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ПРОФЕССИОНАЛЬНЫЙ ИНОСТРАННЫЙ ЯЗЫК (АНГЛИЙСКИЙ)
Часть 1

для студентов
направления 13.03.01 «Теплоэнергетика и теплотехника»

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CONTENTS

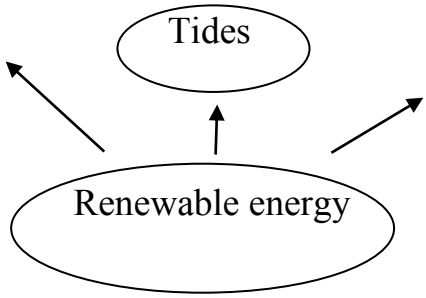
UNIT 1

WHAT IS ENERGY?

Texts: Renewable energy.
Grammar revision: Tenses in Active and Passive Forms.
Types of questions.

LEAD-IN

1. What main resources of renewable energy do you know?



2. What do you think are the main advantages of using renewable energy technologies?

Complete the sentence:
In my opinion, the best kind of alternative energy is….
Give at least three reasons to support your opinion.

3. Study new word combinations and definitions.

a)

renewable	восстановимый, возобновляемый
Photovoltaic (PV)	фотогальванический
consumption	потребление; затрата, издержки
share	доля; делить, распределять
capacity	мощность, нагрузка, производительность
weather	способность подвергаться атмосферным влияниям; переносить, выдерживать, переживать (бурю, натиск, испытание)
derive	получать, извлекать
conventional	обычный, обыкновенный, традиционный
windmills	ветряк, ветродвигатель; ветроэнергетическая установка
blade	лопасть (винта пропеллера, весла и т.п.)

aerofoil	аэродинамическая поверхность; профиль (крыла) крыло
shaft	вал, ось, шпиндель
rim	обод (внешняя цилиндрическая поверхность)
concave	вогнутый
untapped	неиспользованный, нетронутый
untapped resources	неиспользованные ресурсы
paramount	главный, основной, первостепенный
thermocouple	термоэлемент, термопара; термостолбик
circuit	цепь, контур; схема
semiconductor	полупроводник
landfill	мусорная свалка
reduce	ослаблять, понижать, сокращать, уменьшать
carbon dioxide	углекислый газ
residue	осадок; отстой
waste	отходы (производства), потеря, убыль; убыток, ущерб
solar array	солнечная батарея, батарея солнечных элементов; солнечная панель
solar battery	солнечная батарея
solar cell	солнечный элемент

в)

biomass energy: An energy resource derived from organic matter. Many people use biomass energy to heat their homes; they burn wood. Many agricultural crops are also biomass. For instance, corn can be fermented to produce ethanol that is burned as a liquid fuel. Wood is a renewable energy source as long as cut trees are replaced immediately.

chemical energy: The energy stored on the chemical bonds of molecules that it released during a chemical reaction. Chemical energy holds molecules together and keeps them from moving apart. For example, a car engine uses chemical energy stored in gasoline, and moving people use chemical energy from food.

electrical energy: Electrical energy exists when charged particles attract or repel each other. Television sets, computers and refrigerators use electrical energy.

energy: The ability to do work.

kinetic energy: The energy of motion. For example, a spinning top, a falling object and a rolling ball all have kinetic energy. The motion, if resisted by a force, does work. Wind and water both have kinetic energy.

light energy: Visible light energy, such as from a light bulb or fireflies or stars, is just one form of electromagnetic energy. Other forms include infrared and ultraviolet light.

mechanical energy: Mechanical energy is energy that can be used to do work. It is the sum of an object's kinetic and potential energy.

nonrenewable energy: Energy from sources that are used faster than they can be created. Sources include oil (petroleum), natural gas, coal and uranium (nuclear).
nuclear energy: Nuclear energy is the energy found inside the nucleus of atoms and can only be released when atoms are split. Some power companies that supply homes, schools and buildings with electricity use nuclear energy to generate electricity.
potential energy: Potential energy is the energy stored by an object as a result of its position. A roller coaster at the top of a hill has potential energy.
renewable energy: Energy that is made from sources that can be regenerated. Sources include solar, wind, geothermal, biomass, ocean and hydro (water).
sound energy: Audible energy that is released when you talk, play musical instruments or slam a door.
thermal energy: Heat energy produced when the molecules of a substance vibrate. The more heat a substance has, the more rapid the vibration of its molecules. Heat energy flows from places of higher temperature to places of lower temperature.

READING

Text 1

4. Read the text about Renewable energy. For questions 1–6, choose the right letter A, B, C or D.

RENEWABLE ENERGY

Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat. It is derived from natural processes that are replenished constantly. Included in the definition is electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, and biofuels and hydrogen derived from renewable resources. Renewable energy replaces conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services. About 16 % of global final energy consumption comes from renewables. The share of renewables in electricity generation is around 19 %.

Wind power is widely used in Europe, Asia, and the United States. Solar thermal power stations operate in the USA and Spain, and the largest of these is the 354 MW SEGS power plant in the Mojave Desert. The world's largest geothermal power installation is the Geysers in California, with a rated capacity of 750 MW. Brazil has one of the largest renewable energy programs

in the world, involving production of ethanol fuel from sugarcane that provides 18 % of the country's automotive fuel. Ethanol fuel is also widely available in the USA.

While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas, where energy is often crucial in human development. As of 2011, small solar PV systems provide electricity to a few million households, and micro-hydro configured into mini-grids serves many more.

Solar hot water makes an important contribution to renewable heat in many countries. In China most of these systems are installed on multi-family apartment buildings and meet a portion of the hot water needs of a growing number of households. The use of biomass and direct geothermal for heating continues to grow as well. Over 44 million households use biogas made in household-scale digesters for lighting and/or cooking. In Sweden, national use of biomass energy has surpassed that of oil. Renewable biofuels have contributed to a significant decline in oil consumption. The 93 billion liters of biofuels produced worldwide in 2009 displaced the equivalent of an estimated 68 billion liters of gasoline, equal to about 5 % of world gasoline production. United Nations' Secretary-General Ban Ki-moon has said that renewable energy has the ability to lift the poorest nations to new levels of prosperity. Climate change concerns, coupled with high oil prices, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization. New government spending, regulation and policies helped the industry weather the global financial crisis better than many other sectors. According to a 2011 projection by the International Energy Agency, solar power generators may produce most of the world's electricity within 50 years, dramatically reducing the emissions of greenhouse gases that harm the environment.

1) The largest solar thermal power station operates in …..
   A. California
   B. the Mojave Desert
   C. Brazil
   D. Europe
2) 18 % of automotive fuel in Brazil is produced from ….
   A. oil
   B. sugarcane
   C. ocean biomass
   D. greenhouse gases

3) Solar hot water systems in China are situated ….
A. in deserts
B. at the ocean coast
C. in small villages
D. on multi-family apartment buildings

4) Biofuels displace ….
A. solar energy
B. oil
C. ethanol
D. hot water

5) Solar power generators …..
A. can use automotive fuel
B. can increase oil prices
C. can cause climate change
D. can reduce the emissions of greenhouse gases

6) According to Ban Ki-moon, …..
A. renewable energy projects are large-scale
B. Brazil has one of the largest renewable energy programs
C. renewable energy is able to make poor countries the richest in the world
D. energy is crucial in human development

5. Answer the questions according to the text about renewable energy.

1. What is renewable energy derived from?
2. In what areas does renewable energy replace conventional fuels?
3. In what way are renewable technologies suited to rural and remote areas?
4. What are solar PV systems used for?
5. What is the share of renewables in electricity generation and energy consumption?
6. What kinds of fuels have contributed to a decline in oil consumption?
7. What are the advantages of using renewable energy technologies?

USE OF ENGLISH

6. Fill in the blanks, use the collocations from the box. The example is given.

a. wind energy
b. oil shortages
c. no air or water pollution
d. a renewed concern for the environment
e. higher costs for fossil fuels
f. the glistening blades of windmills
g. wind machines
h. negative impacts
i. power plants
j. they use sonar

WIND AND THE ENVIRONMENT

In the 1970s, 1 ***b. oil shortages*** pushed the development of alternative energy sources. In the 1990s, the push came from 2…… in response to scientific studies indicating potential changes to the global climate if the use of fossil fuels continues to increase. 3…… is an economical power resource in many areas of the country. Wind is a clean fuel; wind farms produce 4…. because no fuel is burned. Growing concern about emissions from fossil fuel generation, increased government support, and 5……. (especially natural gas and coal) have helped wind power capacity in the United States grow substantially over the last 10 years. The most serious environmental drawbacks to 6……. may be their negative effect on wild bird populations and the visual impact on the landscape. To some, 7….. on the horizon are an eyesore; to others, they're a beautiful alternative to conventional 8……. Another problem with wind turbines has been their 9…… on bats, which has been a complete mystery because unlike birds, bats are able to sense the rotating blades because 10….. One recent theory as to how turbines kill bats is that the pressure vortex created by the turbine creates enough strain on the bats weak lungs to make them explode.

7. Give Russian equivalents.

renewable energy, geothermal heat, conventional fuels, solar thermal power stations, an important contribution, the emissions of greenhouse gases, to pump water, to generate electricity, alternative energy sources, fossil fuels

8. Give English equivalents.

возобновляемые (альтернативные) источники энергии, солнечные электростанции, традиционная энергетика, современные технологии, ветряная мельница, жидкое топливо, проблемы окружающей среды, потребление электроэнергии и тепла, преимущества биоэнергетики, кинетическая энергия

9. Read the text and put the words at the end of each line into the correct form. The example is given.

1	Water power has been well known since its use in the 1. ***Egyptian***	*Egypt*
2	and classical Greek civilizations, and at the outset of the ….	industry
3	Revolution, it was …….used in Europe and the Americas	wide
4	to grind grain and run looms and in other small-scale ….	industry
5	processes. Today water power is by far the ……of all fossil,	cheap
6	nuclear, and renewable forms of energy for ……electricity,	produce
7	but the ecological …caused by hydroelectric dams have	disrupt
8	caused many ….. controversies. Ocean energy takes	environment
9	advantage of the ….of water in tides or waves or of the	move
10	temperature ……between sun-heated surface water and cold	differ
11	deep water. A few …energy projects have been built, but this	tide
12	form of energy…… is expensive and remains largely experimental.	produce

TRANSLATION

10. Translate from English into Russian.

1. Renewable energy is energy which comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat.
2. Solar power generators may produce most of the world's electricity within 50 years, dramatically reducing the emissions of greenhouse gases that harm the environment.
3. Renewable energy has the ability to lift the poorest nations to new levels of prosperity.
4. There are solar panels that generate electricity and those that absorb heat for hot water.
5. The oil shortages of the 1970s created an interest in alternative energy sources, paving the way for the re-entry of the windmill to generate electricity.

6. The concave surfaces channel wind toward the turbines, amplifying wind speeds by 50 percent or more.
7. Thermoelectric generator (TEG) is a device that converts heat into electricity.
8. Almost any heat source can be used to generate electricity, such as solar heat, ocean heat, geothermal heat, even body heat.
9. Russia has rich high and low temperature geothermal resources.
10. The gigantic concentration of people results in a multiple increase in the supplies of water, energy, and food to cities.

GRAMMAR REVISION

The Passive Voice and the Active Voice

	INDEFINITE	**CONTINUOUS**	**PERFECT**
PRESENT	I am invited	I am being invited	I have been invited
PAST	I was invited	I was being invited	I had been invited
FUTURE	I will be invited	не существует	I will have been invited

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

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

1. Mechanical engineering touches every aspect of life.
2. Experimental models attract young engineers.
3. He obtains his technical experience in the workshop.
4. The engineer showed the new machines.
5. Faraday made many discoveries.
6. The practical engineers will improve this heat engine.
7. The laboratory will study the problem.
8. The researchers are carrying out an experiment.

9. The mechanical engineers have invented a new device.
10. By the end of the year they had arranged two important conferences.

12. Open the brackets using verbs in the Passive Voice.

1. At the last competition the first prize (to win) by our team. 2. The question (to settle) as soon as they arrived. 3. Your report must (to divide) into two chapters. 4. Soon he (to send) to a sanatorium. 5. The book (to discuss) at the next conference. 6. The composition must (to hand) in on Wednesday. 7. Yesterday he (to tell) to prepare a speech. 8. The article (to publish) last week, if I am not mistaken. 9. The lectures (to attend) by all of us. 10. A taxi(to call) fifteen minutes ago, so we are expecting it any moment.

13. Fill in the following verbs in a proper form of the Passive Voice.

Arrest, wake, knock, check, translate, find, drive, make, spend, carry.

1. A decision will not _____ until the next meeting.
2. That old building was dangerous. So it _____ down.
3. When you go through customs, your luggage _____ by the customs officer.
4. In the morning I _____ by my alarm clock.
5. Next year her new book _____ into a number of foreign languages.
6. John kicked a policeman, so he _____.
7. After a long search the missing boy _____ in the forest near the town.
8. Many people think that today too much money _____ on arms.
9. The injured man couldn't walk, so he _____ by the hospital orderlies.
10. I don't mind driving but I like when I _____ by other people.

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

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

1. Our engineers work hard at this problem. (general)
2. They designed this instrument. (special)
3. People are going to use bicycles instead of cars. (alternative)
4. This plant will produce only tyres. (tag)
5. The car has crashed into the tree. (general)
6. The laboratory is provided with new equipment. (special)
7. Irrigation systems were devised by skilled technicians. (alternative)
8. The education and training of engineers must be a partnership between industry and higher education. (tag**)**

SPEAKING

15. Work in pairs, discuss the most environmentally-friendly forms of energy.

16. Work in groups. Energy Identifier: identify the type of energy that is related to each of the following items. You can use the prompts below.

Fan; Battery; Banana; Flashlight; Radio; Guitar; Candle; Waterfall

uses electrical energy;
produces kinetic energy;
a source of chemical energy;
the water has potential energy at the top of the falls and kinetic energy at the bottom of the falls;
uses chemical energy;
produces light energy;
uses electrical energy;
produces sound energy;
uses chemical energy from a person [energy from the food they eat];
produces sound energy;
produces light and thermal energy;
stores chemical energy.

WRITING

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

What is a Thermoelectric Generator?

Thermo generators are the devices that convert any sort of heat into electric energy. The process that allows this uses phenomenon known as the "Seebeck effect" or "thermoelectric effect". The reason why the idea of converting heat into energy is so appealing is that it allows greater efficiency in a lot of cases. Many of the devices that we use on a daily basis produce heat as a byproduct of using energy, so imagine what would be possible if some of that heat was actually converted back into energy! Even if it was just a small percentage, in the long run it would certainly add up and we'd be wasting a lot less energy than we normally do. There are two applications of such generators.

UNIT 2

HEATING

Text: Heat distribution systems.

Grammar Revision: Passive Voice.

LEAD-IN

1. What are the ways of heating the house?

2. Which of the following would you choose for your house? Why?

1. Heat pumps.
2. Furnaces and Boilers.
3. Wood and Pellet-Fuel Heating.
4. Electric Resistance Heating.
5. Active Solar Heating.
6. Radiant Heating.
7. Steam or water heating.

3. Study new vocabulary.

pump	насос
furnace	горн; очаг; печь
maintenance	содержание и техническое обслуживание, уход; текущий ремонт
generate	производить; генерировать, делать
consume	потреблять, расходовать
insulate (from)	изолировать; отделять от
bleed	продувать; спускать воду, опоражнивать баки; спускать лишнее давление
trim the amount of	сократить количество
dehumidify	осушать, сушить
duct	трубопровод; труба; туннель; канал
air duct	вентиляционный канал, воздуховод
retrofit	модифицировать (модель)
add-on	добавление, дополнение, приставка (позволяющая увеличить возможности технического устройства)
feasible	реальный, выполнимый
condenser	холодильник, конденсатор
conduit	трубопровод; водопроводная труба, изоляционная трубка
evaporator	испаритель

suspend (from)	вешать, подвешивать, свешиваться
heating	отопление
slab	плита; лист, пластина
surface	поверхность
concrete	бетон
radiant	излучающий
to radiate	распространяться, излучать (свет, тепло)
to circulate	циркулировать, двигаться по кругу; передвигаться в пределах ограниченного круга
to distribute	распределять
vent	входное или выходное отверстие; отдушина, воздушный клапан

READING

Text 1

4. Read the text and do the tasks below.

HEAT DISTRIBUTION SYSTEMS

Heat is distributed through a variety of ways. Steam heating is one of the oldest heating technologies, but the process of boiling and condensing water is less efficient than modern systems and suffers from lag times between the boiler turning on and the heat arriving in the radiators. The first central heating systems used steam distribution because steam moves itself through piping without the use of pumps. Non insulated steam pipes often deliver unwanted heat. Fiberglass pipe insulation that can withstand the high temperatures of these delivery pipes is very effective. Regular maintenance for steam radiators depends on whether the radiator is a one-pipe system (the pipe that supplies steam also returns condensate) or a two-pipe system (a separate pipe returns condensate). One pipe systems use automatic air vents on each radiator, which bleed air as steam fills the system and then shut automatically when steam reaches the vent. A clogged air vent will keep a steam radiator from heating up. Air vents can be cleaned by boiling them in a water and vinegar solution, but usually need to be replaced.

Steam radiators can also warp the floor and their thermal expansion and contraction over time can dig ruts into the floor. These effects can cause the radiator to tilt, preventing water from properly draining from the radiator when it cools and cause banging noises when the radiator is heating up. Shims should be inserted under radiators to pitch them toward the pipe or the steam trap in a two-pipe system. Older steam traps often stick in either the open or closed position, throwing off the balance in the system. The best ap-

proach is to replace steam traps in the system. Steam radiators located on exterior walls can cause heat loss by radiating heat through the wall to the outdoors. To prevent such heat loss, foil-covered cardboard reflectors should be installed behind these radiators. The foil should face away from the wall, and the reflector should be slightly larger than the radiator. Hot-water radiators are one of the most common heat distribution systems in newer homes. They may be a baseboard-type radiator or of an upright design. The most common problem in hot-water systems is unwanted air in the system. At the start of each heating season it is necessary to go from radiator to radiator and open each bleed valve slightly, then close it when water starts to escape through the valve. To save energy in hot-water systems it is necessary to provide separate zone control for different areas of the building. Automatic valves on the hot water radiators, controlled by programmable thermostats in each zone of the house will allow to heat and cool off portions of the house automatically.

5. Answer the questions.

1. What are the most common heat distribution systems?
2. What are the main disadvantages of steam heating?
3. What does regular maintenance for steam radiators depend on?
4. What can cause heat loss?
5. What is the main problem with hot-water radiators?
6. What are the ways of saving energy in hot-water systems?
7. Which of these systems is more effective from your point of view?

6. Complete the sentences.

1. The first central heating systems used …
2. Fiberglass pipe insulation that can…
3. In a one-pipe system the pipe that supplies steam …
4. Foil-covered cardboard reflectors …….
5. At the start of each heating season it is necessary to go from radiator to radiator and …..
6. Programmable thermostats in each zone of the house will allow…
7. Steam radiators located on exterior walls can cause heat loss….

USE OF ENGLISH

7. Match the words (1–10) with its definitions (a–j). The example is given.

1) ***furnace***	a) to spread throughout a given area
2) heating	b) a broad flat thick piece of wood, stone, or other material
3) slab	c) the process of becoming warmer; a rising temperature
4) surface	d) a strong hard building material composed of sand and gravel and cement and water
5) concrete	e) the outer or the topmost boundary of an object
6) radiant	f) to send out rays or waves
7) to consume	g) to use
8) to radiate	h) sending out rays of heat, light or carried, sent in the form of, or by means of, rays of heat, light
9) to circulate	i) to move through a space, circuit or system, returning to the starting point
10) to distribute	j) ***an enclosed chamber in which heat is produced to heat buildings***

8. Put the words into the correct form. The example is given.

1	A heat pump is a device that ***transfers*** thermal energy from a source to	transfer
2	a sink that is at a……. temperature than the source.	high
3	Thus, heat pumps move thermal energy in a……. which is	direct
4	……. to the direction of spontaneous heat flow. The heat pump uses	flow
5	some form of low entropy energy to accomplish the …….transfer of	oppose
6	thermal energy from source to sink. Compressor-driven air ……	desire
7	and……. are examples of heat pumps. However, the term "heat	condition
8	Pump" is more general and applies to devices which are …..	freeze
9	to heat a conditioned-space that must be…. than a cold environment.	warm
10	A heat pump can provide ……or cooling of a given conditioned-space.	heat

9. Complete the sentences with the missing words. Use the words from the box.

a) to heat a building
b) passing hot gases from a furnace
c) of making a building comfortably warm
d) the open fire, the fireplace, and the stove
e) by a fan
f) heated in a furnace
g) cooler air in the rooms
h) a boiler for heating the water
i) connecting pipes
j) metal enclosures containing hot-water pipes

Heating is a means of 1……..relative to a colder outside temperature. Old, primitive methods of heating a building or a room within it include 2….. In ancient Rome a heating system, called a hypocaust, warmed a building by 3….. through enclosed passages under the floors and behind the walls before releasing them outside. The principal modern systems that are used 4…. are classified as warm air, hot water, steam, or electricity. In the warm-air system air, 5….., rises through warm-air ducts and enters the rooms through outlets, while 6…. passes into return ducts that lead back to the furnace. The air circulates through the system by convection, i.e., the tendency of a fluid such as air to rise when warm and sink when cool. In newer buildings the circulation is assisted 7….. The hot-water system has 8….. that is sent through 9…. to radiators and convectors, the latter devices being 10…. surrounded by metal fins. The circulation is maintained by pumps or, in older buildings, by convection. (See F. Porges, Handbook of Heating, Ventilating, and Air Conditioning (1982).

10. Translate the sentences from English into Russia.

1. Heat pump technology has a vast potential for providing renewable energy and reducing energy consumption.
2. A heat pump is able to extract heat from the air, ground or water and concentrate it to provide heating for water or indoor areas.
3. The only energy required is that which is used to concentrate the thermal energy.
4. So the system can provide a heat output up to four times larger than the energy input.
5. A heat pump can potentially reduce heating costs by more than 50 %.
6. By reversing the process heat pumps can also be used for cooling during the summer.
7. Thus, a single system can produce space heating, space cooling and hot water.
8. Not only are heat pumps an efficient form of heating, but reserves of fossil fuels are finite.
9. Carbon dioxide emissions are continually contributing to climate change.
10. “Heat Pumps” are operational around the world, producing safe, reliable heating and cooling.

GRAMMAR REVISION

The Passive Voice

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

1. Robots can identify objects.
2. Modern engineering thinking has created new automated coal-digging complexes.
3. Raising the reliability certainly requires new technologies.
4. We need not merely manipulators.
5. The engineers are going to start producing new generations of machines.
6. The engineers have created machine-tool modules for flexible industries.
7. It will definitely increase productivity several times.
8. The scientists are searching for new highly efficient methods.
9. Unfortunately, it did not extend.
10. They improved the quality of the machine.

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

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

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

SPEAKING

14. Discuss in pairs different forms of heating. Talk about advantages and disadvantages of each type.

15. Work in groups, try to imagine a new form of heating.

WRITING

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

HEAT PUMPS FOR YOUR HOUSE

Heat pumps are an ingenious solution to providing your home with renewable heating capable of providing all of your hot water needs. Heat Pumps are not that common in Britain, whereas in Scandinavia they are used successfully in the majority of new builds, in Sweden alone, 97 % of all new housing projects use them as their source of heating. Why? Not only are they an efficient form of heating, but reserves of fossil fuels are finite and Carbon Dioxide emissions are continually contributing to climate change. The liquid which circulates within the heat pump, boils when it absorbs the outside ambient temperature, the gas created is then compressed which in turn gives it more heat energy, up to 70 ˚C. This heat is then passed through the Heat Exchanger which in turn heats the water used throughout the heating system. A heat pump is able to extract heat from the air, ground or water and concentrate it to provide heating for water or indoor areas.

Ground Source heat pumps are dependent on an area surrounding a property. The cheapest method for ground source heat pumps is a horizontal loop which requires a large surface area. If there isn't enough land available then a vertical closed loop system offers the same efficiencies; however a vertical loop is more expensive. A Water Source heat pump is most suitable when there is a water supply nearby, this could be a river, lake or a borehole. A water source is the most efficient form of heat pump. Air Source heat pumps can be installed anywhere where there is a constant access to outside air – on the ground outside, on a wall or even in a loft with ducting to the outside. Heat pump technology has a vast potential for providing renewable energy and reducing energy consumption and heating costs by more than 50 %.

By reversing the process heat pumps can also be used for cooling during the summer. Thus, a single system can produce space heating, space cooling and hot water.

SELF-STUDY

READING

Text 1

1. Read the text below and choose an appropriate answer for each statement.

1. The largest biomass energy resource now is
   A. wood
   B. oil
   C. coal
   D. industrial waste

2. Pyrolysis
   A. converts biomass into a gas
   B. filters gas before burning
   C. produces steam
   D. occurs when biomass is heated in the absence of oxygen

3. Most of the biopower plants
   A. turn biomass into a liquid
   B. burn bioenergy feedstocks directly to produce steam
   C. generate electricity at a capacity of 5 megawatts
   D. use the waste from livestock

4. Pyrolysis
   A. turns biomass into a liquid called pyrolysis oil
   B. can carry the gas
   C. burns bioenergy feedstocks
   D. releases the methane from the decaying organic matter

5. Microturbines
   A. work like refrigerators
   B. work like batteries
   C. work where there are space limitations for power production
   D. work like greenhouses

BIOENERGY

We have used bioenergy – the energy from organic matter – for thousands of years, ever since people started burning wood to cook food or to keep warm. And today, wood is still our largest biomass energy resource. But many other sources of biomass can now be used, including plants, residues from agriculture or forestry, and the organic component of municipal and industrial wastes. Even the fumes from landfills can be used as a biomass energy source. The use of biomass energy can greatly reduce our greenhouse gas emissions. Biomass generates about the same amount of carbon dioxide as fossil fuels, but every time a new plant grows, carbon dioxide is actually removed from the atmosphere. There are six major types of bio power systems: direct-fired, co firing, gasification, anaerobic digestion, pyrolysis, and small, modular. Most of the bio power plants in the world burn bioenergy feedstocks directly to produce steam. This steam is usually captured by a turbine, and a generator then converts it into electricity. In some industries, the steam from the power plant is also used for manufacturing processes or to heat buildings. These are known as combined heat and power facilities. For instance, wood waste is often used to produce both electricity and steam at paper mills. Many coal-fired power plants can use co firing systems to significantly reduce emissions, especially sulfur dioxide emissions. Gasification systems use high temperatures and an oxygen-starved environment to convert biomass into a gas (a mixture of hydrogen, carbon monoxide, and methane). The gas fuels what's called a gas turbine turns an electric generator. The decay of biomass produces a gas – methane. In landfills, wells can be drilled to release the methane from the decaying organic matter. Then pipes from each well carry the gas to a central point where it is filtered and cleaned before burning. Methane can be used as an energy source in many ways. It can be burnt in a boiler to produce steam for electricity generation or for industrial processes. Two new ways include the use of micro turbines and fuel cells. Micro turbines have outputs of 25 to 500 kilowatts. About the size of a refrigerator, they can be used where there are space limitations for power production. Fuel cells work much like batteries but never need recharging, producing electricity as long as there is fuel.

In addition to gas, liquid fuels can be produced from biomass through a process called pyrolysis. Pyrolysis occurs when biomass is heated in the absence of oxygen. The biomass then turns into a liquid called pyrolysis oil, which can be burned like petroleum to generate electricity. Several biopower technologies can be used in small, modular systems which generate electricity at a capacity of 5 megawatts or less. Farmers use the waste from their livestock to provide their farms with electricity. These systems also help farmers meet environmental regulations.

Text 2

2. Read the text and answer the questions.

1. How does radiant floor system work?
2. What are the benefits of radiant floor heating?
3. What are ultra-thin electric heating mats used for?
4. What is radiant energy transfer caused by?
5. Where does the radiant energy come from?

RADIATING FLOOR HEATING

Heating your home with a forced-air furnace is not your only option when you have concrete floors. You can save energy and create a healthier, more comfortable living environment by having the floor itself distribute the heat from the round up-via a radiant in-floor heating system. The science behind radiant floor heating is quite simple: tubes that circulate hot water or electrical heating elements are installed in the concrete slab turning the thermal mass of the concrete into an inconspicuous radiator of warm, even heat. Among the many benefits: your feet are always toasty warm, the temperature is consistent and easy to control, you will not feel the drafts or hear the noise of blowing air, and no dust or allergens get circulated within your home through air vents. Best of all, you will typically pay lower utility costs than with a forced-air system, because concrete floor radiant heating consumes less energy to achieve the same level of comfort.

What if you have an existing concrete floor? Radiant heating is still an option. Newer ultra-thin electric heating mats are available that can be embedded in thin-set cement or gypsum overlays, allowing retrofitting over existing slabs without significantly raising the floor height. Here is more information about what radiant in-floor heating is, how it works, the benefits of radiant heat and where to find installers.

What Is Radiant Floor Heating? What exactly is radiant energy? Here is an excellent description provided by the Radiant Panel Association which installs radiant floor heating: Hold your hand over a cup of coffee and feel the heat. The logical conclusion is that heat rises. Logical maybe, but incorrect!

"Hot air" rises but "heat" can travel in many directions. That is why you can feel the heat of the coffee cup when you place your hand to the side of it. Radiant energy transfer is caused by a warm surface giving up its heat to a cooler surface.

Consider how the sun (10,000 F) heats the earth (61 F). The sun radiates its energy towards the earth. The radiant energy is absorbed by the earth and is released as heat. A radiant floor heating system simply radiates heat upward from the floor to provide optimum comfort and many other benefits.

VOCABULARY AND GRAMMAR

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

1. If you visit someone, you always _____ for a few drinks.
   A. are staying
   B. stayed
   C. stay
   D. have stayed
2. If you say "no", your host _____ that you have more to drink.
   A. insists
   B. will insist
   C. will be insist
   D. will insists
3. If we visit someone, we _____chocolates or flowers.
   A. take
   B. will take
   C. took
   D. will have taken
4. Men and women may kiss each other _____ the cheek if they see each other after a long time, or even each time they meet.
   A. in
   B. on
   C. at
   D. by
5. Americans often _____ a conversation with someone they don't know by making a comment about the weather.
   A. try starting
   B. are trying to start
   C. try to start
   D. tried
6. Usually people _____ explain why they act on superstitions.
   A. must not
   B. might not
   C. cannot
   D. have to

7. The ozone layer screens out the part of the sun's _____ that harms living things.
   A. light
   B. energy
   C. rays
   D. part
8. Air pollution can be reduced by minimizing _____from cars.
   A. sounds
   B. exhaust gases
   C. tracks
   D. light
9. In the Soviet time absolutely everything_____, from magazines and books till private correspondences and conversations.
   A. would control
   B. was censored
   C. censorship
   D. was censorship
10. In our time, censorship_____ and everyone is free to express his thoughts.
   A. cancelled
   B. was cancelled
   C. has been cancelled
   D. is cancelling

TRANSLATION

4. Translate the sentences from English into Russian.

1. The Wind Amplified Rotor Platform (WARP) is more efficient and uses less land.
2. Vertical-axis wind machines are the most popular wind machines used to-day.
3. Ancient wind machines used blades to collect the wind's kinetic energy.
4. Ductless mini-split systems are also often easier to install than other types of space conditioning systems.
5. The main advantages of mini splits are their small size and flexibility for zoning or heating and cooling individual rooms.
6. Some large commercial sized turbines may have a capacity of 5 million watts, or 5 megawatts.

7. It could be used instead to generate electricity, create heat for industrial purposes, or heat hospitals, schools, public buildings or even whole districts.
8. Having the ability to convert heat into usable electrical energy opens the door to many untapped energy sources.
9. The greater the demand for recycled paper, the lower the production and the wastage of new paper.
10. Each module has a pair of small, high capacity turbines mounted to both of its concave wind amplifier module channel surfaces.

WRITING

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

AUTOMOTIVE THERMOELECTRIC GENERATOR

The idea behind the automotive thermoelectric generator is simple – it will convert waste heat generated from an internal combustion engine back into electricity that can be used to power a vehicle. There are two types of these thermo generators. One of them uses heat from the exhaust of the internal combustion engine, whereas the other uses heat from the coolant that is being used to cool the engine. Considering that about 40 % of a typical internal combustion engine's energy is lost through heat, there is certainly a lot of potential for this type of technology. By powering a vehicle's electrical systems (such as the headlights or radio) using electricity generated through this method – less fuel would be burned to do so! Radioisotope thermoelectric generators are already being used to generate power for robotic solutions in remote locations such as deep space or the Arctic. Because they generate power via the heat released by decaying radioactive material – they aren't entirely popular but certainly have found a high amount of usage in satellites, space probes, and so on. If heat engines are a real possibility, it could help reduce the amount of fuel we use on a daily basis!

SELF-STUDY (KEYS)

Text 1

Keys: 1A, 2D, 3B, 4A, 5C.

Text 2

1. The tubes that circulate hot water or electrical heating elements are installed in the concrete slab turning the thermal mass of the concrete into an inconspicuous radiator of warm, even heat.
2. Your feet are always toasty warm, the temperature is consistent and easy to control, you will not feel the drafts or hear the noise of blowing air, and no dust or allergens get circulated within your home through air vents.
3. Newer ultra-thin electric heating mats are available that can be embedded in thin-set cement or gypsum overlays, allowing retrofitting over existing slabs without significantly raising the floor height.
4. Radiant energy transfer is caused by a warm surface giving up its heat to a cooler surface.
5. The sun radiates its energy towards the earth. The radiant energy is absorbed by the earth and is released as heat.

Ex. 3

Keys: 1B, 2D, 3B, 4C, 5A, 6B, 7C, 8B, 9B, 10C.

CONTROL WORK № 1

Variant 1

READING

Text 1

1. Read the text and choose the right ending (A–C) for each sentence (1–10).

1. A heat pump is a device that_____.
   A. transfers thermal energy
   B. consumes thermal energy
   C. produces thermal energy
2. Heat pump_____.
   A. warms a building
   B. cools a building
   C. warms or cools a building
3. Heat is transferred from_____.
   A. a relatively low-temperature reservoir to one at a higher temperature)
   B. the energy of the sun
   C. cool air
4. People need_____.
   A. more heat
   B. more efficient ways to utilize heat
   C. the heat pump industry
5. Air conditioners_____.
   A. are not heat pumps
   B. are used to produce heat pumps
   C. are examples of heat pumps
6. Heat pumps do not_____.
   A. provide heating in the winter and cooling in the summer
   B. displace heat energy to a more useful location and purpose
   C. send electricity through power lines
7. Liquid and/or gas medium_____.
   A. changes phases as a result of altering pressure
   B. changes phases as a result of lowering pressure
   C. do not change phases

8. The demand for more efficient ways _____is rising.
   A. to produce air conditioners
   B. to utilize heat and energy
   C. to control temperatures

9. Heat pumps are_____.
   A. very cheap
   B. not useful
   C. relatively costly to set up

10. Heat pump system_____.
   A. produces electricity
   B. provides a more economical and efficient way to control temperatures and reuse existing heat energy
   C. consumes thermal energy

HEAT PUMP SYSTEM

Heat pump is a device that warms or cools a building by transferring heat from a relatively low-temperature reservoir to one at a higher temperature. As a result of society's increasing concern for ecological and environmental issues, the demand for more efficient ways to utilize heat and energy is rising. The heat pump industry uses technological advances such as year-round space heating to displace heat energy to a more useful location and purpose. This concept is accomplished by providing localized or redirected heat, while exchanging cool air with heated air. The principles of heat pumps are actually the reverse of the technological and thermodynamic principles of an air conditioner unit. The majority of them give the added benefit of providing both heating in the winter and cooling in the summer. This can be accomplished simply by reversing the flow of the working fluid circulating through the coils. The heat pump is an entire thermodynamic system whereby a liquid and/or gas medium is pumped through an assembly where it changes phases as a result of altering pressure. Although relatively costly to setup, the heat pump system provides a more economical and efficient way to control temperatures and reuse existing heat energy.

Text 2

2. Read the text and match the questions (A–F) to the numbered spaces (1–5), as in the example (0).

A. How is geothermal hot water used?
B. Where do reservoirs of hot water exist?
C. What are the main benefits of geothermal resources?

D. What makes geothermal power plants environmentally clean?
E. What fuel is needed for using geothermal resources for power production?
F. How can the rate of energy extraction be balanced with a reservoir's natural heat recharge rate?

WHAT IS GEOTHERMAL RESOURCE?

0. Geothermal resources are reservoirs of hot water that exist at varying temperatures and depths below the Earth's surface.

1. Mile-or-more-deep wells can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for use in a variety of applications, including electricity generation, direct use, and heating and cooling.

2. Geothermal energy is a vast underutilized heat and power resource that is renewable, baseload, domestic and clean.

3. Renewable – Through proper reservoir management, the rate of energy extraction can be balanced with a reservoir's natural heat recharge rate. Baseload – Geothermal power plants produce electricity consistently, running 24 hours per day / 7 days per week, regardless of weather conditions.

4. Domestic – Geothermal resources can be harnessed for power production without importing fuel. Small Footprint – Geothermal power plants are com pact; using less land per GWh (404 mi^2) than coal (3642 mi^2), wind (1335 mi^2) or solar PV with center station (3237 mi^2).

5. Clean – Modern closed-loop geothermal power plants emit no greenhouse gasses. Geothermal power plants consume less water on average over the lifetime energy output than the most conventional generation technologies.

VOCABULARY AND GRAMMAR

3. Choose the correct item.

1. Thermogenerators are the devices that _____ any sort of heat into electric energy.
   A. convert
   B. consume
   C. waste
2. The idea of converting ____ into energy is so appealing because it allows greater efficiency.
   A. hot
   B. heat
   C. heating

3. Many of the devices ____ heat as a byproduct of using energy.
   A. produce
   B. share
   C. residue
4. Renewable energy_____ the ability to lift the poorest nations to new levels of prosperity.
   A. have
   B. has
   C. haves
5. Wood _____is often used to produce both electricity and steam at paper mills.
   A. water
   B. plants
   C. waste
6. Liquid fuels can be_____ from biomass through a process called pyrolysis.
   A. produced
   B. produce
   C. produces
7. Windmills_____ because they slow down the speed of the wind.
   A. works
   B. work
   C. to work
8. The most common problem in hot-water systems is____ air in the system.
   A. unwanted
   B. hot
   C. cold
9. Heat_____ can provide your home with renewable heating capable of providing all of your hot water needs.
   A. pumps
   B. consumption
   C. production
10. Old, primitive method _____ heating a building include the open fire, the fireplace, and the stove.
    A. in
    B. at
    C. of

TRANSLATION

4. Translate the sentences from English into Russian.

1. The ecological and economic benefits to the world in the development of these systems would be huge.
2. Already today, wind power is the world's most rapidly growing modern type of energy.
3. Heat is distributed through your home through a variety of ways.
4. Steam heating is one of the oldest heating technologies.
5. Hot-water radiators are one of the most common heat distribution systems.
6. Almost any heat source can be used to generate electricity, such as solar heat, ocean heat, geothermal heat, even body heat.
7. About 16 % of global final energy consumption comes from renewables, with 10 % coming from traditional biomass.
8. The amount of power generated by a PV system at a particular site depends on how much of the sun's energy reaches it.
9. Thermal pump belongs among alternative energy sources.
10. Heat Pumps are not that common in Britain, whereas in Scandinavia they are used successfully.

WRITING

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

GEOTHRMAL DIRECT USE

Many technologies have been developed to take advantage of geothermal energy – the heat from the earth. This heat can be drawn from several sources: hot water or steam reservoirs deep in the earth that are accessed by drilling; geothermal reservoirs located near the earth's surface. This variety of geothermal resources allows them to be used on both large and small scales. A utility can use the hot water and steam from reservoirs to drive generators and produce electricity. Other applications apply the heat produced from geothermal directly to various uses in buildings, roads, agriculture, and industrial plants. Still others use the heat directly from the ground to provide heating and cooling in homes and other buildings. Geothermal direct use has a long history, going back to when people began using hot springs for bathing, cooking food, and loosening feathers and skin from game. Today, hot springs are still used as spas. But there are now more sophisticated ways of using this geothermal resource. In modern direct-use systems, a well is

drilled into a geothermal reservoir to provide a steady stream of hot water. The water is brought up through the well, and a mechanical system – piping, a heat exchanger, and controls – delivers the heat directly for its intended use. A disposal system then either injects the cooled water underground or disposes of it on the surface. Geothermal hot water can be used for many applications including heating buildings, raising plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes, such as pasteurizing milk.

CONTROL WORK № 1

Variant 2

READING

Text 1

1. Read the text and choose the best word (A, B or C) for each sentence (1– 10).

THERMAL ENERGY

Thermal Energy is a 0. A (part) of the internal energy of a system which is the total present kinetic energy resulting from the random 1……. of atoms and molecules. The ultimate source of 2…..... energy available to mankind is 3….., the huge thermo-nuclear furnace that supplies the earth with the 4…….. and light that are essential to life. The nuclear fusion in the sun increases the sun's thermal 5…… Once the thermal energy leaves the sun (in the form of 6……..) it is called heat. Heat is thermal energy in transfer. Thermal energy is part of the overall internal energy of a system. When you put your hand over a hot stove you can feel the 7…... You are feeling thermal energy in transfer. 8……. in the metal of the burner are moving very rapidly because the electrical energy from the wall outlet has 9….. the thermal energy in the burner. We all know what happens when we rub our hands together. Our 10……. energy increases the thermal energy content of the atoms in our hands and skin. We then feel the consequence of this – heat.

0 A part	B peace	C lump
1 A movements	B heat	C pump
2 A conventional	B heat	C thermal
3 A the sun	B the moon	C the universe
4 A wind	B heat	C cold
5 A heat	B energy	C movement
6 A light	B wind	C radiation
7 A heat	B radiation	C light
8 A the sun and the moon	B the atoms and molecules	C the earth and the sun
9 A increased	B decreased	C moved
10 A thermal	B conventional	C mechanical

Text 2

2. Read the text and match the questions (A–F) to the numbered spaces (1–5), as in the example (0).

A. What is a solar cell?
B. What energy is generated from solar modules?
C. What are solar modules used for?
D. What are photovoltaics used for?
E. What is used for detecting light or other electromagnetic radiation?
F. What is a solar panel?

0-A

SOLAR CELLS

A. solar cell (also called photovoltaic cell or photoelectric cell) is a solid state electrical device that converts the energy of light directly into electricity by the photovoltaic effect.

1. _____

Assemblies of solar cells are used to make solar modules which are used to capture energy from sunlight.

2. _____

When multiple modules are assembled together (such as prior to installation on a pole-mounted tracker system), the resulting integrated group of modules all oriented in one plane is referred to in the solar industry as a solar panel.

3. _____

The electrical energy generated from solar modules, referred to as solar power, is an example of solar energy.

4. _____

Photovoltaics is the field of technology and research related to the practical application of photovoltaic cells in producing electricity from light, though it is often used specifically to refer to the generation of electricity from sunlight.

5. _____

Cells are described as photovoltaic cells when the light source is not necessarily sunlight (lamplight, artificial light, etc.). These are used for detecting light or other electromagnetic radiation near the visible range, for example infrared detectors, or measurement of light intensity.

VOCABULARY AND GRAMMAR

3. Choose the correct item.

1. Thermoelectric generator (TEG) is a device that converts_____ into electricity.
   A. capacity
   B. heat
   C. share
2. Almost any heat source can be used to ____ electricity.
   A. derive
   B. reduce
   C. generate
3. The vast majority of wood burning_____ today use gasification technology.
   A. furnaces
   B. residue
   C. waste
4. Renewable energy is _____ from natural processes that are replenished constantly.
   A. derive
   B. derives
   C. derived
5. Renewable energy replaces conventional ____ .
   A. fuels
   B. heat
   C. waste
6. The use of biomass energy can greatly _____ our greenhouse gas emissions.
   A. reduced
   B. reduce
   C. reduces
7. The earliest known windmills _____ in Persia.
   A. was
   B. are
   C. were
8. Steam radiators located on exterior walls can cause heat loss by radiaing_____ through the wall to the outdoors.
   A. waste
   B. heat
   C. furnace

9. The first central heating systems used steam _____.
   A. distribute
   B. distribution
   C. distributing
10. A radiant floor heating system simply _____ heat upward from the floor to provide optimum comfort.
   A. radiates
   B. consumes
   C. wastes

TRANSLATION

4. Translate the sentences from Russian into English.

1. Thermogenerators are the devices that convert any sort of heat into electric energy.
2. The reason why the idea of converting heat into energy is so appealing is that it allows greater efficiency in a lot of cases.
3. Many of the devices that we use on a daily basis produce heat as a byproduct of using energy.
4. Most of the biopower plants in the world burn bioenergy feedstocks directly to produce steam.
5. Wood waste is often used to produce both electricity and steam at paper mills.
6. Liquid fuels can be produced from biomass through a process called pyrolysis.
7. Windmills work because they slow down the speed of the wind.
8. The most common problem in hot-water systems is unwanted air in the system.
9. Heat pumps are an ingenious solution to providing your home with renewable heating capable of providing all of your hot water needs.
10. Old, primitive methods of heating a building or a room within it include the open fire, the fireplace, and the stove.

WRITING

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

HOW CAN NANOTECHNOLOGY IMPROVE SOLAR CELLS

Using nanoparticles in the manufacture of solar cells has the following benefits: reduced manufacturing costs as a result of using a low temperature process similar to printing instead of the high temperature vacuum deposition process typically used to produce conventional cells made with crystalline semiconductor material; reduced installation costs achieved by producing flexible rolls instead of rigid crystalline panels. Cells made from semiconductor thin films will also have this characteristic. Currently available nanotechnology solar cells are not as efficient as traditional ones, however their lower cost offsets this. In the long term nanotechnology versions should both be lower cost and, using quantum dots, should be able to reach higher efficiency levels than conventional ones. Combining lead selenide quantum dots with titanium dioxide to form higher efficiency solar cells. Combining carbon nanotubes, bucky-balls and polymers to produce inexpensive solar cells that can be formed by simply painting a surface.

Researchers at Stanford University have found a way to trap light in organic solar cells. The idea is that the longer light is in the solar cell the more electrons will be generated. The researchers found that by making the organic layer much thinner than the wavelength of light and sandwiching the organic layer between a mirror layer and a rough layer the light stayed in the solar cell longer and excited more electrons. Nanoparticles in plastic film to form solar cells that can be incorporated into cases for devices such as mobile phones and laptop computers.

CONTROL WORK № 1

Variant 3

READING

Text 1

1. Read the article about Thermal Energy. Choose the best word (A, B or C) for each space (1–10).

THERMAL ENERGY

Thermal Energy is a 0. A (part) of the internal energy of a system which is the total present kinetic energy resulting from the random1…... of atoms and molecules. The ultimate source of 2..... energy available to mankind is 3…..., the huge thermo-nuclear furnace that supplies the earth with the 4..…. and light that are essential to life. The nuclear fusion in the sun increases the sun's thermal 5…… Once the thermal energy leaves the sun (in the form of 6…..) it is called heat. Heat is thermal energy in transfer. Thermal energy is part of the overall internal energy of a system.

When you put your hand over a hot stove you can feel the 7….. You are feeling thermal energy in transfer. 8…. in the metal of the burner are moving very rapidly because the electrical energy from the wall outlet has 9…... the thermal energy in the burner. We all know what happens when we rub our hands together. Our 10.… energy increases the thermal energy content of the atoms in our hands and skin. We then feel the consequence of this – heat.

0 A part	B peace	C lump
1 A movements	B heat	C pump
2 A conventional	B heat	C thermal
3 A the sun	B the moon	C the universe
4 A wind	B heat	C cold
5 A heat	B energy	C movement
6 A light	B wind	C radiation
7 A heat	B radiation	C light
8 A the sun and the moon	B the atoms and molecules	C the earth and the sun
9 A increased	B decreased	C moved
10 A thermal	B conventional	C mechanical

Text 2

2. Read the text and match the questions (A–F) to the numbered spaces (1–5), as in the example (0).

A. How is geothermal hot water used?
B. Where do reservoirs of hot water exist?
C. What are the main benefits of geothermal resources?
D. What makes geothermal power plants environmentally clean?
E. What fuel is needed for using geothermal resources for power production?
F. How can the rate of energy extraction be balanced with a reservoir's natural heat recharge rate?

WHAT IS GEOTHERMAL RESOURCE?

0. Geothermal resources are reservoirs of hot water that exist at varying temperatures and depths below the Earth's surface.

1. Mile-or-more-deep wells can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for use in a variety of applications, including electricity generation, direct use, and heating and cooling.

2. Geothermal energy is a vast underutilized heat and power resource is renewable, baseload, domestic and clean.

3. Renewable – Through proper reservoir management, the rate of energy extraction can be balanced with a reservoir's natural heat recharge rate. Baseload – Geothermal power plants produce electricity consistently, running 24 hours per day / 7 days per week, regardless of weather conditions.

4. Domestic – geothermal resources can be harnessed for power com pact; using less land per GWh (404 mi^2) than coal (3642 mi^2) wind (1335 mi^2) or solar PV with center station (3237 mi^2).

5. Clean – Modern closed-loop geothermal power plants emit no greenhouse gasses. Geothermal power plants consume less water on average over the lifetime energy output than the most conventional generation technologies.

VOCABULARY AND GRAMMAR

3. Choose the correct item.

1. Many of the devices_____ heat as a byproduct of using energy.
   A. produce
   B. share
   C. residue
2. Renewable energy ____ the ability to lift the poorest nations to new levels of prosperity.
   A. have
   B. has
   C. haves
3. Thermogenerators are the devices that_____ any sort of heat into electric energy.
   A. convert
   B. consume
   C. waste
4. The idea of converting ____ into energy is so appealing because it allows greater efficiency.
   A. hot
   B. heat
   C. heating
5. Renewable energy replaces conventional _____.
   A. fuels
   B. heat
   C. waste
6. The use of biomass energy can greatly _____ our greenhouse gas emissions.
   A. reduced
   B. reduce
   C. reduces
7. The earliest known windmills_____ in Persia.
   A. was
   B. are
   C. were

8. Steam radiators located on exterior walls can cause heat loss by radiating _____ through the wall to the outdoors.
   A. waste
   B. heat
   C. furnace
9. The first central heating systems used steam _____.
   A. distribute
   B .distribution
   C. distributing
10. A radiant floor heating system simply _____ heat upward from the floor to provide optimum comfort.
   A. radiates
   B. consumes
   C. wastes

TRANSLATION

4. Translate the sentences from English into Russian.

1. Almost any heat source can be used to generate electricity, such as solar heat, ocean heat, geothermal heat, even body heat.
2. Already today, wind power is the world's most rapidly growing modern type of energy.
3. Heat is distributed through your home through a variety of ways.
4. Steam heating is one of the oldest heating technologies.
5. Hot-water radiators are one of the most common heat distribution systems.
6. Most of the biopower plants in the world burn bioenergy feedstocks directly to produce steam.
7. Wood waste is often used to produce both electricity and steam at paper mills.
8. About 16 % of global final energy consumption comes from renewables, with 10 % coming from traditional biomass.
9. Heat Pumps are not that common in Britain, whereas in Scandinavia they are used successfully.
10. Thermal pump belongs among alternative energy sources.

WRITING

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

GEOTHERMAL DIRECT USE

Many technologies have been developed to take advantage of geothermal energy – the heat from the earth. This heat can be drawn from several sources: hot water or steam reservoirs deep in the earth that are accessed by drilling; geothermal reservoirs located near the earth's surface. This variety of geothermal resources allows them to be used on both large and small scales. A utility can use the hot water and steam from reservoirs to drive generators and produce electricity. Other applications apply the heat produced from geothermal energy directly to various uses in buildings, roads, agriculture, and industrial plants. Still others use the heat directly from the ground to provide heating and cooling in homes and other buildings.

Geothermal direct use has a long history, going back to when people began using hot springs for bathing, cooking food, and loosening feathers and skin from game. Today, hot springs are still used as spas. But there are now more sophisticated ways of using this geothermal resource. In modern direct-use systems, a well is drilled into a geothermal reservoir to provide a steady stream of hot water. The water is brought up through the well, and a mechanical system – piping, a heat exchanger, and controls – delivers the heat directly for its intended use. A disposal system then either injects the cooled water underground or disposes of it on the surface. Geothermal hot water can be used for many applications including heating buildings, raising plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes, such as pasteurizing milk.

CONTROL WORK № 1

Variant 4

READING

Text 1

1. Read the text and choose the right ending (A–C) for each sentence (1–10).

1. A heat pump is a device that_____.
   A. transfers thermal energy
   B. consumes thermal energy
   C. produces thermal energy
2. Heat pump_____.
   A. warms a building
   B. cools a building
   C. warms or cools a building
3. Heat is transferred from_____.
   A. a relatively low-temperature reservoir to one at a higher temperature
   B. the energy of the sun
   C. cool air
4. People need_____.
   A. more heat
   B. more efficient ways to utilize heat
   C. the heat pump industry
5. Air conditioners_____.
   A. are not heat pumps
   B. are used to produce heat pumps
   C. are examples of heat pumps
6. Heat pumps do not_____.
   A. provide heating in the winter and cooling in the summer
   B. displace heat energy to a more useful location and purpose
   C. send electricity through power lines
7. Liquid and/or gas medium_____.
   A. changes phases as a result of altering pressure
   B. changes phases as a result of lowering pressure
   C. do not change phases

8. The demand for more efficient ways ____ is rising.
   A. to produce air conditioners
   B. to utilize heat and energy
   C. to control temperatures

9. Heat pumps are_____.
   A. very cheap
   B. not useful
   C. relatively costly to setup

10. Heat pump system_____.
   A. produces electricity
   B. provides a more economical and efficient way to control temperatures and reuse existing heat energy.
   C. consumes thermal energy

HEAT PUMP SYSTEM

Heat pump is a device that warms or cools a building by transferring heat from a relatively low-temperature reservoir to one at a higher temperature.

As a result of society's increasing concern for ecological and environmental issues, the demand for more efficient ways to utilize heat and energy is rising. The heat pump industry uses technological advances such as year-round space heating to displace heat energy to a more useful location and purpose. This concept is accomplished by providing localized or redirected heat, while exchanging cool air with heated air. The principles of heat pumps are actually the reverse of the technological and thermodynamic principles of an air conditioner unit. The majority of them give the added benefit of providing both heating in the winter and cooling in the summer. This can be accomplished simply by reversing the flow of the working fluid circulating through the coils. The heat pump is an entire thermodynamic system whereby a liquid and/or gas medium is pumped through an assembly where it changes phases as a result of altering pressure. Although relatively costly to setup, the heat pump system provides a more economical and efficient way to control temperatures and reuse existing heat energy.

Text 2

2. Read the article about Solar Cells, and match the questions (A–F) to the numbered spaces (1–5), as in the example (0).

A. What is a solar cell?
B. What energy is generated from solar modules?
C. What are solar modules used for?

D. What are photovoltaics used for?
E. What is used for detecting light or other electromagnetic radiation?
F. What is a solar panel?

0-A

A solar cell (also called photovoltaic cell or photoelectric cell) is a solid state electrical device that converts the energy of light directly into electricity by the photovoltaic effect.

1._____

Assemblies of solar cells are used to make solar modules which are used to capture energy from sunlight.

2._____

When multiple modules are assembled together (such as prior to installation on a pole-mounted tracker system), the resulting integrated group of modules all oriented in one plane is referred to in the solar industry as a solar panel.

3._____

The electrical energy generated from solar modules, referred to as solar power, is an example of solar energy.

4._____

Photovoltaics is the field of technology and research related to the practical application of photovoltaic cells in producing electricity from light, though it is often used specifically to refer to the generation of electricity from sunlight.

5._____

Cells are described as photovoltaic cells when the light source is not necessarily sunlight (lamplight, artificial light, etc.). These are used for detecting light or other electromagnetic radiation near the visible range, for example infrared detectors, or measurement of light intensity.

VOCABULARY AND GRAMMAR

3. Choose the correct item.

1. Heat _____ can provide your home with renewable heating capable of providing all of your hot water needs.
   A. pumps
   B. consumption
   C. production

2. Old, primitive methods_____ heating a building include the open fire, the fireplace, and the stove.
   A. in
   B. at
   C. of
3. Thermoelectric generator (TEG) is a device that converts_____ into electricity.
   A. capacity
   B. heat
   C. share
4. Almost any heat source can be used to _____ electricity.
   A. derive
   B. reduce
   C. generate
5. The vast majority of wood burning _____today use gasification technology.
   A. furnaces
   B. residue
   C. waste
6. Renewable energy is _____from natural processes that are replenished constantly.
   A. derive
   B. derives
   C. derived
7. Wood _____is often used to produce both electricity and steam at paper mills.
   A. water
   B. plants
   C. waste
8. Liquid fuels can be_____ from biomass through a process called pyrolysis.
   A. produced
   B. produce
   C. produces
9. Windmills _____because they slow down the speed of the wind.
   A. works
   B. work
   C. to work

10. The most common problem in hot-water systems is_____ air in the system.
A. unwanted
B. hot
C. cold

TRANSLATION

4. Translate the sentences from English into Russian.

1. Old, primitive methods of heating a building or a room within it include the open fire, the fireplace, and the stove.
2. Thermogenerators are the devices that convert any sort of heat into electric energy.
3. The ecological and economic benefits to the world in the development of these systems would be huge.
4. The amount of power generated by a PV system at a particular site depends on how much of the sun's energy reaches it.
5. The reason why the idea of converting heat into energy is so appealing is heat it allows greater efficiency in a lot of cases.
6. Many of the devices that we use on a daily basis produce heat as a byproduct of using energy.
7. Heat pumps are an ingenious solution to providing your home with renewable heating capable of providing all of your hot water needs.
8. Liquid fuels can be produced from biomass through a process called pyrolysis.
9. Windmills work because they slow down the speed of the wind.
10. The most common problem in hot-water systems is unwanted air in the system.

WRITING

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

COOLANTS

The most common coolant is water. Its high heat capacity and low cost makes it a suitable heat-transfer medium. It is usually used with additives, like corrosion inhibitors and antifreeze. Antifreeze, a solution of a suitable organic chemical (most often ethylene glycol, diethylene glycol, or propylene glycol) in water, is used when the water-based coolant has to withstand tem-

peratures below 0 °C, or when its boiling point has to be raised. Betaine is a similar coolant, with the exception that it is made from pure plant juice, and is therefore not toxic or difficult to dispose of ecologically.

Very pure deionized water, due to its relatively low electrical conductivity, is send to cool some electrical equipment, often high-power transmitters and high-power vacuum tubes. Heavy water is a neutron moderator used in some nuclear reactors; it also has a secondary function as their coolant. Light water reactors, both boiling water and pressurized water reactors the most common type, use light water. Polyalkylene Glycol or PAGs are used as high temperature, thermally stable heat transfer fluids exhibiting strong resistance to oxidation. Cutting fluid is a coolant that also serves as a lubricant for metal shaping machine tools. Oils are used for applications where water is unsuitable. With higher boiling points than water, oils can be raised to considerably higher temperatures (above 100 degrees Celsius) without introducing high pressures within the container or loop system in question.

UNIT 3

ENGINES

Text What are engines?
Grammar Revision: Conditional sentences.

LEAD-IN

1. Answer the questions.

* What do you know about engines?
* What kinds of engines do you know? (steam engine, heat engine, automobile engine, aircraft engine, donkey engine, switch engine, rotary engine)

READING

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

cyclic compression	сжатие; сокращение, компрессия
a heat engine	тепловой двигатель
expansion	увеличение, расширение
fluid	текучая среда (жидкость или газ)
conversion	превращение, изменение; переход (из одного состояния в другое)
a combustion engine	двигатель внутреннего сгорания
combustion	горение, возгорание, сжигание
transfer	перенос; перемещение
input	потребляемая мощность; подводимая мощность
enclose	заключать (где-л., в чём-л.)
efficiency	отдача, коэффициент полезного действия, эффективность
usage	употребление, использование
device	устройство, приспособление; механизм, приводить в действие, вызывать (напряжение)
torque	вращающий момент

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

THE ORIGIN OF ENGINES

Originally an engine was a mechanical device that converted force into motion. Military devices such as catapults, trebuchets and battering rams are referred to as siege engines. The term “engine” is a short form of the Latin word “ingenious”. In modern usage, the term is used to describe devices capable of performing mechanical work, as in the original steam engine. In most cases the work is produced by exerting a torque or linear force, which is used to operate other machinery which can generate electricity, pump water, or compress gas. An engine burns or otherwise consumes fuel, and is differentiated from an electric machine (i.e., electric motor) that derives power without changing the composition of matter. A heat engine may also serve as a prime mover, a component that transforms the flow or changes in pressure of a fluid into mechanical energy. An automobile powered by an internal combustion engine may make use of various motors and pumps, but ultimately all such devices derive their power from the engine. The term motor was originally used to distinguish the new internal combustion engine-powered vehicles from earlier vehicles powered by steam engines but nowadays may be used to refer to any engine. Simple machines, such as the club and oar (examples of the lever), are prehistoric. More complex engines using human or animal power, water, wind and even steam power date back to antiquity. Human power was focused by the use of simple engines, such as the capstan, windlass or treadmill, and with ropes, pulleys, and block and tackle arrange-

ments; this power was transmitted usually with the forces multiplied and the speed reduced. These were used in cranes and aboard ships in Ancient Greece, in mines, water pumps and siege engines in Ancient Rome. It is known that a water powered mill was built in Kaberia of the kingdom of Mithridates during the 1st century BC. Use of water wheels in mills spread throughout the Roman Empire over the next few centuries. Some were quite complex, with aqueducts, dams, and sluices to maintain and channel the water, along with systems of gears, or toothed-wheels made of wood and metal to regulate the speed of rotation.

Medieval engineers employed gears in mills and water-raising machines, and used dams as a source of water power to provide additional power to watermills and water-raising machines.

STATEMENTS	T/F
1. Military devices were siege engines. 2. Simple engines were used in prehistoric times. 3. An engine derives power without changing the composition of matter. 4. There were no complex devices in Ancient Rome. 5. The rotor motor invented in China was able to deliver sustained power. 6. An engine burns or otherwise consumes fuel. 7. The term "engine" is a short form of the English word "ingenious". 8. A heat engine may also serve as a component that transforms the flow or changes in pressure of a fluid into mechanical energy. 9. More complex engines using human or animal power, water, wind and even steam power date back to Rome times. 10. In the 13th century, the solid rocket motor was invented in Vietnam.	

4. Answer the questions.

1. What kind of device is an engine?
2. What is the difference between the engine and the electric motor?
3. What kinds of engines were used in Ancient Rome and Greece?
4. What did the term 'motor' originally mean? What does it mean nowadays?
5. What machines were used in the Middle Ages?
6. When and where was the first rotor motor invented?
7. How was the rotor motor used in war times?

USE OF ENGLISH

5. Complete the sentences with the missing words. Use each word only once.

a) machine; b) motion; c) energy; d) heat; e) air; f) efficiency; g) fuels; h) power; i) heat source; j) climate change

An engine or motor is a 1. …. designed to convert 2…… into useful mechanical motion. Heat engines, including internal combustion engines and external combustion engines (such as steam engines) burn a fuel to create 3….. which is then used to create motion. Electric motors convert electrical energy into mechanical motion, pneumatic motors use compressed 4…… and others, such as wind-up toys use elastic energy. In biological systems, molecular motors like myosins in muscles use chemical energy to create 5…….. The Stirling engine is noted for its high 6…… compared to steam engines, quiet operation, and the ease with which it can use almost any 7……. This compatibility with alternative and renewable energy sources has become increasingly significant as the price of conventional 8…… rises, and also in light of concerns such as peak oil and 9…... This engine is currently exciting interest as the core component of micro combined heat and 10 (CHP) units, in which it is more efficient and safer than a comparable steam engine.

6. Match the words 1–10 with the definitions A–J.

1. HEAT **2.** MOTION **3.** COMBUSTION **4.** ENERGY **5.** FLUID **6.** STEAM **7.** COMPRESSION **8.** TORQUE **9.** EFFICIENCY **10.** CONDUCTION	**A)** the process of continual change in the physical position of an object; movement **B)** the energy transferred as a result of a difference in temperature **C)** a chemical change, especially oxidation, accompanied by the production of heat and light **D)** continuous amorphous matter that tends to flow and to conform to the outline of its container: a liquid or a gas **E)** force that tends to shorten or squeeze something, decreasing its volume. **F)** the capacity of a body or system to do work **G)** the gas or vapour into which water is changed when boiled **H)** any force or system of forces that causes or tends to cause rotation **I)** the ratio of the energy delivered (or work done) by a machine to the energy needed (or work required) in operating the machine. **J)** the transfer of energy, such as heat or an electric charge, through a substance

7. Word building.

verb	noun	adjective
compress	compression	compressive
		different
		comparative
	reaction	
restrict		
		applicable
	operation	
	significance	
conduct		

8. Insert the prepositions: (in, for, of, as).

1. The Stirling engine is noted …. its high efficiency.
2. The primary effect of regeneration … a Stirling engine is to increase the thermal efficiency … "recycling" internal heat.
3. These inherent design conflicts are one of many factors which limit the efficiency …. practical Stirling engines.
4. The Watt steam engine was the next great step … the development of the steam engine.
5. The general cycle consists … compressing cool gas, heating the gas, expanding the hot gas, and finally cooling the gas before repeating the cycle.
6. The appliance consumed a large amount …. fuel compared with later engines.
7. All thermodynamic cycles require large temperature differentials …. efficient operation.
8. Dissipation of waste heat is especially complicated because the coolant temperature is kept … low … possible to maximize thermal efficiency.
9. The materials must resist the corrosive effects … the heat source.
10. The Stirling engine encloses a fixed quantity …. permanently gaseous fluid such as air.

TRANSLATION

9. Translate the sentences from English into Russian.

1. A Stirling engine is a heat engine operating by cyclic compression and expansion of air or other gas, the working fluid, at different temperature levels such that there is a net conversion of heat energy to mechanical work.

2. Stirling engines can run on any available heat source, not just one produced by combustion.
3. In a Stirling engine, the regenerator is an internal heat exchanger and temporary heat store placed between the hot and cold spaces such that the working fluid passes through it first in one direction then the other.
4. Since the Stirling engine is a closed cycle, it contains a fixed mass of gas called the "working fluid", most commonly air, hydrogen or helium.
5. The primary effect of regeneration in a Stirling engine is to increase the thermal efficiency by "recycling" internal heat which would otherwise pass through the engine irreversibly.
6. Combustion engines are heat engines driven by the heat of a combustion process.
7. The regenerator is the key component invented by Robert Stirling and its presence distinguishes a true Stirling engine from any other closed cycle hot air engine.
8. The working fluid can be a gas as in a Stirling engine, or steam as in a steam engine.
9. Medieval engineers employed gears in mills and water-raising machines, and used dams as a source of water power to provide additional power to watermills and water-raising machines.
10. An engine burns or otherwise consumes fuel.

GRAMMAR REVISION

TYPES OF CONDITIONALS

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

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

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

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

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

12. Complete the sentences.

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

SPEAKING

13. Read the text about advantages and disadvantages of the Stirling Engines. Discuss in groups.

Advantages: Stirling engines can run directly on any available heat source, not just one produced by combustion, so they can run on heat from solar, geothermal, biological, nuclear sources or waste heat from industrial processes. A continuous combustion process can be used to supply heat, so those emissions associated with the intermittent combustion processes of a reciprocating internal combustion engine can be reduced. The engine mechanisms are in some ways simpler than other reciprocating engine types and can be made using common household materials. A Stirling engine uses a single-phase working fluid which maintains an internal pressure close to the design pressure, and thus the risk of explosion is low. In some cases, low operating pressure allows the use of lightweight cylinders. They can be built to run quietly and without an air supply, for air independent propulsion use in submarines. They start easily and run more efficiently in cold weather, in contrast to the internal combustion which starts quickly in warm weather, but not in cold weather. A Stirling engine used for pumping water can be configured so that the water cools the compression space. This is most effective when pumping cold water.

Disadvantages: Stirling engine designs require heat exchangers for heat input and for heat output, and these must contain the pressure of the working fluid, where the pressure is proportional to the engine power output. The materials must resist the corrosive effects of the heat source, and have low creep (deformation). Typically these material requirements substantially increase the cost of the engine up to 40 % of the total engine cost. All thermodynamic cycles require large temperature differentials for efficient operation. In an external combustion engine, the heater temperature always equals or exceeds

the expansion temperature. This means that the metallurgical requirements for the heater material are very demanding. Dissipation of waste heat is especially complicated because the coolant temperature is kept as low as possible to maximize thermal efficiency. This increases the size of the radiators, which can make packaging difficult.

WRITING

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

COMBUSTION

All internal combustion engines depend on combustion of a chemical fuel, typically with oxygen from the air (though it is possible to inject nitrous oxide to do more of the same thing and gain a power boost). The combustion process typically results in the production of a great quantity of heat, as well as the production of steam and carbon dioxide and other chemicals at very high temperature; the temperature reached is determined by the chemical make-up of the fuel and oxidizers (see stoichiometry), as well as by the compression and other factors.

The most common modern fuels are made up of hydrocarbons and are derived mostly from fossil fuels (petroleum). Fossil fuels include diesel fuel, gasoline and petroleum gas, and the rarer use of propane. Except for the fuel delivery components, most internal combustion engines that are designed for gasoline use can run on natural gas or liquefied petroleum gases without major modifications. Large diesels can run with air mixed with gases and a pilot diesel fuel ignition injection. Liquid and gaseous biofuels, such as ethanol and biodiesel (a form of diesel fuel that is produced from crops that yield triglycerides such as soybean oil), can also be used. Engines with appropriate modifications can also run on hydrogen gas, wood gas, or charcoal gas, as well as from so-called producer gas made from other convenient biomass. Recently, experiments have been made with using powdered solid fuels, such as the magnesium injection cycle. Internal combustion engines require ignition of the mixture, either by spark ignition (SI) or compression ignition (CI). Before the invention of reliable electrical methods, hot tube and flame methods were used.

Experimental engines with laser ignition have been built. Gasoline engine ignition systems generally rely on a combination of a lead–acid battery and an induction coil to provide a high-voltage electric spark to ignite the air-fuel mix in the engine's cylinders.

UNIT 4

HEAT EXCHANGERS

Text Energy recovery. **Grammar Revision**: Conditional sentences.

LEAD-IN

1. Answer the questions.

* What unites all these pictures?
* What is a heat exchanger?



READING

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

recovery	возврат, получение вновь, получение обратно
input	потребляемая мощность; подводимая мощность
latent	скрытый, латентный
incandescence	накал, накаливание; белое каление
convection	конвекция
combustion chamber	камера сгорания
capacity	мощность, нагрузка, емкость
observations	наблюдения
premises	помещение, дом
warmth	тепло
length	продолжительность, протяжённость
buffer	резервный запас
supply	питание, подача, подвод, приток
hydrogen	водород
dissociate	разъединять, диссоциировать; разлагать

3. You are going to read the text. For questions 1–5, choose the right letter A, B, C or D.

ENERGY RECOVERY

Energy recovery includes any technique or method of minimizing the input of energy to an overall system by the exchange of energy from one subsystem of the overall system with another. The energy can be in any form in either subsystem, but most energy recovery systems exchange thermal energy in either sensible or latent form.

An energy recovery system will close this energy cycle to prevent the input power from being released back to nature and rather be used in other forms of desired work. Heat recovery is implemented in heat sources like a steel mill. Heated cooling water from the process is sold for heating of homes, shops and offices in the surrounding area. Regenerative braking is used in electric cars, trains, heavy cranes etc. where the energy consumed when elevating the potential is returned to the electric supplier when released. Active pressure reduction systems where the differential pressure in a fluid flow is recovered rather than converted to heat in a pressure reduction valve and released.

There is a large potential for energy recovery in compact systems like large industries and utilities. Together with Energy conservation it should be possible to dramatically reduce the world energy consumption. The effect of this will then be:

- reduced number of coal-fired power plants;
- reduced airborne particles, NOx and CO_2 – improved air quality;
- slowing or reducing climate change;
- lower fuel bills on transport;
- longer availability of crude oil.

Widespread use of energy recycling could therefore reduce global warming emissions by an estimated 20 percent. Indeed, as of 2005, about 42 percent of U.S. greenhouse gas pollution came from the production of electricity and 27 percent from the production of heat.

Heat recovery systems in private homes can have an efficiency as low as 30 % or less. It may be more realistic to use energy conservation like insulation or improved buildings. Many areas are more dependent on forced cooling and a system for extracting heat from dwellings to be used for other uses are not widely available. Ineffective infrastructure can cause losses of heat. Heat recovery in particular need a short distance from producer to consumer to be viable. A solution may be to move a large consumer to the vicinity of the producer. The transport sector uses about 20 % of the energy supply,

most of the energy is spent on overcoming gravity and friction. Electric cars with regenerative breaking seem to be the best candidate for energy recovery. Wind systems on ships is under development. Very little work on the airline industry is known in this field.

1. Energy recovery systems _____.
   A. exchange thermal energy
   B. consume thermal energy
   C. waste thermal energy
   D. produce thermal energy

2. Heated cooling water from the process of a steel mill should be _____.
   A. cooled
   B. sold for heating of homes
   C. thrown away
   D. heated again

3. Large industries and utilities _____ for energy recovery
   A. have large potential
   B. do not have any potential
   C. are impossible
   D. have no opportunities

4. Heat recovery system in private homes _____.
   A. is very effective
   B. is impossible
   C. has low efficiency
   D. is the same as in steel mines

5. Electric cars with regenerative breaking _____.
   A. have good potential for energy recovery
   B. do not exist
   C. are inefficient
   D. consume much energy

4. Match the words with the definitions (a–e). The example is given. Translate the phrases into Russian.

1. ***coolant***	a) ***a medium, usually fluid, used to draw heat from an object***
2. refrigerator	b) a piece of equipment built for efficient heat transfer from one medium to another
3. heat exchanger	c) a device in which the coolant is pumped around by an electric motor, an appliance for storing food at a low temperature
4 engine	d) an enclosed chamber in which heat is produced to heat buildings
5. furnace	e) the motor that converts thermal energy to mechanical work

USE OF ENGLISH

5. Read the article. Choose the best word (A, B, C or D) for each space (1–10).

A refrigerator (colloquially fridge) is a common household appliance that consists of a thermally 1…. compartment and 2…. (mechanical, electronic, or chemical) that transfers heat from the inside of the fridge to its external 3….so that the inside of the fridge is cooled to a temperature 4…... the ambient temperature of the room. Cooling is a popular food storage technique in developed countries and works by 5..…... the reproduction rate of bacteria.

The device is thus used to 6…… the rate of spoilage of foodstuffs. A refrigerator 7..…... a temperature a few degrees above the freezing point of water. Optimum temperature range for perishable food storage is 3 to 5 °C (37 to 41 °F). A similar 8……. which maintains a temperature below the freezing point of water is called a freezer.

The refrigerator is a relatively modern 9……. among kitchen appliances. It replaced the icebox, which had been a common household appliance for almost a century and a half prior. For this reason, a 10…….. is sometimes referred to as an icebox.

1 A. consumed	**B.** insulated	**C.** reduced	**D.** reproduced
2 A. heat pump	**B.** combustion chamber	**C.** energy recovery	**D.** kitchen appliance
3 A. kitchen	**B.** environment	**C.** compartment	**D.** foodstuff
4 A. below	**B.** higher	**C.** freezer	**D.** heater
5 A. increasing	**B.** inventing	**C.** decreasing	**D.** heating
6 A. reduce	**B.** derive	**C.** maintain	**D.** device
7 A. maintain	**B.** reduces	**C.** derive	**D.** maintains
8 A. device	**B.** derive	**C.** decrease	**D.** dissociate
9 A. combustion	**B.** invention	**D.** technique	**D.** temperature
10A. refrigerator	**B.** icebox	**D.** heat pump	**D.** household appliance

6. Match the words (1–10) with their definitions A–J.

1) incandescence	**A)** to perform a function; work
2) convection	**B)** a state or condition in which everything is regular, homogeneous, or unvarying
3) capacity	
4) coolant	**C)** light from heat
5) to insulate	**D)** process of heat transfer through a gas or liquid by bulk motion of hotter material into a cooler region
6) to supply	
7) to operate	**E)** separate (substances) into constituent elements or parts
8) to dissociate	**F)** the ability or power to contain, absorb, or hold
9) insulator	**G)** a fluid agent (gas or liquid) that produces cooling
10) uniformity	**H)** a material or an object that does not easily allow heat, electricity, light, or sound to pass through it.
	I) protect from heat, cold, or noise by surrounding with insulating material
	J) an amount available or sufficient for a given use; stock

7. Put the words into the correct form. The example is given.

1. A ***regenerative*** heat wheel is a revolving disc filled with	***regenerate***
2. an air-permeable medium ….. a desiccant. When the air	include
3. passes through the medium, heat energy and …. are	moist
4. transferred to the medium. As the medium .... into the opposing	rotate
5. air stream, the warmed, moist medium … the heat	transfer
6. and moisture to the …..-flowing air stream. Therefore, a heat	oppose
7. wheel can either reduce … of warm, moist outside air into	enter
8. the lab….., or recover heat and moisture that would	build
9. have been ….exhausted for the building. There has been	simple
10. a…. interest in heat wheels since molecular sieve coatings have been used that ensure minimal contaminant transfer.	renew

TRANSLATION

8. Translate the sentences from English into Russian.

1. Thermal energy is generated and measured by heat of any kind.
2. Most energy recovery systems exchange thermal energy in either sensible or latent form.
3. There is a large potential for energy recovery in compact systems like large industries and utilities.
4. Wooden granules are usually used with the purpose of burning in fireplaces and heating devices with free flame.
5. This method of incandescence is considered to be the most comfortable for people.
6. These systems may be configured as a hydrogen furnace, a vacuum furnace or both.
7. Each vacuum furnace is supplied as a complete system including vacuum chamber, metallic heat zone, power supply, vacuum pumps and a programmable control system.
8. Oil cooling is the process of removing heat from machinery and electrical components with oil as a transfer medium.
9. This form of cooling is typically an immersion process where heat sources operate within an oil bath.
10. Oil is also used to cool high performance electronic components.

GRAMMAR REVISION

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

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

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

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

11. Complete the sentences.

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

WTITING

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

HEAT EXHANGER*

A device used to transfer heat from a fluid flowing on one side of a barrier to another fluid flowing on the other side of the barrier. When used to accomplish simultaneous heat transfer and mass transfer, heat exchangers become special equipment types, often known by other names. When fired directly by a combustion process, they become furnaces, boilers, heaters, tube-still heaters, and engines. If there is a change in phase in one of the flowing fluids – condensation of steam to water, for example – the equipment may be called a chiller, evaporator, sublimator, distillation-column reboiler, condenser, or cooler-condenser.

Heat exchangers may be so designed that chemical reactions or energy generation processes can be carried out within them, e.g. a nuclear reactor, catalytic reactor, or polymerizer. Heat exchangers are normally used for the transfer and useful elimination or recovery of heat without an accompanying phase change. The fluids on either side of the barrier are usually liquids, but they may also be gases such as steam, air, or hydrocarbon vapors; they may be liquid metals such as sodium or mercury.

Most often the barrier between the fluids is a metal wall such as that of a tube or pipe. It can be fabricated from flat metal plate, graphite, plastic, or other corrosion-resistant materials of construction. Heat exchangers find wide

* http://www.answers.com/topic/heat-exchanger

application in the chemical process industries, including petroleum refining; in the food industry for pasteurization of milk and canning of processed foods; in the generation of steam for production of power and electricity; in nuclear reaction systems; in aircraft and space vehicles; and in the field of cryogenics for the low temperature separation of gases. Heat exchangers are the workhorses of the entire field of heating, ventilating, air-conditioning, and refrigeration.

SELF-STUDY

READING

Text 1

1. You are going to read the text about OIL COOLING. Complete the sentences 1–5 by choosing the right option A, B, C or D.

OIL COOLING

Oil cooling is the process of removing heat from machinery and electrical components with oil as a transfer medium. The process typically involves circulating cool oil past the heat source, thereby allowing it to absorb thermal energy, and then circulating the hot oil to a cooling mechanism where it sheds the heat. Oil is an ideal liquid coolant medium because it has a higher boiling point than water and can be used for cooling components with temperatures in excess of 212 °F (100 °C). It is also an electrical insulator when free of moisture and impurities. The oils in cooling applications are typically mineral varieties produced as byproducts in the petroleum refinement process, though plant varieties are sometimes used.

These byproducts of petroleum refinement are typically low to medium viscosity, colorless combinations of alkanes and cyclic paraffins. Several additives are included in cooling oils to enhance their performance including corona and arc suppressants, fire retardants, and corrosion inhibitors. This form of cooling is typically an immersion process where heat sources operate within an oil bath. The process relies on the oil absorbing thermal energy from direct contact with the hot equipment. Once heated, the oil then circulates through convection or is pumped out of contact with the heat source to a radiator where it sheds the heat into water or the air. It then moves back to the heat source to repeat the cycle. This process is a good example of heat transfer cooling where thermal energy is moved or transferred from a high temperature source to a low temperature sink or absorber.

Electrical oil cooling applications include transformers, switchgear, and oil bath welding machines. Oil is also used to cool high performance electronic components; several experimental computers feature main boards and processors totally submerged in mineral oil. Mechanical oil cooling applications include machining operations such as cutting, milling, and turning where oil is used to lubricate and cool the tool tip. The lubricating oil in automobile engines also serves as a coolant, thereby absorbing heat from the combustion area and shedding it through a separate oil cooler or the reserve oil in the engine sump. Large industrial gearboxes and drive trains also utilize combined oil lubrication and cooling.

1. Oil cooling is the process of_____.
   A. removing heat from machinery
   B. producing heat
   C. absorbing oil
   D. involving energy
2. The process typically involves circulating cool oil past_____.
   A. liquid coolant
   B. the heat source
   C. cyclic paraffins
   D. higher boiling
3. Oil is an ideal _____.
   A. liquid coolant
   B. thermal energy
   C. heat source
   D. moisture
4. When free of moisture and impurities, oil is _____.
   A. thermal energy
   B. heat source
   C. electrical insulator
   D. electrical component
5. This form of cooling is an immersion process where heat sources operate within _____.
   A. electronic components
   B. oil bath
   C. fire retardants
   D. heating

2. Answer the questions.

1. What is oil cooling?
2. Why is oil an ideal liquid coolant medium?
3. Under what conditions can it be an electrical insulator?
4. What does the process of heat transfer cooling consist of?
5. What do electrical oil cooling applications include?

Text 2

3. Read the text about WOODEN GRANULES. For questions 1–5, choose the best answer A, B, C or D.

WOODEN GRANULES

Wooden granules are usually used with the purpose of burning in fireplaces and heating devices with free flame, which are placed inside premises and return warmth as a result of incandescence or convection. This method of incandescence is considered to be the most comfortable for people. Fireplaces contain separated from the combustion chamber special small capacity with granules store, from which granules are automatically moved to the combustion chamber. Granules burn in it behind the observation glass. The length of the burning process is from 24 to 100 hours. This reservation can be refilled by hand even during the burning process. Movement of granules from buffer capacity to combustion chamber is automatically organized with the help of screw. At the same time heating power can be fixed by hand or regulated with the help of thermostat (range of the power from 2 to 10 kilowatt or from 3 to 15 kilowatt).

Some producers also offer heaters with remote control. Correlation of the air combustion, the quantity of granules and temperature of operation are controlled with the help of electronic-digital devices. It makes possible to improve the burning process, the emission of harmful substances is trifling and the coefficient of efficiency is very high. Fireplaces with hot-water heating, in opposite with forced-air heating devices, contain water reservoir to which hot-water supply can be connected. As a result fireplaces turn into central heating devices. In many systems water reservoir has such size that 60–80 % of the heating power got to heating contour and the rest power in the form of incandescence and convection heating move directly to the heated rooms. The heater cannot be used in summer that is why it is suggested to combine it with thermal solar device, used for warming of drinking water. But heating system of the kind (fireplace with water contour) can be used only for heating of objects with low warmth requirements, for instance for low-rise buildings.

Heating devices working on wooden granules are automatically regulated. Wooden granules are inflamed by means of electricity. It is appropriate to combine boiler working on wooden granules with hot water storage device. Moreover the heating system may include heating solar device. Different combinations are available on the market: boilers working on logs, in which wooden granules as well as wood chips can be burned. The only disadvantage of such heating system is the need to remove ashes from time to time and regularly clean heating surface. Cleaning can be made in automatic regime, although this will require increase of investments.

1. Fireplace is _____.
   A. hot-water storage device
   B. an electronic-digital device
   C. a heating device with free flame
   D. an electric device
2. Fireplaces contain_____.
   A. the combustion chamber
   B. harmful substances
   C. thermal solar device
   D. heating device
3. Correlation of the air combustion is controlled with the help of _____.
   A. hot water storage device
   B. heating solar device
   C. electronic-digital devices
   D. thermal solar device
4. Coefficient of efficiency is very _____.
   A. low
   B. trifling
   C. high
   D. soaring
5. Fireplace with water contour can be used for _____.
   A. warming of drinking water
   B. removing ashes
   C. cleaning heating surface
   D. improving the burning process

4. Answer the questions.

1. Where are wooden granules usually used?
2. How is the movement of granules from buffer capacity to combustion chamber organized?
3. How long is the burning process?
4. How is the temperature of operation controlled?
5. What is the disadvantage of such heating systems?

WRITING

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

REGENARATIVE HEAT EXCHANGER

In a Stirling engine, the regenerator is an internal heat exchanger and temporary heat store placed between the hot and cold spaces such that the working fluid passes through it first in one direction then the other. Its function is to retain within the system that heat which would otherwise be exchanged with the environment at temperatures intermediate to the maximum and minimum cycle temperatures, thus enabling the thermal efficiency of the cycle to approach the limiting Carnot efficiency defined by those maxima and minima.

The primary effect of regeneration in a Stirling engine is to increase the thermal efficiency by 'recycling' internal heat which would otherwise pass through the engine irreversibly. As a secondary effect, increased thermal efficiency yields a higher power output from a given set of hot and cold end heat exchangers. It is these which usually limit the engine's heat throughput. In practice this additional power may not be fully realized as the additional 'dead space' (unswept volume) and pumping loss inherent in practical regenerators reduces the potential efficiency gains from regeneration. The regenerator is the key component invented by Robert Stirling and its presence distinguishes a true Stirling engine from any other closed cycle hot air engine. Many small 'toy' Stirling engines, particularly low temperature difference (LTD) types, do not have a distinct regenerator component and might be considered hot air engines, however a small amount of regeneration is provided by the surface of displacer itself and the nearby cylinder wall, or similarly the passage connecting the hot and cold cylinders of an alpha configuration engine. In small, low power engines this may simply consist of the walls of the cold space(s), but where larger powers are required a cooler using a liquid like water is needed in order to transfer sufficient heat.

Self-Study (KEYS)

Text 1

Keys: 1A, 2B, 3A, 4C, 5B.

Task 2

1. Oil cooling is the process of removing heat from machinery and electrical components with oil as a transfer medium.
2. Oil is an ideal liquid coolant medium because it has a higher boiling point than water and can be used for cooling components with temperatures in excess of 212 °F (100 °C).
3. It is also an electrical insulator when free of moisture and impurities.
4. Several additives are included in cooling oils to enhance their performance including corona and arc suppressants, fire retardants, and corrosion inhibitors. This form of cooling is typically an immersion process where heat sources operate within an oil bath.
5. Electrical oil cooling applications include transformers, switchgear, and oil bath welding machines.

Text 2

Keys: 1A, 2A, 3C, 4C, 5A.

Task 2

1. Wooden granules are usually used with the purpose of burning in fireplaces and heating devices with free flame, which are placed inside premises and return warmth as a result of incandescence or convection.
2. Movement of granules from buffer capacity to combustion chamber is automatically organized with the help of screw. At the same time heating power can be fixed by hand or regulated with the help of thermostat (range of the power from 2 to 10 kilowatt or from 3 to 15 kilowatt).
3. The length of the burning process is from 24 to 100 hours.
4. Correlation of the air combustion, the quantity of granules and temperature of operation are controlled with the help of electronic-digital devices
5. The only disadvantage of such heating system is the need to remove ashes from time to time and regularly clean heating surface.

CONTROL WORK № 2

Variant 1

READING

Text 1

1. Read the text. Choose the best word (A, B or C) for each space (1–10).

THE STERLING ENGINES

The Stirling engine is 1 …that is vastly different from amount of oxygen in our cars. Invented by Robert Stirling in 1816, the Stirling engine has the potential to be much more 2…. than a gasoline or diesel engine. But today, Stirling engines are used only in some very specialized applications, like in submarines or auxiliary 3… generators for yachts, where quiet operation is important. A Stirling engine uses the Stirling 4…, which is unlike the cycles used in internal 5… engines. The gasses used inside a Stirling engine never leave the engine. There are no 6… that vent high-pressure gasses, as in a gasoline or diesel engine, and there are no explosions taking place. Because of this, Stirling engines are very quiet. The Stirling cycle uses 7…, which could be anything from gasoline to solar energy to the heat produced by decaying plants. No combustion takes place inside the cylinders of the engine. There are different types of Stirling engines. A displacer-type engine has one piston and a displacer. The displacer serves to control when the 8….is heated and when it is cooled. In order to run, the engine requires a 9..... difference between the top and the bottom of the large cylinder. In this case, the difference between the temperature of the hand and the air around it is 10..... to run the engine.

1 A. heat engine	**B.** an internal engine	**C.** a hot engine
2 A. fluid	**B.** enclosed	**C.** efficient
3 A. torque	**B.** power	**C.** fluid
4 A. cycle	**B.** compression	**C.** usage
5 A. compression	**B.** combustion	**C.** conversion
6 A. exhaust valves	**B.** specialized applications	**C.** generators for yachts
7 A. diesel engine	**B.** combustion	**C.** an external heat source
8 A. gas chamber	**B.** temperature difference	**C.** decaying plants
9 A. compression	**B.** temperature	**C.** a hot engine
10. A.not enough	**B.** right	**C.** enough

Text 2

2. Match the questions (A–F) to the statements (1–5), as in the example (0).

A. What is combustion?
B. What does the time needed for burning to begin depend on?
C. What substance is more readily ignited?
D. What is an example of burning a fuel?
E. What reactions do combustion reactions involve?
F. What experiments did A. L. Lavoisier perform?

A-0. *Combustion is a rapid chemical reaction of two or more substances with a characteristic liberation of heat and light*; *it is commonly called burning.*

1. The burning of a fuel (e.g., wood, coal, oil, or natural gas) in air is a familiar example of combustion.
2. Combustion need not involve oxygen; e.g., hydrogen burns in chlorine to form hydrogen chloride with the liberation of heat and light characteristic of combustion. Combustion reactions involve oxidation and reduction.
3. Before a substance will burn, it must be heated to its ignition point, or kindling temperature. Pure substances have characteristic ignition points. Although the ignition point of a substance is essentially constant, the time needed for burning to begin depends on such factors as the form of the substance and the amount of oxygen in the air.
4. A finely divided substance is more readily ignited than a massive one; e.g., sawdust ignites more rapidly than does a log. The vapors of a volatile fuel such as gasoline are more readily ignited than is the fuel itself. The rate of combustion is also affected by these factors, particularly by the amount of oxygen in the air.
5. In 1774 the French chemist A. L. Lavoisier performed experiments that led to the modern understanding of the nature of combustion.

VOCABULARY AND GRAMMAR

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

1. Originally an engine was a mechanical device that converted force into _____ .
A. motion
B. fuel
C. substance

2. Engines using human or animal power, water, wind and even _____ power date back to antiquity.
A. electric
B. steam
C. physical

3. _____ distinguishes a true Stirling engine from any other closed cycle hot air engine.
A. The heat pump
B. The heat exchanger
C. The regenerator

4. The still-war_____ was recycled as feed water for the boiler.
A. condensate
B. device
C. fuel

5. "Combustion" refers to burning fuel with an oxidizer, to supply the _____.
A. reaction
B. heat
C. boiler

6. Some producers also offer heaters with _____.
A. remote control
B. amount of oxygen
C. amount of oxygen

7. The Stirling engine encloses a fixed quantity of permanently gaseous fluid such as _____.
A. air
B. breath
C. wind

8. Widespread use of energy _____ could therefore reduce global warming emissions.
A. recycle
B. recycling
C. recycled

9. The large surface area heating elements _____excellent temperature uniformity within the working volume.
A. provide
B. provides
C. providing

10. A heat exchanger _____a piece of equipment built for efficient heat transfer.

A. am
B. be
C. is

TRANSLATION

4. Translate the sentences from English into Russian.

1. In modern usage, the term “engine” is used to describe devices capable of performing mechanical work, as in the original steam engine.
2. Engines using human or animal power, water, wind and even steam power date back to antiquity.
3. The design challenge for a Stirling engine regenerator is to provide sufficient heat transfer capacity without introducing too much additional internal volume.
4. Typical of heat engines, the general cycle consists of compressing cool gas, heating the gas, expanding the hot gas, and finally cooling the gas before repeating the cycle.
5. Fireplaces contain separated from the combustion chamber special small capacity with granules store.
6. Heat exchangers are normally used for the transfer and useful elimination or recovery of heat without an accompanying phase change.
7. Each vacuum furnace is supplied as a complete system including vacuum chamber, metallic heat zone, power supply, vacuum pumps and a programmable control system.
8. A heat exchange is a piece of equipment built for efficient heat transfer from one medium to another.
9. An enclosed chamber in which heat is produced to heat buildings is defined as a furnace.
10. A regenerative heat wheel is a revolving disc filled a with an air-permeable medium including a desiccant.

WRITING

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

Our fuel cubes are a proven, clean-burning, high-BTU fuel alternative for paper mills and other wood- or coal-burning plants. Made from recycled wood, plastics, and other challenging recyclables, they divert materials that would have otherwise been destined for the landfill and produce an alternative fuel that's better for the environment. Customers drastically reduce their waste hauling costs and help meet environmental goals or guidelines. Mills, plants, and kilns get better performance from our high-BTU fuels. Fewer natural resources are pulled from the environment to create fuel. Air pollution is minimized with our cleaner-burning alternative fuel. Always striving for new solutions and outlets for recyclables, Balcones Resources is working with a technology company to develop a second alternative fuel for the ethanol market. Today, this new process generates fuel that's ideally suited for cement kilns. Tomorrow, these same waste streams could be converted into higher value, non-food feedstock based, automobile grade ethanol. Plastics help traditional energy recovery technology work better. Because plastics have a higher energy value than other components of municipal solid waste, they help to significantly increase the efficiency of the energy recovery process in traditional energy from waste facilities.

CONTROL WORK № 2

Variant 2

READING

Text 1

1. Read the article. Choose the best word (A, B or C) for each space (1–10).

SELECT A SUITABLE HEAT EXCHANGER

Heat exchangers control a system or substance's temperature by adding or removing 1….energy. While there are many different sizes and types of heat exchangers, they all use a thermally conducting element generally in the form of a tube or plate – to separate two 2….., such that one can transfer thermal energy to the other. Home heating systems use a heat exchanger to transfer 3…. heat to water or air, which is circulated through the house. 4….use locally available water or ambient air in quite large heat exchangers to condense steam from the turbines. Many industrial applications use small heat exchangers to create or 5…. a required temperature.

In industry, heat exchangers do many tasks, ranging from 6…. lasers to establishing a controlled sample temperature prior to chromatography. Anyone who wants to use a heat exchanger deals with a basic challenge: fully defining the problem to be solved, which requires an understanding of the 7… and transport 8..... of fluids. It is necessary to define a specific 9….problem and select a suitable 10.....exchanger.

1 A. thermal	**B.** conventional	**C.** renewable
2 A. heat	**B.** fluids	**C.** energy
3 A. control a system	**B.** industrial applications	**C.** combustion gas
4 A. home heating systems	**B.** power plants	**C.** thermal energy
5 A. maintain	**B.** dehumidify	**C.** insulate
6 A. cooling	**B.** exchanging	**C.** demidifying
7 A. control	**B.** thermodynamic	**C.** available
8 A. facilities	**B.** properties	**C.** components
9 A. heat-transfer	**B.** conventional	**C.** thermal
10 A. heat	**B.** fluid	**C.** cooling

Text 2

2. Match the questions (A–F) to the statements (1–5), as in the example (0).

A. What appliance did Thomas Savery invent?
B. Where did the Watt steam engines replace Newcomen engines?
C. What made the appliance impracticable?
D. What was the engine able to do?
E. What principle was the Newcomen engine based on?
F. What was new about the Watt steam engine?

A-0. *In 1698, the English mechanical designer Thomas Savery invented a steam pumping appliance that drew water directly from a well by a vacuum, then sent it up to a higher level by steam pressure.*

1. The appliance was also proposed for draining mines, but its pumping height was limited, making this impracticable. It consumed a large amount of fuel compared with later engines.
2. The solution to draining deep mines was found by Thomas Newcomen who developed an "atmospheric" engine also working on the vacuum principle. The Newcomen engine was more powerful than the Savery engine.
3. For the first time water could be raised from a depth of over 150 feet. The engine was able to replace a team of 500 horses. Seventy-five Newcomen pumping engines were installed at mines in Britain, France, Holland, Sweden and Russia. In the next fifty years only a few small changes were made to the engine design.
4. The Watt steam engine was the first type of steam engine to make use of steam at a pressure just above atmospheric to drive the piston helped by a partial vacuum. Improving on the design of the 1712 Newcomen engine, the Watt steam engine was the next great step in the development of the steam engine.
5. Offering a dramatic increase in fuel efficiency, the new design replaced Newcomen engines in areas where coal was expensive, and then went on to be used in the place of most natural power sources such as wind and water. James Watt's design became synonymous with steam engines.

VOCABULARY AND GRAMMAR

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

1. Oil _____ is the process of removing heat from machinery and electrical components with oil as a transfer medium.
   A. heating
   B. cooling
   C. reducing
2. Heat exchangers control a system or substance's _____by adding or removing thermal energy.
   A. energy
   B. system
   C. temperature
3. Heat _____ is implemented in heat sources like a steel mill.
   A. recovery
   B. engine
   C. machinery
4. Fireplaces with hot-water heating contain water reservoir to which ____can be connected.
   A. hot-water supply
   B. a steel mill.
   C. coolant
5. In a Stirling_____ , the regenerator is an internal heat exchanger.
   A. windmill
   B. engine
   C. energy
6. The primary effect of regeneration in a Stirling engine is to increase the _____efficiency by 'recycling' internal heat.
   A. global
   B. thermal
   C. atmospheric
7. This type of condenser_____ as a surface condenser.
   A. is known
   B. are known
   C. will known
8. In 1774 John Wilkinson _____ boring machine.
   A. invent
   B. invents
   C. invented

9. Thermal energy _____and measured by heat of any kind.
   A. generated
   B. generate
   C. is generated
10. Electric cars with regenerative breaking seem to be the best candidate for energy _____.
   A. recovery
   B. heat
   C. temperature

TRANSLATION

4. Translate the sentences from English into Russian.

1. Widespread use of energy recycling could therefore reduce global warming emissions by an estimated 20 percent.
2. The Newcomen engine was more powerful than the Savery engine.
3. These improvements allowed the steam engine to replace the water wheel and horses as the main sources of power for British industry.
4. The greater fuel-efficiency of their engines meant that they were most attractive in areas where fuel was expensive.
5. The regenerator is the key component invented by Robert Stirling and its presence distinguishes a true Stirling engine from any other closed cycle hot air engine.
6. These systems may be configured as a hydrogen furnace, a vacuum furnace or both.
7. Oil cooling is the process of removing heat from machinery and electrical components with oil as a transfer medium.
8. Most energy recovery systems exchange thermal energy in either sensible or latent form.
9. A variety of work volumes, temperature, and processing capabilities are offered to match the system to the customer's requirements.
10. Most often the barrier between the fluids is a metal wall such as that of a tube or pipe.

WRITING

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

ENERGY RECOVERY INC. SOLUTIONS
DELIVER UNIQUE ENERGY SAVINGS

ERI (Energy Recovery Inc.) develops award-winning, industry-leading products that offer innovations solutions to global industries. Our technologies have revolutionized the water industry, making desalination a viable economic. By utilizing ERI products, desalination plants recover and recycle massive amounts of otherwise wasted fluid energy many times over. This significantly reduces their carbon footprint, and saves our clients more than $1 billion in energy costs each year. Imagine the impact now that ERI is focusing on energy recovery from all industrial flows. In gas processing applications, innovative ERI gas processing solutions deliver unique energy savings and reduced capital and operational costs. With installations on practically every continent, our solutions are best suited for industrial applications that translate into energy savings.

For more than a quarter of a century we have developed technologies that recapture the otherwise lost energy from fluids at the highest efficiencies possible, making desalination affordable. Our flagship technology, called the PX Pressure Exchanger™ (PX™) device, provides the highest efficiencies and guarantees the best economic solution in energy recovery for desalination. In addition, the low investment Turbo Charger solution offers substantial savings and quality for those sensitive to upfront costs and where power costs are very minimal. ERI pumping solutions are efficient, robust and reliable. In gas processing applications, the innovative ERI gas processing solution delivers unique energy saving and reduced capital and operational costs.

CONTROL WORK № 2

Variant 3

READING

Text 1

1. Read the article. Choose the best word (A, B or C) for each space (1–10).

ENGINES

Do you know what the first engine was1….? It was called the "water wheel". This was an ordinary wheel with blades fixed to it, and the current of a river turned it. These first engines were 2….for irrigating fields. Then a wind-powered engine was invented. This was a wheel, but a very small one. Long wide wooden blades were 3……to it. The new engine was driven by the wind. Some of these ones can still be seen in the country. Both of these, the water- and wind-operated engines are very economical. They do not need fuel 4….. to function. But they are dependent on the weather. Many years passed and people invented a new engine, one operated by steam. In a steam engine, there is a furnace and a boiler. The furnace is filled with wood or coal and then lit. The fire heats the water in the boiler and when it boils, it 5…… steam which does some useful work. The more coal is put in the furnace, the stronger the fire is burning. The more steam there is, the faster a train or a boat is moving. The steam engine drove all sorts of machines, for example, steam ships and steam locomotives. Indeed, the very first aero plane built by A.F. Mozhaisky also had a steam engine. However, the steam engine had its 6…….... It was too large and heavy, and needed too much fuel. The imperfections of the steam engine led to the design of a new type. It was 7…….the internal combustion engine, because its fuel ignites and burns inside the engine itself and not in a furnace. It is smaller and lighter than a steam engine because it does not have a boiler. It is also more 8……., as it uses better-quality fuel: petrol or kerosene. The internal combustion engine is now used in cars, diesel locomotives and motor ships. But to enable aero planes to fly 9.....than the speed of sound another, more powerful engine was needed. Eventually, one was invented and it was given the name "jet engine". The gases in it reach the temperature of over a thousand degrees. It is made of a very 10.....metal so that it will not melt.

1 A. look	**B.** like	**C.** remember
2 A. used	**B.** put	**C.** taken
3 A. put	**B.** closed	**C.** attached
4 A. in order	**B.** suiting	**C.** keeping
5 A. modifies	**B.** keeps into	**C.** turns into
6 A. peculiarities	**B.** advantages	**C.** disadvantages
7 A. taken	**B.** called	**C.** named
8 A. powerful	**B.** thermal	**C.** conventional
9 A. faster	**B.** quieter	**C.** slower
10A. persistent	**B.** resistant	**C.** solid

Text 2

2. Match the questions (A–F) to the statements (1–5), as in the example (0).

A. How are the hot zones designed to operate?
B. How may these systems be configured?
C. What is the highest operation temperature?
D. What do APF and CPF provide?
E. What heating elements provide temperature uniformity within the working volume?
F. What are Automatic Processing Furnace systems (APF) used for?

A-0. *Hot zones are designed to operate in wet or dry hydrogen*, *fully dissociate dry ammonia*, *inert gasses*, *nitrogen*, *or vacuum.*

1. Automatic processing furnace systems (APF) and ceramic processing furnace systems (CPF) provide fully automatic, unattended operation.
2. At temperatures to 2500 °C. parts processing may be cycled in under two hours with rapid temperature ramp up (> 100 °C/min) and ramp down (>300 °C/min).
3. These systems may be configured as a hydrogen furnace, a vacuum furnace or both.
4. Thermal Technology's APF and CPF furnaces are used for processing high purity advanced ceramic materials which are susceptible to contamination in traditional graphite furnaces. These furnaces also process refractory metals under high vacuum conditions at elevated temperatures and can be supplied without high vacuum pumps for processing under inert or reducing gas atmospheres.
5. The large surface of heating elements provide excellent temperature uniformity within the working volume. Molybdenum sheet, molybdenum wire mesh, or tungsten wire mesh heating elements are used, depending on the operating temperature.

VOCABULARY AND GRAMMAR

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

1. Originally an engine was a mechanical device that converted force into _____.
   A. motion
   B. fuel
   C. substance
2. The large surface of heating elements _____excellent temperature uniformity within the working volume.
   A. provide
   B. provides
   C. providing
3. _____ distinguishes a true Stirling engine from any other closed cycle hot air engine.
   A. the heat pump
   B. the heat exchanger
   C. the regenerator
4. The still-warm _____ was recycled as feed water for the boiler.
   A. condensate
   B. device
   C. fuel
5. "Combustion" refers to burning fuel with an oxidizer, to supply the _____.
   A. reaction
   B. heat
   C. boiler
6. The primary effect of regeneration in a Stirling engine is to increase the _____ efficiency by 'recycling' internal heat.
   A. global
   B. thermal
   C. atmospheric
7. This type of condenser _____ as a surface condenser.
   A. is known
   B. are known
   C. will known
8. In 1774 John Wilkinson _____ a boring machine.
   A. invent
   B. invents
   C. invented

9. Thermal energy_____ and measured by heat of any kind.
   A. generated
   B. generate
   C. is generated
10. Electric cars with regenerative breaking seem to be the best candidate for energy _____.
   A. recovery
   B. heat
   C. temperature

TRANSLATION

4. Translate the sentences from English into Russian.

1. In modern usage, the term “engine” is used to describe devices capable of performing mechanical work, as in the original steam engine.
2. Engines using human or animal power, water, wind and even steam power date back to antiquity.
3. The design challenge for a Stirling engine regenerator is to provide sufficient heat transfer capacity without introducing too much additional internal volume.
4. Typical of heat engines, the general cycle consists of compressing cool gas, heating the gas, expanding the hot gas, and finally cooling the gas before repeating the cycle.
5. Fireplaces contain separated from the combustion chamber special small capacity with granules store.
6. Heat exchangers are normally used for the transfer and useful elimination or recovery of heat without an accompanying phase change.
7. Each vacuum furnace is supplied as a complete system including vacuum chamber, metallic heat zone, power supply, vacuum pumps and a heat exchange is a piece of equipment built for efficient heat transfer from one medium to another.
8. An enclosed chamber in which heat is produced to heat buildings is defined as a furnace.
9. A regenerative heat wheel is a revolving disc filled with an air-permeable medium including a desiccant.

WRITING

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

BENEFITS OF GEOTHERMAL HEAT PUMP SYSTEMS

The biggest benefit of GHPs is that they use 25–50 % less electricity than conventional heating or cooling systems. This translates into a GHP using one unit of electricity to move three units of heat from the earth. According to the EPA, geothermal heat pumps can reduce energy consumption and corresponding emissions up to 44 % compared to air source heat pumps and up to 72 % compared to electric resistance heating with standard air-conditioning equipment. GHPs also improve humidity control by maintaining about 50 % of relative indoor humidity, making GHPs very effective in humid areas. Geothermal heat pump systems allow for design flexibility and can be installed in both new and retrofit situations. Because the hardware requires less space than that needed by conventional HVAC systems, the equipment rooms can be greatly scaled down in size, freeing space for productive use. GHP systems also provide excellent 'zone' space conditioning, allowing different parts of your home to be heated or cooled to different temperatures.

Because GHP systems have relatively few moving parts, and because those parts are sheltered inside a building, they are durable and highly reliable. The underground piping often carries warranties of 25–50 years, and the heat pumps often last 20 years or more. Since they usually have no outdoor compressors, GHPs are not susceptible to vandalism. On the other hand, the components in the living space are easily accessible, which increases the convenience factor and helps ensure that the upkeep is done on a timely basis.

CONTROL WORK № 2

Variant 4

READING

Text 1

1. Read the article. Choose the best word (A, B or C) for each space (1–10).

THE GREAT INVENTION OF JAMES WATT

By the middle of the 18th century, however, the childhood of the steam-engine was already drawing to an end. A young Scotsman by 1……of James Watt, the fifth son of a ship's carpenter gave the machine its most efficient form – and thereby helped to revolutionize the British way of life. He was a weakly child, suffering from headaches and unable to go to school. His mother taught him, and as soon as James could read he began to devour books. At the age of 15 he had learnt most of what was then known about physics, and his father sent him to Glasgow to study advanced mechanics. Later, his professor helped him to set himself up as an instrument-maker and 'machine-doctor' in a shop in the University building. One day in 1763 – Watt was 27 years old – he was 2……to repair a small model of a Newcomen engine, which was needed for the natural-science lectures. The little machine refused to work properly, stopping again and again after a few strokes of the piston. Watt examined it 3…….. It had a boiler in which the steam was produced. At the bottom of the cylinder were two valves, one to admit the steam and the other to let a jet of cold water cool the 4…….when the piston had reached its highest point .This caused the steam to condense – and as steam takes up 1,700 times more space than water a vacuum was created under the piston, and it was forced down by the pressure of the atmosphere. It was this idea of the separate 5……which made the steam-engine the first great prime mover in modern times. Now the cylinder could remain hot, without having to be cooled and reheated with each cycle; he even put a steam jacket around of 6…..which the Newcomen engine needed. He also closed the upper end of the cylinder, which was open in the Newcomen engine, and built around the piston rod what is now called a stuffing-box; instead of making the air push the piston down he used steam for this purpose too, introducing it above the piston as well as below in the cylinder. The fourth of his improvements was an air pump to 7…….the vacuum on his condenser by pumping out the condensed water and air from it. Watt's first

model was single acting and could be used only for pumping. But great many tasks were awaiting the 8..... New machines in various branches of industry 9.....power; goods 10.....be moved, people transported.

1 A. the headline	**B.** the name	**C.** the call
2 A. asked	**B.** told	**C.** said
3 A. attentively	**B.** carefully	**C.** properly
4 A. heating system	**B.** heat-transfer	**C.** cylinder
5 A. condenser	**B.** heat-transfer	**C.** furnace system
6 A. the water	**B.** the fuel	**C.** the steam
7 A. maintain	**B.** control	**C.** keep
8 A. steam-engine	**B.** heat-transfer	**C.** cylinder
9 A. required	**B.** needed	**C.** considered
10A. were to	**B.** will	C. can be

Text 2

2. Match the questions (A–F) to the statements (1–5), as in the example (0).

A. What appliance did Thomas Savery invent?
B. Where did the Watt steam engines replace Newcomen engines?
C. What made the appliance impracticable?
D. What was the engine able to do?
E. What principle was the Newcomen engine based on?
F. What was new about the Watt steam engine?

A-0. *In 1698, the English mechanical designer Thomas Savery invented a steam pumping appliance that drew water directly from a well by a vacuum, then sent it up to a higher level by steam pressure.*

1. The appliance was also proposed for draining mines, but its pumping height was limited, making this impracticable. It consumed a large amount of fuel compared with later engines.
2. The solution to draining deep mines was found by Thomas Newcomen who developed an “atmospheric” engine also working on the vacuum principle. The Newcomen engine was more powerful than the Savery engine.
3. For the first time water could be raised from a depth of over 150 feet. The engine was able to replace a team of 500 horses. Seventy-five Newcomen pumping engines were installed at mines in Britain, France, Holland, Swe-

den and Russia. In the next fifty years only a few small changes were made to the engine design.

4. The Watt steam engine was the first type of steam engine to make use of steam at a pressure just above atmospheric to drive the piston helped by a partial vacuum. Improving on the design of the 1712 Newcomen engine, the Watt steam engine was the next great step in the development of the steam engine.
5. Offering a dramatic increase in fuel efficiency, the new design replaced Newcomen engines in areas where coal was expensive, and then went on to be used in the place of most natural power sources such as wind and water. James Watt's design became synonymous with steam engines.

VOCABULARY AND GRAMMAR

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

1. Total demand for fuel increased considerably with _____.
   A. the industrial revolution
   B. the technological process
   C. sustainable energy development
2. The most easily available form of fuel is _____.
   A. coal
   B. wood
   C. gas
3. In 1774 John Wilkinson _____ a boring machine.
   A. invent
   B. invents
   C. invented
4. The cleanest fossil fuel is_____.
   A. oil
   B. natural gas
   C. coal
5. Renewable energy engineers _____.
   A. help to ensure that our world is preserved for humans
   B. are focused on finding clean, innovative ways to supply energy
   C. work in building and transport structures
6. The _____ repairs the equipment on the rig.
   A. electrical
   B. electricity
   C. electrician

7. 90 % of energy consumed is lost that's why the main problem is how we produce and _____energy resources.
   A. consumption
   B. consume
   C. consumed
8. The_____ is responsible for every engine in the factory.
   A. engineer
   B. engineering
   C. engine
9. Most of the energy we use originally came from _____.
   A. the air
   B. the ocean
   C. sun
10. Coal, petroleum, natural gas, and propane are fossil fuels. They are called fossil fuels because:_____.
    A. they are burned to release energy and they cause air pollution
    B. they were formed from the buried remains of plants and animals
    C. they are nonrenewable and will run out

TRANSLATION

4. Translate the sentences from English into Russian.

1. Widespread use of energy recycling could therefore reduce global warming emissions by an estimated 20 percent.
2. The Newcomen engine was more powerful than the Savery engine.
3. These improvements allowed the steam engine to replace the water wheel and horses as the main sources of power for British industry.
4. The greater fuel-efficiency of their engines meant that they were most attractive in areas where fuel was expensive.
5. The regenerator is the key component invented by Robert Stirling and its presence distinguishes a true Stirling engine from any other closed cycle hot air engine.
6. These systems may be configured as a hydrogen furnace, a vacuum furnace or both.
7. Oil cooling is the process of removing heat from machinery and electrical components with oil as a transfer medium.
8. Most energy recovery systems exchange thermal energy in either sensible or latent form.

9. A variety of work volumes, temperature, and processing capabilities are offered to match the system to the customer's requirements.
10. Most often the barrier between the fluids is a metal wall such as that of a tube or pipe.

WRITING

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

ABSORPTION HEAT PUMPS

Absorption heat pumps are essentially air-source heat pumps driven not by electricity, but by a heat source such as natural gas, propane, solar-heated water, or geothermal-heated water. Because natural gas is the most common heat source for absorption heat pumps, they are also referred to as gas-fired heat pumps. There are also absorption (or gas-fired) coolers available that work on the same principal. Unlike some absorption heat pumps, however, these are not reversible and cannot serve as a heat source.

Residential absorption heat pumps use an ammonia-water absorption cycle to provide heating and cooling. As in a standard heat pump, the refrigerant (in this case, ammonia) is condensed in one coil to release its heat; its pressure is then reduced and the refrigerant is evaporated to absorb heat. If the system absorbs heat from the interior of your home, it provides cooling; if it releases heat to the interior of your home, it provides heating.

The difference in absorption heat pumps is that the evaporated ammonia is not pumped up in pressure in a compressor, but is instead absorbed into water. A relatively low-power pump can then pump the solution up to a higher pressure. The problem then is removing the ammonia from the water, and that's where the heat source comes in. The heat essentially boils the ammonia out of the water, starting the cycle again. A key component in the units now on the market is generator absorber heat exchanger technology, or GAX, which boosts the efficiency of the unit by recovering the heat that is released when the ammonia is absorbed into the water. Other innovations include high-efficiency vapor separation, variable ammonia flow rates, and low-emissions, variable-capacity combustion of the natural gas.

GRAMMAR REFERENCE

THE PASSIVE VOICE

1.1. The Formation of the Passive Voice
to be + V_3

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

1.2. The Use of the Passive Voice

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

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

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

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

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

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

* when we want to emphasize the agent.

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

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

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

EXERCISES

1. Form the Passive from the verbs.

***Example*:** to take – to be taken

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

11. Change from active into passive.

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

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

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

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

9. (The prisoners/take/to prison/now)…….
10. (The book/read/by next week) ……

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

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

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

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

PROGRESS CHECK TEST 1 (*The Passive forms*)

15. Choose the correct item.

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

4. The salad was made … lettuce, onions and cucumber.
   a) of b) by c) with

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

TYPES OF QUESTIONS

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

1. GENERAL QUESTIONS (or YES/NO QUESTIONS)

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

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

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

There are some auxiliary verbs the choice of which depends on the tense of the verb. These are:
am/is/are/was/were/do/does/did/have/has/had/shall/will.

There are some modal verbs. These are:
an/could/may/might/must/should/ought.

Examples of general questions:

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

2. SPECIAL QUESTIONS (or WH - QUESTIONS)

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

The word order in a special question is:

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

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

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

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

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

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

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

Examples of special questions:

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

3. QUESTIONS TO THE SUBJECT

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

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

Wh → verb → other parts of the sentence?

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

Examples of questions to the subject:

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

Compare with those of special questions:

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

Check yourself

Put the words in the correct order.

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

Keys:

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

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

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

Examples of tag questions:

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

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

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

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

Check yourself

Choose the correct letter.

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

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

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

5. ALTERNATIVE QUESTIONS

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

Examples of alternative questions:

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

Check yourself

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

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

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

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

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

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

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

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

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

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

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

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

CONDITIONALS

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

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

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

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

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

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

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

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

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

TYPES OF CONDITIONALS

Type	If-clause	Main clause
0	**If + present simple**	**present simple**
__If/When__ the sun __shines__, snow __melts__.		
1	**If + present simple/present cont./present perfect/ present perfect cont.**	**future/imperative/can/may/might/ must/should/could present bare infinitive**
__If__ he __doesn't pay__ the fine, he __will go__ to prison. *__If__ you __need help__, __come__ and __see__ me.* *__If__ you __have finished__ your work, we __can have__ a break.*		
2	**If + past simple or past Continuous**	**would/could/might + bare infinitive**
__If__ I __had__ time, I __would take up__ a sport. (but I don't have time-untrue in the present) *__If__ I __were__ you, I __would talk__ to your parents about it. (giving advice)*		
3	**If + past perfect or past perfect continuous**	**would/could/might + have + past participle**
__If__ she __had studied__ harder, she __would have passed__ the test. *__If__ he __hadn't been acting__ so foolishly, he __wouldn't have been punished__.*		

EXERCISES

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

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

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

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

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

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

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

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

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

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

5. Choose the correct form of the verbs.

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

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

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

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

7. Match the two halves of these sentences.

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

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

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

9. Complete the following sentences with your own ideas.

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

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

***Example*:**

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

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

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

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

WISHES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PROGRESS CHECK TEST 2 (*Conditionals*)

15. Choose the correct item.

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

12. The engine will start if you … this key.
a) will turn b) turn c) would turn

13. If John had come to the football match, he … it.
a) would have liked b) will like c) would like

14. I'll go home as soon as I … my work.
a) carry out b) will carry out c) would carry out

15. We won't have the meeting tomorrow unless everybody … .
a) will agree b) agree c) agrees

Keys to grammar exercises

THE PASSIVE VOICE

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

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

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

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

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

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

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

8 Keys: 1. Новая станция метро строится на нашей улице. 2. Когда вы вошли в лабораторию, испытывали прибор. 3. Этот вопрос не связан с проблемой, которая обсуждается сейчас. 4. Много разнообразных ма-

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

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

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

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

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

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

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

PROGRESS CHECK TEST 1 (The Passive forms)

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

CONDITIONALS

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

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

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

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

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

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

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

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

9 Student's individual answer

10 Keys: 1) had worked; 2) had taken; 3) hadn't played; 4) would you have crashed; 5) wouldn't have slept; 6) had come, would have had; 7) hadn't broken down, would have been; 8) Would you have studied, had liked; 9) wouldn't have got, hadn't wanted; 10) Would you have helped, had asked

11 Keys:

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

WISHES

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

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

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

PROGRESS CHECK TEST 2 (*Conditionals*)

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

APPENDIX

Рекомендации по написанию аннотации английского текста

(Abstract)

Рекомендуемый объем аннотации — 150–200 слов.

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

Аннотация выполняет следующие функции:

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

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

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

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

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

Аннотация (abstract) состоит из:

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

При написании аннотации следует использовать клишированные вводные слова:

Вводная часть:

The text deals with …

As the title implies the text describes …

The text is concerned with…

Основная часть

It is known that …

It should be noted about/that …

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

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

Пример составления аннотации:

Subwavelength Plasmonic Waveguides and Plasmonic Materials **This text is concerned with** surface plasmon based photonics materials to show possibility of creation such plasmonic device as plasmonic waveguide with new properties.

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

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

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

GLOSSARY

Unit 1. Energy

renewable – восстановимый, возобновляемый
Photovoltaic (PV) – фотогальванический
consumption – потребление; затрата, издержки, расход
share – доля; делить, распределять
capacity – мощность, нагрузка, производительность; пропускная способность
weather – подвергать(ся) атмосферным влияниям; переносить, выдерживать, переживать (бурю, натиск, испытание и т.п.)
derive – получать, извлекать
conventional – обычный, обыкновенный, традиционный
windmills – ветряк, ветродвигатель; ветроэнергетическая установка
blade – лопасть (винта пропеллера, весла и т.п.)
aerofoil – аэродинамическая поверхность; профиль (крыла); крыло
shaft – вал, ось, шпиндель
rim – обод (внешняя цилиндрическая поверхность)
concave – вогнутый;
untapped – неиспользованный, нетронутый
untapped resources – неиспользованные ресурсы
paramount – главный, основной, первостепенный
thermocouple – термоэлемент, термопара; термостолбик
circuits – цепь, контур; схема
semiconductor – полупроводник
landfill – мусорная свалка
reduce – ослаблять, понижать, сокращать, уменьшать
carbon dioxide – углекислый газ
residue – осадок; отстой
waste – отходы (производства), потеря, убыль; убыток, ущерб
solar array – солнечная батарея, батарея солнечных элементов; солнечная панель
solar battery – солнечная батарея
solar cell – солнечный элемент

Unit 2. Heating

furnace – горн; очаг; печь
maintenance – содержание и техническое обслуживание, уход; текущий ремонт
generate – производить; генерировать, делать

consume – потреблять, расходовать
insulate (from) – изолировать; отделять от
bleed – продувать; спускать воду, опоражнивать баки; спускать лишнее давление
trim the amount of – сократить количество
dehumidify – осушать, сушить
duct – трубопровод; труба; туннель; канал
air duct – вентиляционный канал, воздуховод
retrofit – модифицировать (модель)
add-on – добавление, дополнение, приставка (позволяющая увеличить возможности технического устройства)
feasible – реальный, выполнимый
condenser – холодильник, конденсатор
conduit – трубопровод; водопроводная труба, изоляционная трубка
evaporator – испаритель
suspend (from) – вешать, подвешивать, свешиваться
heating отопление
slab – плита; лист, пластина
surface – поверхность
concrete – бетон
radiant – излучающий
to radiate – распространяться, излучать (свет, тепло)
to circulate – циркулировать, двигаться по кругу; передвигаться в пределах ограниченного круга
to distribute – распределять
vent – входное или выходное отверстие; отдушина, воздушный клапан

Unit 3. Engines

cyclic compression – сжатие; сокращение, компрессия
a heat engine – тепловой двигатель
expansion – увеличение, расширение
fluid – текучая среда (жидкость или газ)
conversion – превращение, изменение; переход (из одного состояния в другое)
a combustion engine – двигатель внутреннего сгорания
combustion – горение, возгорание, сжигание
transfer – перенос; перемещение
input – потребляемая мощность; подводимая мощность
enclose – заключать (где-л., в чём-л.)
efficiency – отдача, коэффициент полезного действия ,эффективность,

результативность, действенность
usage употребление, применение, использование
device – устройство, приспособление; механизм; аппарат, машина, прибор
exert – приводить в действие, вызывать (напряжение)
torque – вращающий момент
ingenious – изобретательный, находчивый, искусный
a heat exchanger – теплообменник
compression – сжатие; сокращение; компрессия
compression chamber – камера сжатия/сгорания
quantity – количество; численность, величина; размер; параметр
supply – питание, подача, подвод, приток, питать
supply with – снабжать
restrict – ограничивать
fuel – топливо, бензин; легковоспламеняющееся вещество (любой вид топлива)
retain – держать; удерживать, аккумулировать; вмещать
regeneration – регенерация, рекуперация; восстановление
resistance – сопротивление

Unit 4. Heat Exchangers

recovery – возврат, получение вновь, получение обратно
input – потребляемая мощность; подводимая мощность
latent – скрытый, латентный
incandescence – накал, накаливание; белое каление
convection – конвекция
combustion chamber – камера сгорания
capacity – мощность, нагрузка, вместимость, емкость
observations – наблюдения
premises – помещение, дом
warmth – тепло
length – продолжительность, протяженность,
buffer – резервный запас
supply – питание, подача, подвод, приток
hydrogen – водород
dissociate – разъединять, диссоциировать; разлагать
nitrogen – азот
molybdenum – молибден
tungsten – вольфрам
mesh – петля, ячейка сети, зацепление .

requirements – требование; необходимое условие
containment – сдерживание, вместимость, объем, герметичность
operate – работать; действовать; функционировать
suppressant – супрессивное средство; препарат для подавления
lubricating oil – смазочное масло

SUPPLEMENTARY 1

Engineering Specialties

advisory engineer – инженер-консультант
assistant engineer – младший инженер
automatic-control engineer – инженер по автоматическим системам управления
automotive engineer – инженер-автомобилист, инженер по двигателям внутреннего сгорания
building engineer – инженер-строитель
chief engineer – главный инженер, главный механик
combustion engineer – инженер-теплотехник
civil engineer – инженер-строитель
computer engineer – инженер по вычислительной технике
design engineer – конструктор
efficiency engineer – инженер по рационализации производства
equipment engineer – инженер по оборудованию
ground engineer – инженер по эксплуатации
hydraulic engineer – инженер-гидротехник
industrial engineer – инженер-технолог, инженер по организации производства
industrial-relations engineer – инженер-монтажник
installation engineer – ведущий инженер
management engineer – инженер по ремонту оборудования
maintenance engineer – корабельный инженер-механик
marine engineer – инженер-механик, инженер
mechanical engineer – машиностроитель
metallurgical engineer – инженер-металлург
methods engineer – инженер по рационализации методов работы
operation engineer – инженер по эксплуатации
patent engineer – патентовед
planning engineer – инженер-конструктор; инженер-проектировщик
plant engineer – инженер-технолог; инженер по оборудованию
power engineer – инженер-энергетик

process engineer, production engineer – инженер-технолог
refrigerating engineer – инженер по холодильному делу
safety engineer – инженер по технике безопасности
shift engineer – дежурный техник, сменный инженер
steelmaking engineer – инженер-сталеплавильщик
systems engineer – инженер по системному конструированию
test(ing) engineer – инженер-испытатель
thermal engineer – инженер-термист
tool(ing) engineer – технолог
vacuum engineer – технолог по вакууму
water engineer – инженер-гидротехник
weight-and-balance engineer – специалист, занимающийся центровкой самолетов и определением их весовых характеристик

SUPPLEMENTARY 2

Engineering Spheres

engineering – a) техника, конструирование; технический, инженерный; b) машиностроение; машиностроительный; c) технология; d) строительство
advanced production engineering – разработка опытного образца
agricultural engineering – агротехника
atomic power engineering – атомная энергетика
automotive engineering – автотракторная техника
chemical engineering – химическая технология
civil engineering – гражданское строительство
construction engineering – строительная техника
control engineering – техника контроля; техника автоматического регулирования
design engineering – конструирование
development engineering – инженерное проектирование
electrical engineering – электротехника
fuel engineering – технология топлива
high-frequency engineering – высокочастотная техника
hydraulic engineering – гидротехника
industrial engineering – организация производства
management engineering – техника управления

marine engineering – судостроительная техника

mechanical engineering – машиностроение

methods engineering – технологическая разработка

military engineering – военно-инженерное дело

nuclear engineering – ядерная техника

plant engineering – промышленная эксплуатация, промышленная технология

power engineering – энергетика

process engineering – разработка технологического процесса, организация производства, технология

production engineering – организация производственного процесса, технологическое проектирование

radio engineering – радиотехника

research engineering – технические исследования

structural engineering – строительная техника

systems engineering – системный метод разработки, системотехника

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Учебное пособие

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