
application – применение	wealth – богатство, благополучие
asbestos – асбест	pollution – загрязнение
ultrafine – очень маленький	damage – ущерб, вред
particle – частица	handle – сделать руками
admit – допускать	drain sewage system – водосток
capture – ловить	titanium dioxide – диоксид титана
coating – слой, покрытие	consumer – потребитель
comparison – сравнение	adsorb – поглощать, впитывать
temperature support system – система подержания температуры	health regulations – правила охраны труда

Reading

Ex. 5. Skim the text and express your own point of view about nanotechnologies. Think about negative features of nanomaterials and nanotechnologies.

Nanomaterials and nanotechnologies

The term 'nanomaterials' means: 1. the study of how materials behave when their dimensions (particle size, for example) are reduced to the nanoscale (1–100 nm); 2. the materials themselves that are used in nanotechnology.

Nanotechnology is engineering at the atomic scale. One nanometre (nm) is a billionth of a metre, or about 1/80,000 the width of a human hair. Nanotechnology works on a scale from 1 up to 100 nm. A particle of sand is a million nanometres across.

Physical properties of chemicals change at this scale, which gives new possibilities for products and applications. Gold, for example, is usually inert, but it is highly reactive at the nano-scale. Similarly, titanium dioxide, which is one of the most commonly used substances in nanotechnology.

The unique properties of nanomaterials and nanoproducts have attracted the attention of materials developers. You may already have or work with such products. The website of global technology watchdog includes an unofficial document generated by the US Environmental Protection Agency (EPA) that lists over 100 commercial products based on nanotechnologies. These are already or soon will be on the market.

Ex. 6. Skim the text. Propose your own advice how to use technology today.

Nanotechnology today

As we see nanotechnology could spread over almost any industry – medicine, plastics, energy, electronics, aerospace. However, experts say that nanotechnology is simply a technology, bringing changes and advances in many applications. They say that there will be no "nanotechnology industry", but only other industries employing the technology.

We are told about tiny nanosensors detecting cancers at an early stage, exotic new lightweight materials that will be 10 times stronger than steel, electronic 'nano-chips' that can store and process much more information than today's microchips, 'nano-fibres' for better and always-clean clothes, and 'nano-materials' for high-performance coatings, for instance in aircraft and space ships. Mass media reports of desktop nanomachine factories.

In 2004 the European Commission put the industry's value today at Euro 2.5 billion worldwide. By 2011, it could be the US$1 trillion mark. The policy calls for Europe to become world leader in the field of nanotechnology and for more investment in nanotechnology "to realise wealth generating products and services."

Ex. 7. Give the summary of this text in English.

The new asbestos?

It was 100 years before asbestos companies and their insurers claimed that they were almost "ruined" by paying compensations for deadly diseases to asbestos victims.

For nanotechnology, the problem may start much earlier. One of the insurance companies has already said that uncertainty about risks from nanotoxicity and nanopollution meant there was insufficient information to offer insurance on the industry.

Two factors can make nanoparticles a very serious occupational risk. Firstly their size alone can be dangerous; secondly their massive surface area may adsorb other toxins that can then be transported into the human body.

Even before nanotechnology became an industry, there was environmental pollution on a nano scale. Pollution from power and cement plants and diesel engines all contain "ultrafines" (ultrasmall particles). These particles are associated with thousands of pollution-related deaths each year – perhaps 60,000 per year in the US alone. A California study shows that these ultrafines are 10 to 50 times more damaging to humans than larger particles. The danger is most probably of a chronic nature, and it will take some time before it manifests itself. That is where the real risk is, and the comparison with asbestos should be seen in this light.

Trades Union Congress of Great Britain concludes: "It is important to ensure that we do not have a return of the asbestos tragedy where hundreds of thousands of people were exposed to a killer dust that even today kills over 3,000 people a year."

Writing

Ex. 8. Summarize what is said on *One of the scientists said about nanotech "This is a modern day gold rush – forget precaution, get to production".*

Speaking

Ex. 9. Work with a partner and check how much he/she knows about engineering.

1. What source does solar power generate electricity from?
2. Did the Apple iPhone first become available in 2005, 2006 or 2007?
3. In computing terms what does CPU stand for?
4. Is it true that Nintendo was founded after the year 1900?
5. What American astronomer is the Hubble Space Telescope named after?
6. Is the wavelength of infrared light too long or short to be seen by humans?
7. Firefox, Opera, Chrome, Safari and Explorer are types of what?
8. Is it true that gold is not a good conductor of electricity?
9. What car company made the technologically advanced humanoid robot ASIMO?
10. Is it true that atomic bombs work by atomic fission?
11. In computing terms what does ROM stand for?
12. Did the original Sony Playstation use CDs or cartridges to play games?
13. What is the Earth's primary source of energy?
14. IBM is a well known computer and information technology company, what does IBM stand for?
15. Who helped Bill Gates to found Microsoft?
16. What science fiction writer wrote the three laws of robotics?
17. Is it true or false that in computing, keyboards are used as input devices?
18. What does the abbreviation WWW stand for?
19. Nano, Shuffle, Classic and Touch are variations of what?
20. Is it true or false that DNA is an abbreviation for 'Deoxyribonucleic acid'?

Quiz Answers 1. The Sun 2. 2007 3. Central Processing Unit 4. False - 1889 5. Edwin Hubble 6. Long 7. Web browsers 8. False 9. Honda 10. True 11. Read Only Memory 12. CDs 13. The Sun 14. International Business Machines 15. Paul Allen 16. Isaac Asimov 17. True 18. World Wide Web 19. The Apple iPod 20. True

Ex. 10. In 2007 there was an international conference on nanoproducts and nanotechnologies. Skim the text and say what aspect(s) of nanotechnology the conference was devoted to.

Nanomaterials summit

Report(er)	Extract from the report
The Royal Society and Royal Academy, UK	There are uncertainties about the potential effects of nanoparticles and nanotubes on human health and the environment.
Prof. Ann Dowling, UK	Nanoparticles can behave quite differently from larger particles of the same material. We must know both the positive and negative effects they might have.
John Howard, Head of the Government's safety research body,	Research over the past few years has shown that nanometre-diameter particles are more toxic than larger particles.
The Insurance company, Sweden	Nanoparticles must be handled with the same care as certain bio-organisms or radioactive substances.
Dr Wiesner, Rice University, US, Texas,	Carbon nanotubes resemble asbestos fibres in shape: they are long and needle-like.
Vyvyan Howard, toxicopathologist, UK	Nano-tubes produce more toxicity in rats than quartz dust and they can get into the blood and brain in humans, and gold nano-particles can move from mother to her future child.
Prof. Jim Thomas, Oxford	The US and other regulatory agencies are "privately admitting they have made a mistake in letting nanoproducts onto the market without safety studies".
Environment and Health News	Governments on both sides of the Atlantic agreed that current safety and health regulations may not be adequate for nanomaterials. But they are already at least one decade late: nanotech products are already on the market and laboratory workers and consumers are already being exposed to nanoparticles.
Environment and Health News	There is a tradition to ignore early warnings. The examples are tobacco, atomic power, radiation, and the biggest industrial killer of all time, asbestos.

Ex. 11. Role play.

Work in two groups. You are going to issue a scientific edition of newspaper devoted to environmental engineering. The project for discussion in this newspaper is "*The first vertical forest park*". Having combined ecology, design and architecture, engineers decided to equip the walls of the buildings live trees. One group is pros, the other cons the project. It has several stages, discuss the the possibility of the following:

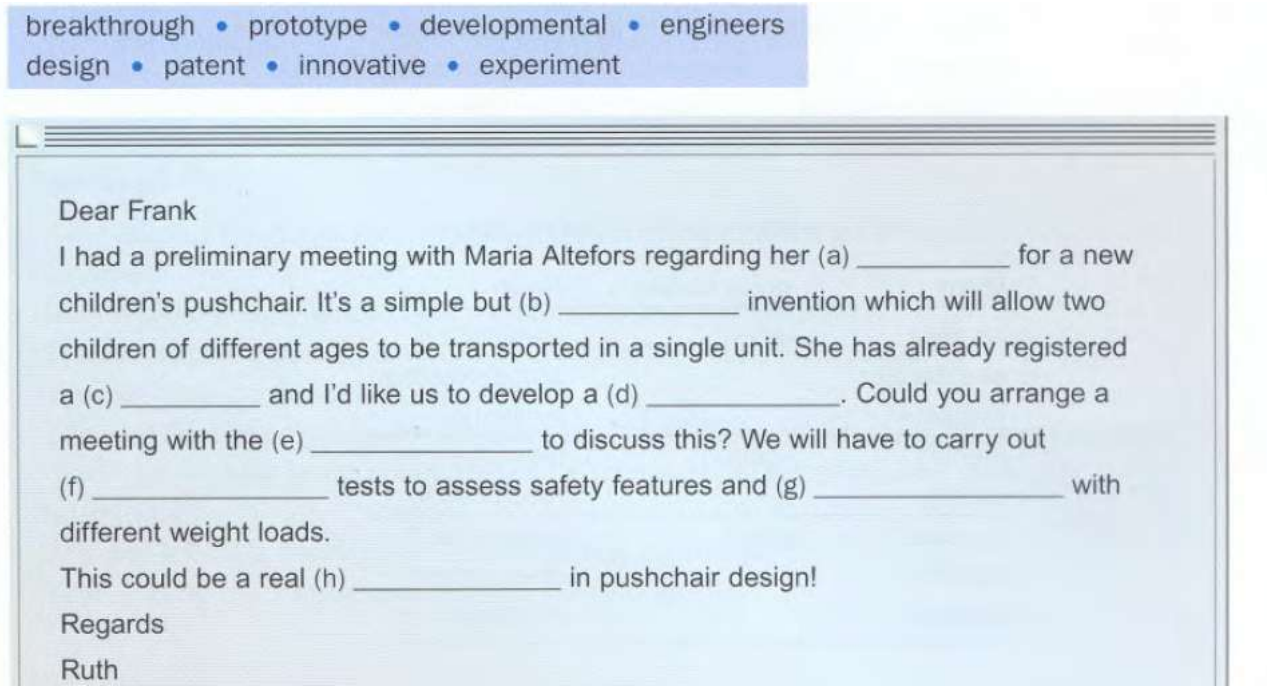
- to plant trees on every 6th floor of a new 35-storey building,
- each of these trees can grow up to 10 meters,
- trees will be planted in a special deep boxes to form roots in such conditions,
- each tree improves the exterior of the building,
- each tree cleans oxygen and provides needed shade on hot days,
- engineers decided to establish a special reflective glass to accumulate and store solar energy for trees,
- drain sewage system will capture and accumulate rainwater to water the "air" gardens,
- the temperatures support system, installed in every garden, pumps water only to six floors, three floors above and three floors below,
- a short pipeline system minimizes the loss of water heating and cooling,
- in this building there will be offices, shops and 154 apartments.

UNIT 8
Ways of saving materials

Warming up

Ex. 1. Think of how can materials saving problems be related to our life?

Ex. 2. Complete the following letter using the words from the list.


breakthrough • prototype • developmental • engineers
design • patent • innovative • experiment

Dear Frank

I had a preliminary meeting with Maria Altefors regarding her (a) _____ for a new children's pushchair. It's a simple but (b) _____ invention which will allow two children of different ages to be transported in a single unit. She has already registered a (c) _____ and I'd like us to develop a (d) _____. Could you arrange a meeting with the (e) _____ to discuss this? We will have to carry out (f) _____ tests to assess safety features and (g) _____ with different weight loads.

This could be a real (h) _____ in pushchair design!

Regards

Ruth

Ex. 3. Words to be remembered.

reuse – повторно использовать
breakthrough – открытие
pellet – гранула, крупинка
billet – брусок, заготовка
admissible stress – допускаемое напряжение
torque – изгибающий момент
expenditures – расходы
antifriction layer – антифрикционный слой
welded part – сварная деталь
blank – прессованная заготовка
fatigue damage – усталостное повреждение
unification – объединение
liners – втулка
rigidity – жесткость, крепость
recycle – перерабатывать
raw material – сырье
steel bloom – стальная заготовка
process – обрабатывать
finish-ground – отшлифованный начисто
chips – крошка, гранулят
reliability – надежность
maintenance – поддержание, сохранение
rolled – катаный
handling equipment – погрузочно-разгрузочное оборудование
plastic deformation – пластическая деформация
increase – повышать, увеличивать
waste metal – отходы металла
vibration failure – вибрационное разрушение

Ex. 4.Decide whether the sentences below are true or false, and correct the false sentences.

1. Raw materials are often intended to be melted or mixed.
2. Powder particles are smaller than pellets.
3. Pellets do not require further processing.
4. A steel bloom is a type of ingot.
5. Steel billets can be cut into smaller sized pieces called blooms.

Reading

Ex. 5. Skim the text and expresses your own point of view about ways of saving materials. Define if the statements after it are true or false.

Ways of saving materials

There are several principal ways to save engineering materials.

1. Making more accurate calculations and increasing failure resistance. The mass of parts should be estimated on the basis of the admissible stress.

2. Choice of optimal types of parts and their design features. For example, welded parts require from 15 to 20% less metal than the corresponding riveted ones.

3. Choice of optimal parameters of parts and units (design speeds, design stress, etc.). It is well-known that the dimensions of machines and units are determined by the torque and not the power transmitted. Hence if the rotational speed of a unit is increased, its mass can be greatly reduced for the same power.

4. Choice of optimal materials and their heat treatment, the application of surface hardening and the use of bimetallic and nonmetallic parts. Hardening, for example, enables the admissible stresses for toothed gears and similar parts to be almost doubled. By making bimetallic liners with a thin antifriction layer (instead of liners from antifriction metal), the expenditures for antifriction materials can be reduced to a small fraction of the previous amount.

5. Reducing the mass of blanks, designing parts of shapes that are close to those of the simplest and cheapest blanks, using blanks in the form of tubing, rolled, finish-ground materials, etc. Reducing the mass of blanks is no less important than that of finished parts. It is known that the

utilization factor for metals in the engineering industries is extremely low (in lot production, for instance, it ranges from 0.5 to 0.7, and in mass production, from 0.75 to 0.8).

The selection of the rational blank for certain parts enables to reduce the waste metal in the form of chips.

Great role in materials saving is played by standardization and unification of products and technological processes. Standards make it possible to ensure quality, safety, and reliability as well as the optimal number of products and their dimensions. Unification of machine parts results in their interchangeability, in efficient maintenance and repair of machines.

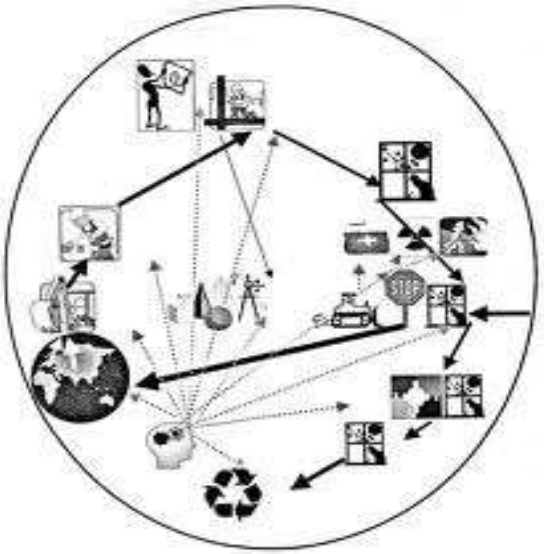
Ex. 6. Are these statements True or False? Correct the false ones.

1. The utilization factor for metals may be increased by the rational choice of blanks.
2. The simpler the blank shape, the less material is needed for its production. Admissible stress should not be taken into account when designing a machine part.
3. Unification of machine parts is impossible without standardization.
4. The less the rotational speed of a unit, the less is its mass.
5. Interchangeable parts and units can give great saving of structural materials.
6. The cost of a riveted part is the same as that of a welded one.
7. In mass production the cost of a part is higher than that in a lot production.
8. Heat treatment is one of the technologies to increase failure strength of materials.
9. The selection of the rational blank for certain parts enables to reduce the waste metal.
10. The utilization factor for metals is not associated with wastes.
11. One of the reasons of using nonmetallic materials is to increase failure resistance of machine parts.

Ex. 7. Skim text and explain the difference between the terms: a) scrap – waste – refuse b) recycling – deposition. Support your ideas by examples.

The materials cycle

For the application of materials, their quality, safety and reliability as constituents of products and engineered components and systems are of special importance. In this context the materials cycle is very important.



The picture illustrates that all materials (accompanied by the necessary flow of energy and information) move in cycles through the techno-economic system: from raw materials to engineering materials and technical products, and finally, after the termination of their task and performance, to deposition or recycling.

Materials for machine parts are chosen so that they could meet (a) the required reliability of the parts over their specified service life and (b) economic factors and manufacturing conditions. It should be pointed out that the cost of materials constitutes a considerable part of the cost of the machine, for instance, 65 to 70 per cent in automobiles and 70 to 75 per cent in materials handling equipment. The main reasons for equipment failure include fatigue damage, plastic deformation, low rigidity, and vibration failure. From the materials cycle, which applies to all branches of technology, it is obvious that materials and their properties are of critical importance for the performance of technical products.

Ex. 8. Give the summary of this text in English.

Способы хранения материалов и готовых изделий должны согласовываться с пожарной охраной и органами санэпиднадзора. Способы хранения материалов разных видов и изделий различны, как правило, устанавливаются техническими условиями на эти материалы и изделия.

Площади кладовых и складских помещений должны соответствовать запасу материалов и готовых изделий, обеспечивающему нормальный технологический процесс производства. Способы хранения материалов, готовых изделий должны быть согласованы с пожарной охраной. Склады должны иметь достаточные размеры, обеспечивающие возможность свободного доступа к предметам и материалам, хранящимся в них. Это может быть достигнуто двумя путями: а) соответствующей обработкой материалов перед употреблением их в дело и б) выбором рациональных конструктивных решений. Немаловажную роль при этом играют и способы хранения материалов и конструктивных деталей на складах и строительных площадках.

Writing

Ex. 9. Summarize what is said on *Materials cycle, applies to all branches of technology*

Speaking

Ex. 10. Working in pairs make up dialogues using the following words and combinations.

materials saving, unification of machine parts, to save engineering materials, several principal ways, technical products, manufacturing conditions, optimal parameters of parts and units.

Ex. 11. Comment on the following quotation: "*There is the possibility that the future of nanotechnology is very bright, that this will be the one science of the future that no other science can live without. There is also a chance that this is the science that will make the world highly uncomfortable with the potential power to transform the world".*

Try to use the phrases expressing opinions:

- I suppose
- In my opinion
- To my mind
- I personally think
- You could be right, but I…

- I am sorry, but I can't agree with you
- Yes, I agree with you, but on the other hand…
- I am afraid I'm not of the same opinion

Ex. 12. Role play. Imagine you are an engineer or a designer, speak about positive and negative features of materials saving.

UNIT 9
Health and Safety

Warming up

Ex. 1. What comes to your mind when you see such a picture?

Ex. 2.Choose the correct word in each sentence.

1. Store container s in a *well-ventilated/good-ventilated* place
2. Wipe up any spillages immediately and *wash/rinse* with soapy water.
3. Process cooling water can be *returned/recycled*.
4. This chemical is *toxic/intoxicating* if swallowed.
5. Leftover chemicals should be *disproved/disposed* of safely.
6. Please wear protective gloves when *fingering/handling* this material.
7. Remember that asbestos fibres can cause *cancer/coma*.
8. Pregnant women should not take this medicine as it may cause birth *defects/effects*.
9. Increased levels of radiation may lead to *compared/impaired* fertility.
10. Do not empty chemical paint products into the *drains/grains*.
11. *Protect/ Avoid* contact with skin and eyes.

12. Do not use with other products as it may release dangerous *fumes/fumigation*.

Ex. 3.Complete the following sentences with a form of the word in brackets.

1. When working in this area, please wear … clothing (protect).
2. Don't pour used chemicals into the drains as they will cause …. (contaminate).
3. Heating this liquid may cause an … (explode).
4. These chemicals must be kept in a locked cupboard because they are … (harm).
5. While they repair the roof, we will close this department as a measure … (precaution).
6. Health … is one part of Health and Safety (occupation).
7. Working in a noisy factory without ear protectors is a … activity (danger).
8. Petrol and oil are … chemicals (flame).
9. Make sure the container s are closed … (tight).
10. Make sure you are wearing breathing equipment before starting … (fume).

Ex. 4. Words to be remembered.

toxic – токсичный	intoxicating – опьяняющий
wash – мыть, промывать	rinse – полоскать
disproved – опровергнутый	disposed – распределенный
compared – сравниваемый	impaired – ослабленный
drains – сточные трубы	grains – крупинки
defects – дефекты	effect – воздействие
explode – взрывать	dizziness – головокружение
tight – тугой, плотный	combustion – горение
grinding – шлифовка	vomiting – тошнота
occupational health – менеджмент охраны труда	precautionary – профилактический
drowsiness – дремота	seal – изоляция

Reading

Ex 5. Read the text and answer the questions after it:

The average person finds it difficult to assess risks. For this reason, work practices need to be regulated. Examples of dangerous activities are:

- welding or grinding without goggles;
- working on a construction site work without a hard hat;
- working in noisy factories, cabs, on airport tarmacs and with outdoor machinery without ear protection;
- working in chemical areas without protective clothing;
- smoking near hazardous substances.

Without regulation some employees will take risks. Health and safety is a part of employment (labour) law. It covers general matters such as:

- occupational health;
- accident prevention regulations;
- special regulations for hazardous occupations such as mining and building;
- provisions for risks such as poisons, dangerous machinery, dust, noise, vibration, and radiation;
- the full range of dangers arising from modern industrial processes, for example the widespread use of chemicals.

1. What are the examples of dangerous activities?
2. What is health and safety part about in labour law?
3. How can employees minimize risk?

Ex 6. The manager in charge of health and safety is explaining things to some new employees. Complete what he says by filling the blanks with the correct word from the box.

noise • protection • drowsiness • dust • accidents • smoke • poisonous • fumes • risks • burns • goggles

MANAGER: New government regulations mean that we are all required to be more aware of (a) _____ in the workplace. As your employer, we will provide you with the necessary safety equipment. You must wear (b) _____ to protect your eyes when working on this machinery. You should also wear ear (c) _____ because the (d) _____ from the machines is high enough to cause damage to your hearing. And of course, there is a lot of (e) _____ in the air, so please wear masks to stop you breathing it in. But, you too are responsible for your safety and for preventing (f) _____ happening.

EMPLOYEE: Are we looking at fire risks?

MANAGER: Yes, of course. Remember that it is very dangerous to (g) _____ near the chemical store. In fact, we have a no smoking policy throughout the company. Chemicals themselves are, of course, (h) _____ so they should never enter your mouth. They could cause (i) _____ if you get them on your skin. If you leave them without a lid, (j) _____ may escape and cause headaches, (k) _____ or dizziness.

Ex. 7. Study the safety instructions from a workshop below and answer the questions:
Who are the instructions for?
Who wrote them?
What was the writer's purpose?

1 Wear protective clothing all times.

2 Always wear eye protection when operating lathes, cutters, and grinders and ensure the guard is in place.

3 Keep your workplace tidy.

4 The areas between benches and around machines must be kept clear.

5 Tools should be put away when not in use and any breakages and losses reported.

6 Machines should be cleaned after use.

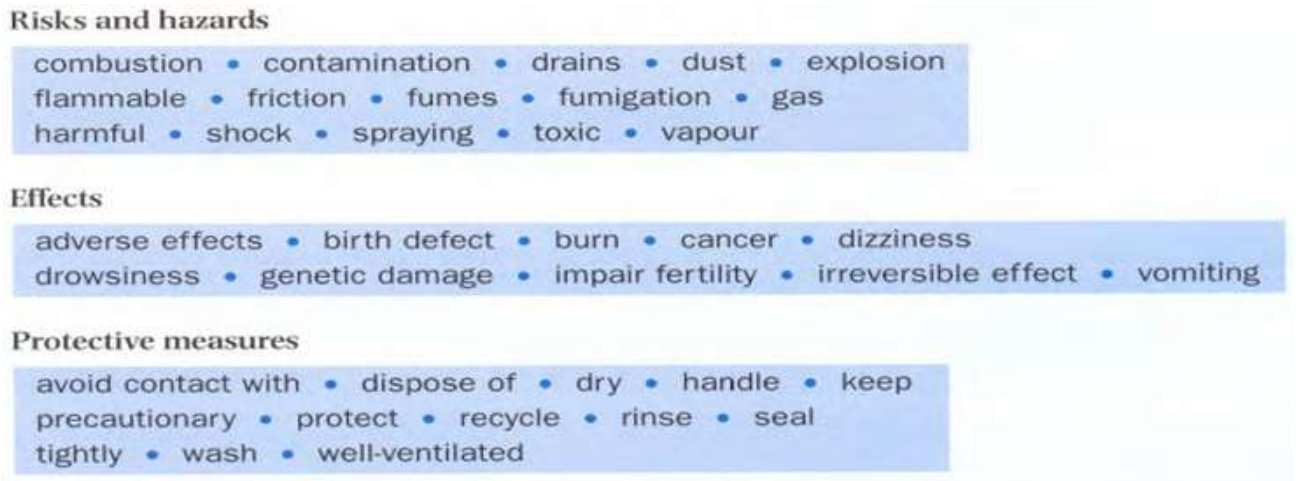
Writing

Ex. 8. Summarize what is said on *the potential dangers in the laboratory, workshop or place of work. How is the risk of these hazards reduced?*

Speaking

Ex. 9. Discuss the information of the chart. Try always to show your own opinion and your experienced knowledge.

The key concerns for health and safety are to assess the *risks* and *hazards* by identifying and quantifying the *effects* so that appropriate *protective measures* can be taken.



Ex. 10. Study this list of unsafe environmental conditions (hazards). Compose safety rules to limit these hazards using the methods given above. For example:

inadequate lighting

Lighting must be adequate.

Or

Lighting should be adequate.

1 uneven floors
2 unguarded machinery
3 untidy workbenches
4 untidy workplaces
5 badly maintained machinery
6 carelessly stored dangerous materials
7 inadequate ventilation
8 damaged tools and equipment
9 machinery in poor condition
10 equipment used improperly
11 equipment operated untrained personnel
12 apprentices working without supervision

UNIT 10
Ecological problems

Warming up

Ex. 1. What comes to your mind when you look at this picture? How does it refer to the topic?

Ex. 2. Do you agree or disagree with these ideas? Discuss your answers with a partner.

1. It is not necessary to educate people on the issue of protecting the environment.
2. Cooking the gas is more environmentally friendly than cooking the electricity.
3. Consumers should be obliged to buy only energy-saving electrical equipment.
4. Fossil fuel power plants should be totally replaced by ones using renewable sources.
5. A speed limit 90 km/h should be established throughout the country to conserve oil stocks.
6. People should be encouraged to use public transport and not to use their cars.
7. All houses and buildings should be checked each year for the energy efficiency.

8. A massive green tax should be put on long-distance air travel to protect the environment.

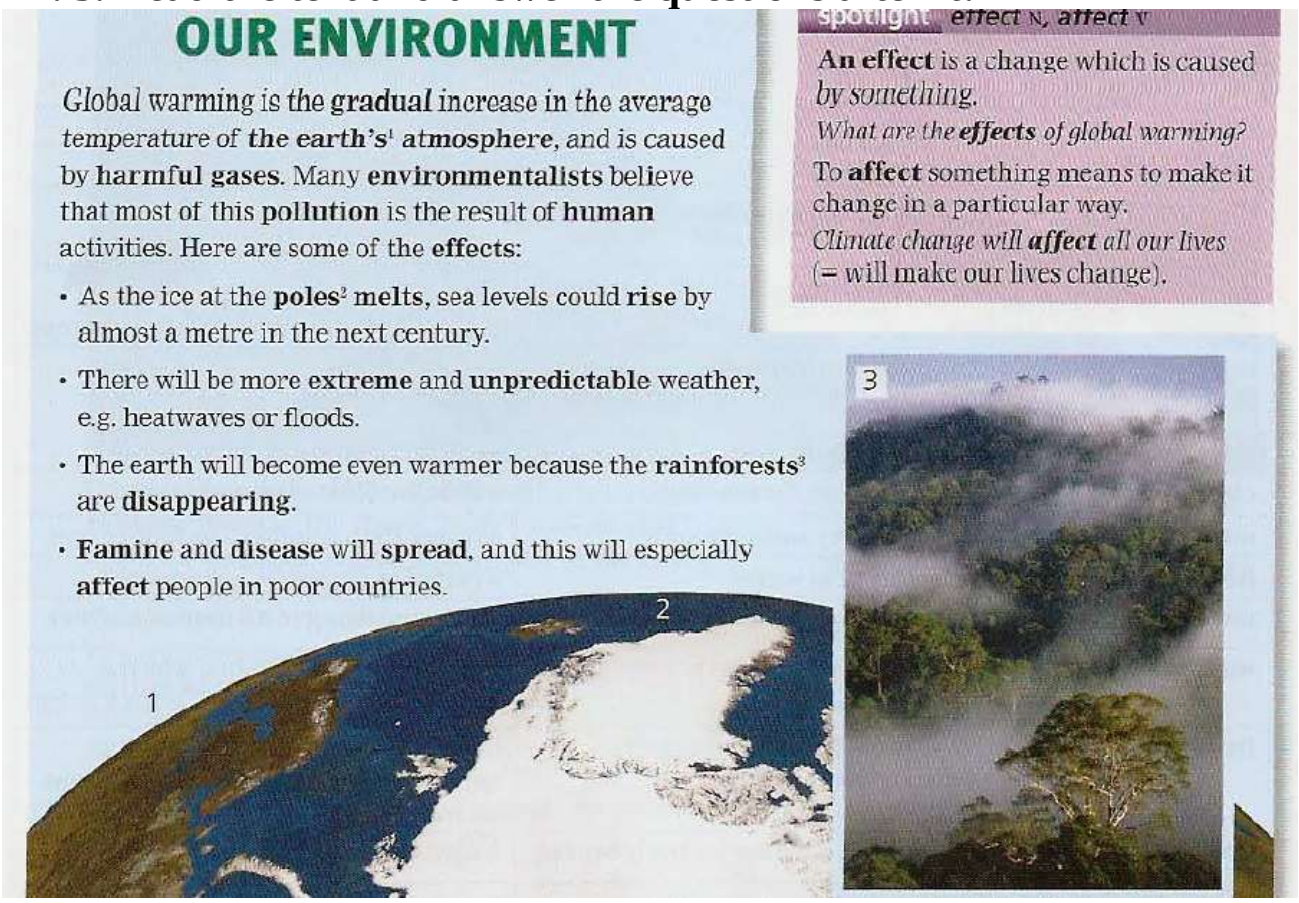
Ex. 3. Words to be remembered

arable land – пахотная земля
bulk – большая часть
cancer rate – заболеваемость раком
catalytic converter – каталитический преобразователь
leach – просачиваться
lead exposure – отравление свинцом
kidney – почка
per capita на – душу населения
refinery – нефтеперерабатывающий завод
waste – отходы
emissions – выбросы
power plant – электростанция
greenhouse – effect парниковый эффект
incinerator – завод, сжигающий мусор
run-off – сток
fuel consumption – потребление топлива
puddle – лужа, грязь
raw material – сырье
industrial – discharges промышленные стоки
tar – гудрон

Ex. 4. There are currently many problems with the environment. Match two halves of the sentences.

1 Global warming means that		**A** pollute the air in most cities.
2 Heavy traffic and exhaust fumes		**B** which is taken to landfill sites.
3 The emissions produced by factories		**C** have caused serious flooding.
4 The pesticides used on crops in the countryside		**D** create acid rain which destroys crops.
5 Heavy rain and rising water levels in rivers		**E** the weather is becoming hotter and drier.
6 Most households produce large amounts of waste		**F** are dangerous to birds and other wildlife.

Ex. 5. Read the text and answer the questions after it:



OUR ENVIRONMENT

Global warming is the **gradual** increase in the average temperature of **the earth's**[1] **atmosphere**, and is caused by **harmful gases**. Many **environmentalists** believe that most of this **pollution** is the result of **human** activities. Here are some of the **effects**:

- As the ice at the **poles**[2] **melts**, sea levels could **rise** by almost a metre in the next century.
- There will be more **extreme** and **unpredictable** weather, e.g. heatwaves or floods.
- The earth will become even warmer because the **rainforests**[3] are **disappearing**.
- **Famine** and **disease** will **spread**, and this will especially **affect** people in poor countries.

spotlight *effect* N, *affect* V

An effect is a change which is caused *by something.*
What are the ***effects*** *of global warming?*

To **affect** something means to make it change in a particular way.
Climate change will ***affect*** *all our lives* (= will make our lives change).

1. What are the reasons of global warming?
2. What are the effects of global warming?
3. How can we stop global warming?
4. How climate change will affect our lives?

Ex. 6. Look through the information about the environmental initiative of Ford and answer the questions given below the text:

The environmental initiative

The protection of our world and its resources has become a vitally important issue to us all.

Ford has been recycling automotive materials since the 1920s and continues to produce motor vehicles with due concern for their impact upon the environment, and for conserving and safeguarding the earth's natural resources.

Recycling

The Ford Vehicle Recycling program is focused on the disposal of cars, (crashes in which a vehicle rolled over accounted for 28 % of all passenger-vehicle accident deaths) which have reached the end of their

useful lives. The challenge is to direct all materials contained within the vehicles into positive applications, so preserving natural resources.

Ford has begun a program to reduce vehicle disassembly times, develop material, chemical and energy recovery technologies, and communicate with car manufacturers and automotive legislators (законодатели) worldwide to help enable Ford to develop a 100 per cent recyclable vehicle.

In 1991, Ford opened a pilot disassembly plant at the Cologne-Niehl factory. Its primary purpose is to gather and evaluate recycling data. From there, optimised disassembly techniques can be developed for the removal of automotive materials and fluids for recycling. Work at the plant has led to recommendations for design changes to Ford cars and will make the task of dismantling and recycling easier and more ecologically effective in the future.

Already, recycled material of old cars is used by Ford. Over 95 per cent of metals can be recovered for reuse. Development research is being carried out to ensure that in the future plastics, glass, rubber and textiles can also be recovered. An identification system for the twelve different types of plastic used in vehicle manufacture is also being developed in order that they can be more readily separated for recycling in the future.

Vehicle Design and Production

Environmentally conscious (сознательный, здравый) developments are made during the design process. Design guidelines (генеральные линии, установки) relating to materials selection and assembly methods in the production of vehicles are continually evolving to ensure that Ford cars have maximum recyclability. The use of recycled materials in the production of Ford cars is also central to the Ford's policy. Ford's commitment (обязательство) to the environment is such that when we cannot recycle the material in the manufacturing process it undergoes thermal treatment at exceptionally high temperatures to generate energy to fuel our production processes.

The Ford Exchange Parts program

Ford has been active in the remanufacturing of major components almost since it began building vehicles. Remanufactured components are sold on for as little as half the original price as an alternative to new parts replacement. Remanufacturing, unlike reconditioning, means to effectively build again to the original high specifications and quality.

Design, development, production engineering and manufacturing departments are all deeply involved in setting the standards of materials,

process procedures, investment, tooling and quality control management for the remanufacturing cycle.

All parts in the Ford Exchange Plan are as efficient, durable, powerful and reliable as those fitted to new vehicles on the production line. They are manufactured in purpose-built factories, using the very latest engineering and testing techniques.

Used units are first dismantled, then passed through a chemical washing process to clean thoroughly all potentially re-usable components. Meticulous (тщательный) checking for flaws (изъяны, брак) or damage then identifies those components which are suitable for re-use.

Ex. 7. Answer the questions.

1. When did Ford begin to recycle automotive materials?
2. How does the Ford Vehicle Recycling Program preserve natural resources?
3. What can be recycled?
4. How can recycled materials be used?
5. What are the stages of used units testing?
6. What is the main purpose of Ford Company's research?

Writing

Ex. 8. Summarize what is said on *Ecological problems of the world.*

Speaking

Ex. 9. Agree or disagree. Try to prove your opinion.

1. Motor cars did not bring any social or economic benefits.
2. The car industry is the largest in the world economy.
3. Global car fleet growth was accompanied by a decrease of fuel consumption.
4. The widespread use of cars does not produce any environmental problems.
5. The motor car industry requires a vast quantity of raw materials.
6. Car engines use 80 % of energy in fuel.
7. Car exhausts do not contain harmful substances.
8. Developed countries are responsible for the largest share of carbon dioxide emissions.

9. There is no use to run your car on unleaded gasoline, because lead is absolutely harmless.
10. Towns with oil refineries have the highest cancer rates.
11. Roads use up large areas of arable land.
12. People have been encouraged to use cars by the changed design of cities.
13. People do not protest against the expanded use of cars.

Ex. 10. Say which of the following is not true?

(A) Crude oil is found below land and water.
(B) Crude oil is always found a few hundred feet below the surface.
(C) Pumping and pressure force crude oil to the surface.
(D) A variety of petroleum products is obtained from crude oil.

Many thousands of hydrocarbon compounds are possible because

A) the petroleum products vary greatly in physical appearance.
B) complicated refining processes rearrange the chemical structure.
C) the two atoms in the molecule assume many positions.
D) the pressure needed to force it to the surface causes molecular transformation.

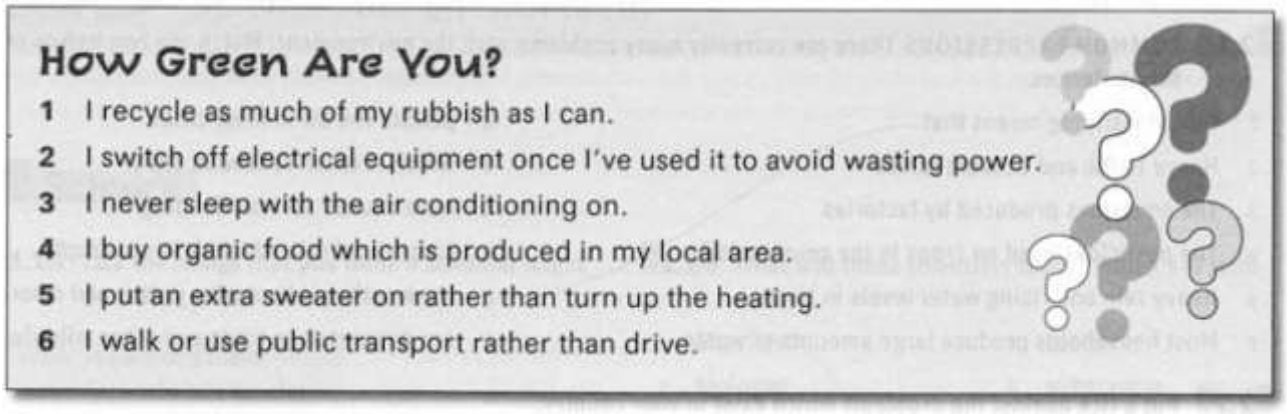
Which of the following is true?

A) The various petroleum products are produced by filtration.
B) Heating and condensation produce the various products.
C) Chemical separation is used to produce the various products.
D) Mechanical means such as the centrifuge are used to produce the various products.

How is crude oil brought to the surface?

A) expansion of the hydrocarbons
B) pressure and pumping
C) vacuum created in the drilling pipe
D) expansion and contraction of the earth's surface

Ex. 10. What can all do something to help the environment. Mark the sentences below true or false for you.



How Green Are You?

1 I recycle as much of my rubbish as I can.
2 I switch off electrical equipment once I've used it to avoid wasting power.
3 I never sleep with the air conditioning on.
4 I buy organic food which is produced in my local area.
5 I put an extra sweater on rather than turn up the heating.
6 I walk or use public transport rather than drive.

Ex. 11. Role-play.

A. You are recruiting a manager try to persuade a specialist to join your safety security company.
B. You are an environmental engineer try to be hot to get for the company.

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TECHNICAL ENGLISH IN USE
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и самостоятельной работы студентов

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