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Чтение научно-технических текстов

Методические указания
к аудиторной работе

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Целью данных методических указаний является подготовка студентов к работе с оригинальными научно-техническими текстами: развитие умений и навыков читать литературу по специальности, извлекать необходимую информацию и использовать профессиональную терминологию при подготовке сообщений по пройденной тематике. Тексты представлены в основном материалами из оригинальных и частично из переводных источников.

Предназначены для аудиторной и внеаудиторной работы студентов-бакалавров второго курса по направлениям подготовки «Электроэнергетика и электротехника» и «Автоматизация технологических процессов и производств» всех форм обучения.

ВВЕДЕНИЕ

Методические указания предназначены для практических аудиторных занятий, а также внеаудиторной самостоятельной работы.

Целью данных методических указаний является формирование навыков использования научно-технической литературы на английском языке, умений читать тексты по специальности, извлекать из них нужную информацию, а также беседовать на профессиональную тематику.

Методические указания состоят из девяти разделов (units), включающих два текста. Первый текст содержит информацию и задания по специальности, второй текст – биографию ученого, деятельность которого связана с решением важных научно-технических проблем и открытиями в той или иной области знаний.

При расположении текстов по специальности учитывалась преемственность слов и выражений и их многократная повторяемость от раздела к разделу. В первом тексте даются различные упражнения на закрепление лексического материала и повторение грамматики, пройденной на 1 курсе. Второй текст предназначен для пересказа или сообщения о том или ином ученом, что способствует углублению навыков устной речи.

UNIT 1

Text 1. ELECTRICITY

It is im possible to imagine our civilization without electricity: economic and social progress will be turned to the past and our daily lives completely transformed.

Electrical power has become universal. Thousands of applications of electricity such as lighting, electrochemistry and electrometallurgy are longstanding and unquestionable.

With the appearance of the electrical motor, power cables replaced transmission shafts, gear wheels, belts and pulleys in the 19-th century workshops. And in the home a whole range of various time and labour saving appliances have become a part of our everyday lives.

Other devices are based on specific properties of electricity: electrostatics in the case of photocopying machine and electromagnetism in the case of radar and television. These applications have made electricity most widely used.

The first industrial application was in the silver workshops in Paris. The generator – a new compact source of electricity – was also developed there. The generator replaced the batteries and other devices that had been used before.

Electric lighting came into wide use at the end of the last century with the development of the electric lamp by Thomas Edison. Then the transformer was invented, the first electric lines and networks were set up, dynamos and induction motors were designed.

Since the beginning of the 20-th century the successful development of electricity has begun throughout the industrial world. The consumption of electricity has doubled every ten years.

Today consumption of electricity per capita is an indicator of the state of development and economic health of a nation. Electricity has replaced other sources of energy as it has been realized that it offers improved service and reduced cost.

One of the greatest advantages of electricity is that it is clean, easily regulated and generates no by-products. Applications of electricity now cover all fields of human activity from

house washing machines to the latest laser devices. Electricity is the efficient source of some of the most recent technological advances such as the laser and electron beams. Truly electricity provides mankind with the energy of the future.

Notes to the Text:

• transmission shafts, gear wheels, belts and pulleys – трансмиссионные валы, зубчатые колеса, ремни и блоки;

• time and labour saving appliances – электроприборы, экономящие время и труд;

• induction motors – моторы;

• per capita – на человека; на душу населения;

• by-products – побочные продукты;

• truly – поистине.

Words to be learnt:

• application – (n) применение;

• appliance – (n) приспособление. прибор, устройство;

• appearance – (n) появление;

• range – (n)ряд, сфера, диапазон;

• replace – (v) заменять, замещать;

• property – (n) свойство, качество;

• source – (n) источник;

• generate – (v) вырабатывать, генерировать, производить;

• development – (n) разработка, развитие, сооружение;

• network – (n) сеть, энергосистема;

• consumption – (n) потребление;

• improve – (v) улучшать, совершенствовать;

• reduce – (v) уменьшать, сокращать, понижать;

• costs – (n) затраты, издержки;

• advantage – (n) преимущество, польза, выгода;

• cover – (v) охватывать, покрывать;

• advance – (n) достижение, успех, прогресс.

Exercise 1. *Live the Russian equivalents to the following word combinations.*

Appearance of electrical motors; a whole range of various appliances; specific properties of electricity; industrial application of electricity; the generator replaced batteries and other devices; electric lighting; the consumption of electricity;

indicator of the state development; the greatest advantages of electricity; fields of human activity; recent technological advances.

Exercise 2. *Find in the text the English equivalents for the following word combinations.*

Новый компактный источник электричества; электрические провода; не производит побочных продуктов; электричество снизило затраты; лазерные приборы; невозможно представить; преимущества электричества; охватывает все области (сферы) деятельности человека; новейшие технические достижения; электричество обеспечивает человечество; потребление электричества на душу населения.

Exercise 3. *Translate info Russian the following sentences. Pay attention to the functions of the verb «to have».*

1. Electricity has many useful properties: it is clean and generates no by-products.
2. The latest laser devices have found application in many branches of industry.
3. Electricity has provided mankind with the most efficient source of energy.
4. Our lives have been completely transformed with the appearance of electricity.
5. The generator replaced batteries that had been used before.
6. Electricity offers improved service at reduced cost.
7. No other source of energy has been so widely used as electricity.

Exercise 4. *Identify the Passive constructions in the text analyse the Tense.*

Exercise 5. *Look through the text again and answer the following questions.*

1. What is this text about?
2. What industrial applications of electricity do you know?
3. What home applications of electricity do you know?
4. Which devices are based on specific properties of electricity?
5. Where was the generator developed?

6. What are the advantages of electricity?

7. Does electricity offer improved service and reduced cost?

8. Electriciby is the efficient source of some of the most recent technological advanced. Name them.

Exercise 6. *Read and translate the text below.*

Radar is classified as means belonging to the sphere of radio communication. The word RADAR is an abbreviation of the word Radio Detection And Ranging.

Radar as a term is now used to include any system employing microwaves. To them belong microwaves ranging from 30 cm to 1 mm. Radar as a system of communication is used for locating, identifying, or guiding such moving objects as [1]ships, aircraft, missiles, or artificial satellites. The radar system consists essentially of a generator, of electromagnetic radiation, the output of which is pulse modulated[1].

Then the output is fed to a movable aerial where from it is radiated as a beam. The aerial is rotating continuously when in use. The basic principle of radar is the scanning of the area by a beam of microwaves and detection of the waves that are reflected from the object to be located. The time taken for a pulse to travel to the object and back can be measured. In this way the distance to the object from the transmitter can be calculated, and its direction can be defined from the detection of the aerial direction. This technique has been extended to the use of computers, which accept data, apply logical processes to the data and supply the results of these processes as the information being sought.

Exercise 7. *Describe a radar. If you can't, find the description in the text.*

Text 2. MIKHAIL VASILYEVICH LOMONOSOV

Read the text and retell it.

Mikhail Vasilyevich Lomonosov was a famous Russian writer, chemist, and astronomer who made a lot in literature and science.

[1] Modulation is known as the process of varying some characteristic of one wave – usually it is a radio-frequency carrier wave – in accordance with some characteristic of another wave.

Lomonosov was born on November 19, 1711, in Denisovka (now Lomonosov), near Archangelsk, and studied at the University of the Imperial Academy of Sciences in St.Petersburg. After studying in Germany at the Universities of Marburg and Freiberg, Lomonosov returned to St. Petersburg in 1745 to teach chemistry and built a teaching and research laboratory there four years later.

Lomonosov is often called the founder of Russian science. He was an innovator in many fields. As a scientist he rejected the phlogiston theory of matter commonly accepted at the time and he anticipated the kinetic theory of gases. He regarded heat as a form of motion, suggested the wave theory of light, and stated the idea of conservation of matter. Lomonosov was the first person to record the freezing of mercury and to observe the atmosphere of Venus during a solar transit.

Interested in the development of Russian education, Lomonosov helped to found Moscow State University in 1755, and in the same year wrote a grammar that reformed the Russian literary language by combining Old Church Slavonic with modern language. In 1760 he published the first history of Russia. He also revived the art of Russian mosaic and built a mosaic and colouredglass factory. Most of his achievements, however, were unknown outside Russia. He died in St. Petersburg on April 15, 1765.

UNIT 2

Text 1. ATOMIC STRUCTURE OF MATTER. ELECTRONS IN MOTION

The development of scientific atomic theory started with Dalton in 1803. Since then through important discoveries scientists have been able to present a true picture of an atomic structure of matter. All matter is composed of atoms and molecules. Atoms are the smallest units of matter into which an element can be subdivided and still retain the properties of that element. A modern theory considers that at extremely high temperatures all molecules break up to form atoms or portions of molecules. The atoms or molecules making up a crystalline structure are arranged according to a definite geometrical pattern. This pattern is known to be a space lattice.

Atoms consist of a massive nuclei and small negatively charged particles called «electrons». The mass of an electron was found to be about 2.000 times as small as the mass of the lightest atom, the hydrogen atom. The positive electricity is concentrated within the nucleus of dimensions very small compared with the total space occupied by an atom. This nucleus is responsible for practically the whole of the atomic mass.

An atom is a loose structure of electrons surrounding a heavy central core, the atomic nucleus, which is about one tenthousandth the size of the atom. It was later discovered that the nucleus consists of positively charged particles called «protons» and other particles of about the same weight without any charge, called «neutrons».

The negative electron charge equals the positive nucleus charge: hence the atom has no charge. However, sometimes an atom may gain an electron, and then it has a negative charge. If an atom loses an electron, the nucleus protons are more numerous than the negative electrons, so the atom has a positive charge.

A body with a considerable excess of electrons has a strong negative charge; one with few electrons has a strong positive charge. Thus there is a difference of potential.

If something allowing a free movement of electrons is placed between the negative and the positive charges, electrons move along this conductive path to occupy the nuclei which lack electrons. This movement is an electric current and it can take place through any conductor.

A conductor readily allows the free exchange of orbital electrons, so electrons forming the electric current can move from atom to atom along the material. Silver and copper are good conductors. A perfect insulator would allow no exchange of electrons Hence there would be no movement from atom to atom, and no current would flow. Glass, mica and rubber are good insulators.

Words to be learnt:

- matter – (n) материя;
- unit – (n) элемент; единица измерения;
- pattern – (n) образец; структура; модель; форма;
- space lattice – (n) пространственная решетка;
- particle – (n) частица;
- dimension – (n) размер; измерение;
- charge – (n,v) заряд; заряжать;
- excess – (n) избыток; излишек;
- in excess of – больше, сверх(нормы);
- current – (n) ток; поток;
- lack – (n,v) недостаток; нехватка; полное отсутствие; не иметь; испытывать недостаток;
- loose – (adj) свободный; несвязанный; просторный;
- considerable – (adj) значительный;
- be composed of – (v) состоять из;
- arrange – (v) организовывать; располагать; классифицировать;
- compare – (v) сравнивать;
- retain – (v) сохранять;
- gain – (v) приобретать;
- consider – (v) рассматривать; считать; полагать;
- equal – (v, adj) уравнивать; равный;
- be equal to – (v) равняться;
- according to – (pr) в соответствии, согласно чему-либо.

Exercise 1. *Live the Russian equivalents to the following word combinations.*

To present a true picture of atoms and molecules; the smallest units of matter; the lightest atom; the nucleus is responsible for.....; loose structure of electrons; positively charged particles; to move along the conductive path; a strong negative charge; electrons forming the electric current; according to a definite pattern.

Exercise 2. *Find in the text the English equivalents for the following word combinations.*

Представлять истинную картину атомного строения материи; чрезвычайно высокие температуры; сохранять свойства; приобретать (терять) электрон; значительный избыток электронов, молекулы распадаются; располагаться в определенном порядке; по сравнению с; электрический ток; движение атома к атому.

Exercise 3. *Use the right word in the text given below:* atom, physicist, the nucleus, the nuclei, nuclear, carried out, heavy, weights, isotopes, a number of, properties, charge.

THE NUCLEI OF ATOMS

In 1911 the British ... Ernest Rutherford ... ... some experiments which showed that every ... contains, in addition to one or more electrons, another particle called ... of the atom.

Every nucleus has a positive electric ... . It is very small. It is about as big as an electron about 10 cm in diameter (ten to the minus twelfth power). It is very ...-the lightest nucleus is 1836 times as heavy as an electron. There are many different kinds of every other element.

A part of no lesser importance is played by radioactive and stable ... obtained in ... reactors and special separation plants. Isotopes are various forms of the same chemical elements differing in their atomic ... and physical ... , but chemically identical. Almost every chemical element has ... ... isotopes.

Exercise 4. *Render the following sentences in English.*

1. Все вещества состоят из атомов и молекул.
2. Атом считается мельчайшей частицей материи.

3. Атомы составляют кристаллическую структуру и располагаются в определенном порядке в пространственной решетке.

4. Атом состоит из тяжелого ядра и отрицательно заряженных электронов.

5. Электроны занимают пространство, окружающее положительно заряженное ядро.

6. Иногда атом может терять электроны, тогда он становится положительным.

7. Если тело имеет значительный избыток электронов, оно приобретает сильный отрицательный заряд.

Exercise 5. *Identify the Passive Constructions in the text. Analyze the text.*

Exercise 6. *Look through the text again and answer the following questions.*

1. When did the development of a scientific atomic theory begin?
2. What is matter composed of?
3. What happens to molecules at extremely high temperatures?
4. What is an atom?
5. What is a space lattice?
6. What is the structure of an atom?
7. What is the charge of a nucleus (an atom)?
8. What happens of an atom gains (loses) an electron?
9. What is an electric current?

Exercise 7. *Read the text below and find out the information about the main electronic devices.*

OUR ELECTRONIC WORLD

Electronics is the tool of today. It has given us radar, automation, space vehicles, radio telescopes, and a host of other inventions that have transformed our lives.

Electronics means putting electrons to work. An electron is one of the particles in an atom, and travels at incredible speed round the nucleus. Also of the first importance are the facts that the electron has a negative charge, the nucleus a positive one.

Many devices are used in our life. For example, transformers, transform or change one voltage to another, or perform other useful functions. A transistor is a device made from semiconductor material, e.g. a tiny slice of germanium or silicon. It allows a small current (between base and emitter) to control a large current (between emitter and collector). It us used in TV, in computers, and in many other devices.

Everywhere electronics is at work for example, in medicine, building, accountancy, metallurgy, telecommunications, manufacturing, industry-calculating, checking, testing, stopping, starting, watching, and carry out many other functions.

Text 2. MICHAEL FARADAY

Read the text and retell it.

One of the great names in the history of man's work in electricity is that of Michael Faraday. He was born in a small village near London on September 22, 1791 in a poor family. His father, a blacksmith, could feed his family with difficulty, and could not even dream of an education for his boy.

As a boy Michael did not have much schooling. He had to work, and he had to learn a trade. So in 1804, when he was thirteen, he went to work in a bookbinder's shop. The work was not very interesting. At first he delivered the ready book's. Later he learnt how to bind books.

He lived among books. Some of the scientific works which passed through his hands aroused his interest in science and he started to read. The boy could not read every book in the shop because he was busy and had not much time. He began to take home the books which he liked best.

Once he ran across an article on electricity. When Faraday began to read it he knew nothing of the subject, but it struck his imagination. Soon his chief interest was in science, and especially in electricity and chemistry. He read as much as he could on these subjects. He made careful notes from the books that interested him most. Like all true scientists Faraday wanted to make experiments. He was very poor but found some money to buy a cheap and simple apparatus and some materials.

He wanted to go to scientific lectures but he had no money to pay for the lectures. It was his brother who gave him the money. One of the most popular lecturers in London at that time was Humphry Davy. When Faraday listened to his lectures he made notes and drawings to illustrate them.

Faraday's scientific interests were varied. He studied flying, made a new kind of steel and a new kind of glass. Faraday worked very much and did most of his work alone. He often worked fourteen hours a day. He began to get work from other people who had heard of his cleverness as a scientist. Men who wanted to know the answers to scientific questions asked him to make experiments to find out the truth. Because of this work he had no time to do his own research in electricity. When he found that such work took much of his time he decided to give all his attention to scientific research.

During his lifetime Faraday made more than two thousand difficult experiments and made countless discoveries in chemistry and physics. But the most interesting discovery of his is the generation of electricity from magnetism.

After some more experiments of this kind he made a machine. The machine gave Faraday a current of electricity.

UNIT 3

Text 1. FROM THE HISTORY OF ELECTRICITY

There are two types of electricity, namely, electricity at rest or in a static condition and electricity in motion, that is, the electric current. Both of them are made up of electric charges, static charges being at rest, while electric current flows and does work. Thus, they differ in their ability to serve mankind as well as in their behaviour. For a long time it was the only electrical phenomenon to be observed by man. At least 2,500 years ago, or so, the Greeks knew how to get electricity by rubbing substances. However, the electricity to be obtained by rubbing objects cannot be used to light lamps, to boil water, to run electric trains, and so on. It is usually very high in voltage and difficult to control, besides it discharges in no time.

As early as 1753, Franklin made an important contribution to the science of electricity. He was the first to prove that unlike charges are produced due to rubbing dissimilar objects. To show that the charges are unlike and opposite, he decided to call the charge on the rubber – negative and that on the glass-positive.

In this connection one might remember the Russian academician V.V. Petrov. He was the first to carry on experiments and observations on the electrification of metals by rubbing them one against another. As a result he was the first scientist in the world who solved that problem.

Who does not know that the first man to get the electric current was Volta after whom the unit of electric pressure, the volt, was named? His discovery developed out of Galvani's experiments with the frog. Galvani observed that the legs of a dead frog jumped as a result of an electric charge. He tried his experiment several times and every time he obtained the same result. He thought that electricity was generated within the leg itself.

Volta began to carry on similar experiments and soon found that the electric source was not within the frog's leg but was the result of the contact of both dissimilar metals used during his observations. However, to carry on such experiments was not an easy thing to do. He spent the next few years

trying to invent a source of continuous current. To increase the effect obtained with one pair of metals, Volta increased the number of these pairs. Thus the voltaic pile consisted of a copper layer and a layer of zinc placed one above another with a layer of flannel moistened in salt water between them. A wire was connected to the first disc of copper and to the last disc of zinc.

The year 1800 is a date to be remembered: for the first time in the world's history a continuous current was generated.

Words to be learnt:

- motion – (n) движение, перемещение, ход;
- behaviour – (n) поведение;
- rub – (v) тереть, натирать;
- contribution– (n) вклад;
- dissimilar – (adj) разнородный, несходный, неоднородный;
- pressure – (n) давление, сжатие; electric pressure – напряжение;
- generate – (v) вырабатывать, генерировать;
- pile – (n) столб, кол, свая;
- layer – (n) слой, прокладка;
- moisten – (v) увлажнять, смачивать;
- connect – (v) соединять, присоединять, подсоединять.

Exercise 1. *Give the Russian equivalents to the follow word combinations.*

Electricity in static condition and in motion; to rub substances; unlike charges; electrification of metals; the unit of electric pressure; to carry on similar experiments; a source of continuous current; copper layer and a layer of link.

Exercise 2. *Match the words opposite in meaning from the left column with the words from the right one:*

1) alive;	1) dissimilar;
2) charge;	2) forget;
3) similar;	3) discharge;
4) positive;	4) static;
5) dynamic;	5) dead;
6) easy;	6) decrease;
7) increase;	7) negative;
8) remember.	8) difficult.

Exercise 3. *Make up all types of questions to the following sentences.*

1. V.V. Petrov, the Russian academician, was the first scientist in the world who solved the problem of metals electrification.
2. Frankllin made an important contribution to the science of electricity.
3. Volta spent several years trying to invent a source of continuous current.

Exercise 4. *Read and translate the sentences below; pay attention to the modal verbs and their equivalents.*

1. We can't imagine our civilization without electricity.
2. Practically all modern machines that are household appliances can't work without electricity.
3. The date 1800 should be remembered: a continuous current was generated.
4. People may use electricity almost everywhere.
5. Electricity can be named as an efficient source of some of the most recent technological advances.
6. Electricity may be used in different fields of human activities.
7. One must be very careful while using electrical devices.

Exercise 5. *Look through the text again and answer the following questions.*

1. What are the two types of electricity?
2. The Greeks knew how to get electricity, didn't they?
3. How did they get electricity??
4. What was «wrong» with the electricity got by the Greeks?
5. What contribution did Franklin make to the science of electricity?
6. What do you know about the Russian academician V.V. Petrov?
7. Who was the first man to get the electric current?
8. Can you describe the voltaic pile? What materials were used?

Exercise 6. Read the text about A. Volta and render it in English.

Volta was born in Como, Italy, on February 18, 1745. For some years he was a teacher of physics in his home town. Later on

he became professor of natural sciences at the University of Pavia. After his famous discovery he travelled in many countries, among them France, Germany and England. He was invited to Paris to deliver lectures on the newly discovered chemical source of continuous current. In 1819 he returned to Como where he spent the rest of his life. Volta died at the age of 82.

Text 2. DMITRY IVANOVICH MENDELEYEV

Read the text and retell it.

Dmitry Ivanovich Mendeleyev is a famous Russian chemist. He is best known for his development of the periodic table of the properties of the chemical elements. This table displays that elements' properties are changed periodically when they are arranged according to atomic weight.

Mendeleyev was born in 1834 in Tobolsk, Siberia. He studied chemistry at the University of St. Petersburg, and in 1859 he was sent to study at the University of Heidelberg. Mendeleyev returned to St. Petersburg and became Professor of Chemistry at the Technical Institute in 1863. He became Professor of General Chemistry at the University of St. Petersburg in 1866. Mendeleyev was a well-known teacher, and, because there was no good textbook in chemistry at that time, he wrote the two-volume «Principles of Chemistry» which became a classic textbook in chemistry.

In this book Mendeleyev tried to classify the elements according to their chemical properties. In 1869 he published his first version of his periodic table of elements. In 1871 he published an improved version of the periodic table, in which he left gaps for elements that were not known at that time. His table and theories were Proved later when three predicted elements: gallium, germanium, and scandium were discovered.

Mendeleyev investigated the chemical theory of solution. He found that the best proportion of alcohol and water in vodka is 40%. He also investigated the thermal expansion of liquids and the nature of petroleum.

In 1893 he became director of the Bureau of Weights and Measures in St. Petersburg and held this position until his death in 1907.

UNIT 4

Text 1. ELECTRIC CURRENT

Ever since Volta first produced a source of continuous current, men of science have been forming theories on this subject. For some time they could see no real difference between the newly- discovered phenomenon and the former understanding of static charges. Then the famous French scientist Ampere (after whom the unit of current was named) determined the difference between the current and the static charges. In addition to it, Ampere gave the current direction: he supposed the current to flow from the positive pole of the source round the circuit and back again to the negative pole.

Ampere was right in his first statement but he was certainly wrong in the second, as to the direction of the current. The student is certain to remember that the flow of current is in a direction opposite to what Ampere thought.

The current which flows along wires consists of moving electrons. The electron is a minute particle having an electric charge that is negative. As these minute charges travel along a wire, that wire is said to carry an electric current.

In addition to travelling through solids, however, the electric current can flow through liquids as well and even through gases. In both cases it produces some most important effects to meet industrial requirements.

Some liquids, such as melted metals for example, conduct current without any change to themselves. Others, called electrolytes, are found to change greatly when the current passes through them.

When the electrons flow in one direction only the current is known to be d. c, that is, direct current. The simplest source of power for the direct current is a battery, for a battery pushes the electrons in the same direction all the time (i.e., from the negatively charged terminal to the positively charged terminal).

The letters a.c. stand for alternating current. The current under consideration flows first in one direction and then in the opposite one. The a.c. used for power and lighting purposes is

assumed to go through 50 cycles in one second. One of the great advantages of a.c. is the ease with which power at low voltage can be changed into an almost similar amount of power at high voltage and vice versa. Hence, on the one hand alternating voltage is increased when it is necessary for long-distance transmission and, on the other hand, one can decrease it to meet industrial requirements as well as to operate various devices at home.

Although there are numerous cases when d.c. is required, at least 90 per cent of electrical energy to be generated at present is a.c. In fact, it finds wide application for lighting, heating, industrial, and some other purposes.

Words to be learnt:

- determine - (v) определять; устанавливать;
- direction – (n) направление;
- suppose – (v) предполагать; полагать; допускать;
- circuit – (n) цепь, контур, схема;
- wire – (n) провод; проволока;
- requirements – (n) требования; условия;
- conduct – (v) проводить (ток);
- direct current – постоянный ток;
- alternating current – переменный ток;
- charge – (v) заряжать;
- terminal – (n) клемма; зажим; вывод;
- transmission – (n) передача; трансмиссия; привод;
- similar – (adj) подобный; похожий;
- amount – (n) количество;
- increase – (v) увеличивать;
- decrease – (v) уменьшать;
- minute – (adj) мелкий; мельчайший; незначительный.

Exercise 1. *Give the Russian equivalents to the follow word combinations.*

A source of continuous current; newly discovered phenomenon; the difference between the current and the static charges; positive and negative poles; traveling through solids, liquids and gases; to conduct current; similar amount of power.

Exercise 2. *Find in the text the English equivalents for the following word combinations.*

Низкое и высокое напряжение; источник постоянного тока; движущиеся электроны; мельчайшая частица; твердые вещества; жидкости и газы; постоянный и переменный ток; вырабатывать электроэнергию.

Exercise 3. *Make up questions to the underlined words in the following sentences.*

1. Electric current can flow through solids, liquids and gases;
2. The famous French scientist ampere determined the difference between the current and the static charges;
3. The Russian scientist and inventor Yablochkov was the first who applied a.c. in practice.

Exercise 4. *Identify the Infinitive Constructions in the text* (complex object and complex subject).

Exercise 5. *Match the words from the left column with the words from the right column:*

1) electric;	1) charges;
2) static;	2) metals;
3) current;	3) pole;
4) positive;	4) application;
5) industrial;	5) direction;
6) melted;	6) current;
7) long-distance;	7) requirements;
8) various;	8) transmission;
9) wide.	9) devices.

Exercise 6. *Read this text and translate it in writing.*

As a matter of fact all of man's knowledge in the field of electricity has been obtained during the last 370 years, or so. Needless to say, it took a long time before scientists learned how to make use of electricity. In effect, most of the electrically operated devices, such as the electric lamp, the refrigerator, the tram, the lift, the radio, and so on, are less than one hundred years old. In spite of their having been employed for such a short period of time, they play the most important in ma's everyday life all over the world. In fact, people cannot do without them at present.

Exercise 7. *Look through the text again and answer the following questions:*

1. What did the famous French scientist Ampere determine?
2. What direction of the current flow did Amper suppose?
3. What is an electron?
4. Do melted metals conduct current without any change to themselves?
5. What can you tell about electrolytes?
6. What is direct current?
7. What is the advantage of alternating current?
8. Why is alternating current used much more than direct current?

Text 2. JAMES WATT

Read the text and retell it.

James Watt was born on January 19, 1736, in Scotland. He was not at all strong and suffered from terrible headaches. He could not go to school and his mother taught him to read, and his father taught him writing and arithmetic. The boy had a very good memory and a natural love of work.

He liked mathematics and was fond of designing and making things. Some time later James was able to go to school, where he learnt a lot of subjects. He became good at languages as well as at mathematics.

When James was eighteen he decided to become a professional instrument – maker, and in June 1754 he went to live with his uncle and aunt in Glasgow. But there were so few qualified instrument – makers in those days that James could not find anyone in Glasgow to teach him. So he went to London. There he learnt this trade and returned to Glasgowto work as an instrument – maker in that town.

Watt decided that his new steam – engine could be used at a large factory in Birmingham, and in May 1774 he and his two children (his wife had died three years before) went to Birmingham.

At the factory Watt continued to improve his engine, he put new cylinders on it, and with their help; the engine at last

became really efficient. More and more orders for the engine from other parts of the; country began to come, one order was from France for an engine for supplying Paris with water.

Watt made several other inventions. The most important of them was a copying machine. He invented this machine in the first place to help him with his correspondence and other written work. Watt's copying machine was used all over the country for about 100 years. Then the typewriter took its place.

In October 1781 James Watt made a still better engine that could do much more than merely pump water out of mines. This was a rotative engine. It could run machines. It was a great invention of that time. The rotative engine became the basis of industry, it could do many things.

James Watt lived to the age of eighty – three. He received many honours in recognition of his valuable work. He was elected a Fellow of the Royal Society of both London and Edinburgh. Glasgow University, the university where he began his successful work, conferred on him the honorary degree of Doctor of Law; and France made him a member of her famous Academy of Sciences.

On August 19, 1819 James Watt died at his home. A few years later a monument was erected to his memory in Westminster Abbey.

UNIT 5

Text 1. HEATING EFFECT OF AN ELECTRIC CURRENT

The production of heat is perhaps the most familiar among the principal effects of an electric current, either because of its development in the filaments of the electric lamps or, maybe, because of the possible danger from overloaded wires.

A metal wire carrying a current will almost always be at a higher temperature than the temperature of that very wire unless it carries any current. It means that an electric current passing along a wire will heat that wire and may even cause it to become red-hot. Thus, the current can be detected by the heat developed provided it flows along the wire.

The heat produced per second depends both upon the resistance of the conductor and upon the amount of current carried through it. As a matter of fact, if some current flowed along a thin wire and then the same amount of current were sent through a thicker one, a different amount of heat would be developed in both wires.

When the current is sent through the wire which is too thin to carry it freely, then more electric energy will be converted into heat than in the case of a thick wire conducting a small current.

Imagine that a small current is flowing along a thick metal conductor. Under such conditions the only way to discover whether heat has been developed is to make use of a sensitive thermometer because the heating is too negligible to be detected by other means.

If, however, the conductor were very thin while the current were large the amount of generated heat would be much greater than that produced in the thick wire. In fact, one could easily feel it. Thus the thinner the wire, the greater the developed heat. On the contrary, the larger the wire, the more negligible is the heat produced.

Needless to say, such heat is greatly desirable at times but at, other times it must be removed or, at least, decreased as it represents a waste of useful energy. In case heat is de-

veloped in a transmission line, a generator or a motor, it is but a waste of electric energy and overheating is most undesirable and even dangerous. This waste is generally called «heat loss» for it serves no useful purposes and does decrease efficiency. Nevertheless, one should not forget that the heat developed in the electric circuit is of great practical importance for heating, lighting and other purposes. Owing to it people are provided with a large number of appliances, such as: electric lamps that light homes, factories, electrical heaters that are widely used to meet industrial requirements, and some other necessary and irreplaceable things which have been serving mankind for so many years.

In short, many of the invaluable electrical appliances without which life would seem strange and impossible at present can be utilized only because they transform electric energy into heat.

The production of heat by an electric current is called heating effect. One might also name its light effect provided the heat in the conductor is great enough to make it white-hot, so that it gives off light as well as heat. Take the filament of an electric lamp as an example. It is known to glow because of heat. By the way, were people able to look inside a hot electric iron, they should see that its wires were glowing too. A similar statement could be applied as well to almost any electric heating device. All of them give off a little light and a lot of heat.

Words to be learnt:

- filament – (n) нить накала, накал;
- overload – (n) перегрузка;
- red-hot – (adj) накаленный докрасна;
- retistance – (n) сопротивление (эл); противодействие;
- thin – (adj) тонкий;
- thick – (adj) толстый;
- convert – (v) преобразовывать; осуществлять переход (из одного состояния в другое);
- sensitive – (adj) чувствительный; восприимчивый;
- negligible – (adj) малый; незначительный;
- detect – (v) открывать; обнаруживать;
- on the contrary – наоборот;

- remove – (v) удалять; убирать;
- waste – (n) ущерб; перерасход; излишняя трата;
- heat loss – (n) потеря тепла; тепловая потеря;
- irreplaceable – (adj) незаменимый;
- invaluable – (adj) неоценимый; бесценный;
- glow – (v) светиться; накаляться добела.

Exercise 1. *Give the Russian equivalents to the follow word combinations.*

Resistance of the conductor; principal effects of an electric current; different amount of heat; thin and thock metal conductors; negligible heating; waste of useful energy; electric circuit; to transform electric energy into heat.

Exercise 2. *Find in the text the English equivalents for the following word combinations.*

Незаменимые электрические приборы; нить накаливания электрической лампочки; опасность от перегруженных проводов; чувствительный термометр; нежелательный и даже опасный; накаливаться докрасна (добела); выделять немного света.

Exercise 3. *Translate the first two passages from the text in writing.*

Exercise 4. *Make up special questions to the underlined words.*

1. The filament of an electric glows <u>because of heat</u>.
2. Many of the invaluable electrical appliances transform <u>electric energy</u> into heat.
3. The production of heat by an electric current is called <u>heating effect</u>.

Exercise 5. *Identify the conditional sentences in the text. Analyse their type.*

Exercise 6. *Read the text below and render it in Russian.*

Many famous names are connected with its history and among them we find that of Phales, the Greek philosopher. As early as about 600 B. C. (that is before our era) he discovered that when amber was rubbed, it attracted and held minute light objects. However, he could not know that amber was charged with electricity owing to the process of rubbing. Then Gilbert,

the English physicist, began the first systematic scientific research on electrical phenomena. Rediscovered that various other substances possessed the property similar to that of amber or, in other words, they generated electricity when they were rubbed. He gave the name «electricity» to the phenomenon he was studying. He got this word from the Greek electrum» meaning «amber».

Many learned men of Europe began to use the new word «electricity» in their conversation as they were engaged in research of their own. Scientists of Russia, France and Italy made their contribution as well as the Englishmen and the Germans.

Exercise 7. *Look through the text and give complete answers to the following questions:*

1. What happens with a wire if carries current?
2. Will an electric current passing along a wire?
3. What happens when the current is sent through the wire which is too thin to carry it freely?
4. How is it possible to discover whether heat is developed?
5. What is called «heat loss»?
6. Different electrical appliances make our life more comfortable and save time and labour.

Do you agree?

Text 2. JAMES MAXWELL

Read the text and render it in English.

In the decade 1860-1870, James Maxwell formulated his classical electromagnetic theory. He showed that light was a form of wave motion travelling with a speed dependent on the electric and magnetic properties of the medium through which it is transmitted, he also predicted that waves longer than those of light could exist.

Even before Maxwell advanced the theory that electromagnetic waves should exist, men were making use of them for other purposes besides vision. For instance, the short ultraviolet rays in sunlight provided suntans; and the heat of the sun – provided by the long infra-red rays – was often concentrated by means of a lens to start fires. After the existence

of electromagnetic waves had been proved by Hertz it was discovered that they range in length from hundreds of miles down to less than a billionth of an inch. The long waves could be used to carry sounds through space; as a consequence radio was developed.

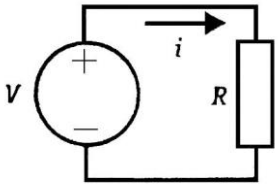
A more recent development, which is related to radio, is television. Not only sounds but pictures can be transmitted at a distance because of electromagnetic waves.

Another modem device, developed to send out electromagnetic waves and to receive the echoes when they return, is radar, since the speed of electromagnetic waves is known, the time it takes for an echo to return to the radar set can tell the operator how far away a plane is from his set. Radar is given the credit for saving Great Britain during World War II, for it warned of enemy planes. Thus James Maxwell had made discoveries that later protected his homeland. Today with radio, television, radar, and communication with outer space making use of these waves, it is easy to realize why James Maxwell is now considered one of the great scientists of all time.

UNIT 6

Text 1. ELECTRIC CIRCUIT

The circuit is known to be a complete path which carries the current from the source of supply to the load and then carries it again from the load back to the source.



A simple electric circuit made up of a voltage source and a resistor

The purpose of the electrical source is to produce the necessary electromotive force required for the flow of current through the circuit.

The path along which the electrons travel must be complete otherwise no electric power can be supplied from the source to the load. The circuit is closed when an electric lamp is switched on.

If the circuit is broken or, «opened» anywhere, the current is known to stop everywhere. The circuit is broken when electrical devices are switched off. Generally speaking, the current may pass through solid conductors, liquids, gases, vacuum, or any combination of these. It may flow in turn over transmission lines from the power-stations through transformers, cables and switches, through lamps, heaters, motors and so on.

There are various kinds of electric circuits such as: open circuits, closed circuits, series circuits, parallel circuits and short circuits.

To understand the difference between the following circuit connections is not difficult at all. When electrical devices are connected so that the current flows from one device to another, they are said to be connected in series. Under such conditions the current flow is the same in all parts of the circuit, as there is only a single path along which it may flow. The electrical bell circuit is considered to be a typical example of a series circuit.

The parallel circuit provides two or more paths for the passage of current. The circuit is divided in such a way that part of the current flows through one path, and part through another. The lamps in a room are generally connected in parallel.

The short circuit is produced when the current is allowed to return to the source of supply without control and without doing the work that is wanted to do. The short circuit often results from cable fault or wire fault. Under certain conditions, the short may cause fire because the current flows where it was not supposed to flow. If the current flow is too great a fuse is to be used as a safety device to stop the current flow.

The fuse must be placed in every circuit where there is a danger of overloading the line. Then all the current to be sent will pass through the fuse.

When a short circuit or an overload causes more current to flow than the carrying capacity of the wire, the wire becomes hot and sets fire to the insulation. If the flow of current is greater than the carrying capacity of the fuse, the fuse melts and opens the circuit.

Words to be learnt:

- circuit – (n) цепь, контур, схема;
- path – (n) контур, путь, курс, маршрут;
- supply – (n, v) подача, снабжение, подвод, питание, подавать, снабжать, подводить, питать;
- load – (n, v) нагрузка, загрузка, нагружать, загружать, заряд, заряжать;
- electromotive force – (adj, n) электродвижущая сила;
- switch – (n) выключатель, переключатель, ключ переключения;
- switch on/off – (v) включать, выключать;
- series – (n) последовательное соединение, серия, ряд, набор;
- flow – (n) поток, течение, циркуляция в замкнутой системе, текучесть;
- passage – (n) прохождение, переход, проход;
- connect - (v) соединять, подсоединять;
- short circuit – короткое замыкание;
- cable fault – (n) повреждение кабеля;

- wire fault – (n) повреждение провода;
- fuse – (n) плавкий предохранитель, пробка;
- capacity – (n) емкость;
- insulation – (n) изоляция, изоляционный материал;
- melt - (v) плавить (-ся).

Exercise 1. *Give the Russian equivalents to the follow word combinations.*

A complete path; the necessary electromotive force; solid conductors and liquids; transmission line; various kinds of electric circuits; a single path; cable fault; safety devices; carrying capacity of the fuse.

Exercise 2. *Find in the text the English equivalents for the following word combinations.*

Цепь с параллельным соединением; цепь с последовательным соединением; электрические приборы; при таких условиях; опасность перегрузки линии; короткое замыкание; повреждение кабеля; течение тока.

Exercise 3. *Complete the sentences using the following words:* stops, circuits, current, fault, paths, parallel, device, capacity.

1. A fuse is a safety _____to stop the current flow.
2. The lamps in a room are connected in _____.
3. The fuse meets and opens the circuit if the flow of _____ is greated than the carrying _____ of the fuse.
4. The short circuit often results from cable _____.
5. The parallel circuit provides two or more _____ for the passage of current.
6. If the circuit breaks the current _____ everywhere.
7. There are various kinds of electric_____ .

Exercise 4. *Skim the text and find definitions for the following notions.*

1. A fuse is _____ .
2. A circuit is _____ .
3. A series circuit is _____ .
4. A parallel circuit is _____ .
5. A short circuit is _____ .

Exercise 5. *Identify the Infinitives in the text. Analyse their voice.*

Exercise 6. *Look through the text again and answer the following questions.*

1. What is the purpose of the electrical source?
2. Why must the path along along which the electrons travel be complete?
3. When is the circuit broken?
4. What kinds of electric circuits are there?
5. What is the connection in series / in parallel?
6. What does the short circuit result from?
7. What is the function of any fuse?

Exercise 7. *Read the passage given below and translate it in writing.*

The electromotive force (e.m.f.) is the very force that moves the electrons from one point in an electric circuit towards another. In case this e.m.f. is direct, the current is direct. On the other hand, were the electromotive force alternating, the current would be alternating, too. The e.m.f. is measurable and it is the volt that is the unit used for measuring it.

A current is unable to flow in a circuit consisting of metallic wires alone. A source of an e.m.f. should be provided as well. The source under consideration may be a cell or a battery, a generator, a thermocouple or a photocell, etc.

Text 2. SIR ISAAK NEWTON

Read the text and render it in English.

Newton was born at Woolsthorpe, Lincolnshire, on December 25, 1642. He attended Grantham grammar school, as a boy, he was more interested in making mechanical devices than in studying. His youthful inventions included a small windmill that could grind wheat and com, a water clock run by the force of dropping Water, and a sundial. He left school when he was 14 to help his widowed mother to manage her farm. But he spent so much time readingJie was sent back to school.

He entered Trinity College, Cambridge University, in 1661. He showed no exceptional ability during his college career, and graduated in 1665 without any particular distinction. He returned to Cambridge as a fellow of Trinity College in 1667.

Newton became professor of mathematics at Cambridge in 1669. He lectured once a week on arithmetic, astronomy, ge- ometiy, optics, or other mathematical subjects, He was elected to the Royal Society in 1672. He became president of the Royal Society in! 703 and was reelected annually until his death. Queen Anne knighted Newton in 1705. He died in 1727 and was buried in Westminster Abbey..

Newton discovered how the universe is held together through his theory of gravitation. He found that the force of universal gravitation makesevery pair of bodies in the universe attract each other. The force depends on the amount of matter in the bodies being attracted and the distance between them. The earth's pull is called the weight of the body. He also proved that many types of motion are due to one kind of force.

Newton concluded his investigation on gravity and motion in 1665 and 1666. Nothing was heard of them for nearly 20 years. Newton's discoveries on the laws of motion and theories of gravitation were published in 1687 in Philosophiae Nat- uralis PrincipiaMathematica (Mathematical Principles of Natural Philosophy). This work, usually called Principia or Prin- cipia Mathematica, is considered one of the greatest contributions in the history of science.

Newton's discoveries in optics were equally spectacular. He explained why bodies appear to be coloured. The discoveries laid the foundation for the science of spectrum analysis. He published the results of his experiments and studies in optics (1704). The study of light led Newton to consider constructing a new type of telescope in which a reflecting mirror was used instead of a combination of lenses.

UNIT 7

Text 1. INSULATION AND INSULATORS

An Insulator, also called a dielectric, is a material that resists the flow of electric charge. In Insulating materials valence electrons are tightly bonded to their atoms. These materials are used in electrical equipment as insulators or insulation. Their function is to support or separate electrical conductors without allowing current through themselves. The term also refers to insulating supports that attach electric power transmission wires to utility poles or pylons. The first electrical systems to make use of insulators were telegraph lines; direct attachment of wires to wooden poles was found to give very poor results, especially during damp weather.

Class insulator were used in large quantities. Amongst the first to produce ceramic insulators were companies in the United Kingdom. The invention of suspension-type Insulators made high-voltage power transmission possible. Electrical Insulation Is the absence of electrical conduction. Electronic band theory (a branch of physics) says that a charge will flow if states are available into which electrons can be excited This allows electrons to gain energy and thereby move through a conductor such as a metal, if no such states are available, the material is an insulator.

Insulators suffer from the phenomenon of electrical breakdown. It is usually accompanied by physical or chemical changes that permanently degrade the material's insulating properties. When the electric field applied across an insulating substance exceeds in any location the threshold breakdown field for that substance, which Is proportional to the band gap energy, the insulator suddenly turns Into a resistor, sometimes with catastrophic results.

Insulators are commonly used as a flexible coating on electric wires and cables. Since air is an insulator, no other substance is needed to keep power where it should be. High-voltage power lines commonly use just air, since a solid (e.g., plastic) coating would be impractical. However, wires which touch each

other will produce cross connections, short circuits, and fire hazards. Insulating coatings help to prevent ail these problems.

In high voltage systems containing transformers and capacitors, liquid insulator oil is the typical method used for preventing arcs. The oil replaces the air in any spaces which must support significant voltage without electrical breakdown.

Insulators used for high-voltage power transmission are made from glass, porcelain, or composite polymer materials. Porcelain insulators are made from clay, quartz or alumina and feldspar, and are covered with a smooth glaze to shed water Insulators made from porcelain rich in alumina are used where high mechanical strength Is a criterion Porcelain has a dielectric strength of about 4–10 kV/mm.

Recently, some electric companies have begun converting to polymer composite materials for some types of Insulators. Composite insulators are less costly, lighter in weight, and have excellent hydrophobic capability. This combination makes them ideal for service in polluted areas.

Higher voltage transmission lines use modular cap and pin Insulator designs.

The wires are suspended in towns through a 'string' of Identical disk-shaped insulators which insulators. The advantage of this design is that insulator strings with different breakdown voltages, for use with different lint voltages, can be constructed by using IL different numbers of the basic units Also, if one of the insulator units in the string breaks, it can be replaced without discarding the entire string.

Standard disk insulator units are 10 inches (25 cm) in diameter and 15 cm in long, can support a load of 80–120 kN, have a dry flashover voltage of about 72 kV, and are rated at an operating voltage of 10–12 kV. However, the flashover voltage of a string is less than the sum of its component disks.

Flashover voltage Is the voltage which causes a breakdown and conduct causing a flashover' arc along the outside of the insulator. They are usually designed to withstand this without damage.

Dirt, pollution, salt, and particularly water on the surface of a high voltage insulator can create a conductive path

across it, causing leakage currents. The flashover voltage can be more than 50% lower when the insulator is wet. High voltage insulators for outdoor use are shaped to maximize the length of the leakage path along the surface from one end to the other (creepage length) to minimize these leakage currents. To accomplish this the surface is molded into a series of corrugations or concentric disk shapes. Minimum creepage distances are 20–25 mm/kV, but must be increased in high pollution or airborne sea-salt areas.

Words to be learnt:

- insulate – (v) изолировать;
- insulator – (n) изолятор; изоляционный материал;
- attach – (v) прикреплять; присоединять;
- suspension insulator – (n, n) подвесной изолятор;
- conduction – (n) проводимость; передвижение электронов;
- available – (adj) доступный; имеющийся в наличии; годный;
- band – (n) полоса частот; диапазон; зона (уровней энергии);
- gap – (n) зазор; промежуток; разрыв; интервал;
- excite – (v) возбуждать;
- suffer – (v) страдать; претерпевать;
- breakdown – (n) поломка; неисправность;
- threshold – (n) порог;
- flexible – (adj) эластичный; легко приспосабливаемый;
- coating – (n) покрытие; облицовка; нанесение защитного слоя;
- present – (v) предотвращать; предохранять;
- capacitor – (n) конденсатор; емкость;
- arc – (n) дуга;
- replace – (v) заменять; замещать;
- porcelain – (n, adj) фарфор; фарфоровый;
- alumina – (n) глинозем; окись алюминия;
- feldspar – (n) полевой шпат;
- flashover voltage (n, n) пробивное напряжение;

• withstand – (v) противостоять; выдерживать; сопротивляться;

• leakage – (n) течь; утечка;

• discard – (v) браковать; выбрасывать;

• creepage – (n) утечка по поверхности изолятора.

Exercise 1. *Give the Russian equivalents to the follow word combinations.*

To separate electrical conductors: attachment of wires: suspension-type insulators: insulating properties of materials: electrical breakdown: flexible coating: high-voltage power transmission lines: replacement without discarding.

Exercise 2. *Find in the text the English equivalents for the following word combinations.*

Подвесной изолятор; гибкое (эластичное) покрытие для электрических проводов и кабелей; короткое замыкание; предотвратить электрическую дугу; штыревой изолятор; замена без выбраковки; пробивное напряжение; для внешнего использования; свести к минимуму утечки тока; минимальное расстояние утечки по поверхности изолятора.

Exercise 3. *Complete the following sentences using the words from the active vocabulary.*

1. All terms _____ definitions.
2. The work of conductors _____, their material.
3. The function of an insulator is _____, electrical conductors without allowing current through themselves.
4. Electrical insulation is _____, of electrical conduction.
5. Insulators suffer from the phenomenon of _____.
6. Insulators are commonly used as a _____ on electric wires and cables.
7. The wires are suspended in towns through a “string” of identical _____ insulators.

Exercise 4. *Skim the text and identify materials which can be used for insulation. Describe any of them.*

Exercise 5. *Look through the text again and answer the following questions.*

1. What is an insulator?
2. Where were first insulators used?

3. What country was the first to produce ceramic insulators?

4. What is electrical insulation?

5. What happens when the insulator suddenly turns into a resistor?

6. What kind of coating is used on electric wires and cables?

7. What is the typical method used for preventing arcs in high-voltage systems containing transformers and capacitors?

8. What are the advantages of polymer composite materials?

9. What is the result of flashover voltage?

10. In which areas must minimum creepage distance be increased?

Exercise 6. *Read the text "Insulation Classes" and be ready to discuss the requirements to the insulation of different appliances.*

All portable or hand-heId electrical devices are insulated to protect their user from harmful shock.

CIass 0. These appliances have no protective-earth connection and were intended for use in dry areas In most countries, the sale of Class 0 mains-voltage appliances is prohibited today, as a single fault could cause an electric shock or other dangerous occurrence

Class 1. Insulation requires that the metal body and other exposed metal parts of the device is connected to earth via a "grounding" wire which is earthed at the main service panel: but only basic insulation of the conductors is needed.

Class 2. Insulation means that the device is double insulated. This is used on some appliances such as electric shavers, hair dryers and portable power tools. Double insulation requires that the devices have both basic and supplementary insulation, each of which is sufficient to prevent electric shock. Double insulated appliances are marked with a symbol of two squares, one inside the other.

A *Class 3* appliance is low enough that under normal conditions a person can safely come into contact with it without risk of electrical shock.

Text 2. LEV DAVIDOVICH LANDAU

Read the text and be ready to speak on:

a) Landau's education; b) his work abroad; c) the Landau school; d) Landau's list.

Landau was born on January 22, 1908 to a Jewish family in Baku, in what was then the Russian Empire. Landau's father was an engineer with focal oil industry and mother was a doctor. Recognized very early as a child prodigy in mathematics, Landau was quoted as saying in later life that he scarcely remembered a time when he was not familiar with calculus. Landau graduated at 13 from gymnasium. His parents regarded him too young to attend university, so for a year he attended the Baku Economical Technicum. In 1922, at age 14, he matriculated at Baku State University, studying at two departments simultaneously: the department of Physics and Mathematics, and the department of Chemistry. Subsequently he ceased studying chemistry, but remained interested in the field throughout his life.

In 1924, he mowed to the main centre of Soviet physics at the time: the Physics Department of Leningrad State University. In Leningrad, he first made the acquaintance of genuine theoretical physics and dedicated himself fully to its study, graduating in 1927. Landau subsequently enrolled for post-graduate study at the Leningrad Physico-Technical Institute, and at 21, received a doctorate. Landau got his first chance to travel abroad in 1929, on a Soviet government traveling fellowship supplemented by a Rockefeller Foundation fellowship.

After brief stays in Gottingen and Leipzig, he went, to Copenhagen to work at Niels Bohr's Institute for Theoretical Physics. After the visit, Landau always considered himself *a* pupil of Niels Bohr and Landau's approach to physics was greatly influenced by Bohr After his stay in Copenhagen, he visited Cambridge and Zurich before returning to the Soviet Union. Between 1932 and 1937 he headed the department of theoretical physics at the Kharkov Polytechnical Institute.

During the Great Purge managed to leave for Moscow. He was arrested on April 27, 1938 and held m an NKVD prison until his release on April 29, 1939, after his colleague Py-

otr Kapitsa, an experimental low-temperature physicist, wrote a letter to Joseph Stalin.

On January' 7, 1962, Landau's car collided with an oncoming truck. He was severely injured and spent two months in a coma. Although Landau recovered in many ways, his scientific creativity was destroyed, and he never returned fully to scientific work. His injuries prevented him from accepting the 1962 Nobel Prize for physics in person.

In 1965 former students and coworkers of Landau founded the Landau Institute for Theoretical Physics, located in the town of Chernogofovka near Moscow, and headed for the following three decades by Isaak Markovich Khalatnikov.

Landau died on April 1, 1968, aged 60, from complications of the injuries from the accident. He was buried at Novodevichy cemetery.

Apart from his theoretical accomplishments, Landau was the principal founder of a great tradition of theoretical physics in Kharkov, Soviet Union (now Kharkiv, Ukraine), sometimes referred to as the Landau school. He was the head of the Theoretical Division at the Institute for Physical Problems from 1937 until 1962 when, as a result of a car accident, he suffered injuries which stopped him from making further contributions to science. His students included Lev Pitaevskii, Alexei Abrikosov, Arkady Levanyuk, Evgeny Lifshitz, Lev Gor'cov, Isaak Khalatnikov, Boris L. Ioffe and Isaak Pomeranchuk.

Lendau developed a comprehensive exam called the "Theoretical Minimum" which students were expected to pass before admission to the school. The exam covered all aspects of theoretical physics, and between 1943 and 1961 only 43 candidates passed.

In Kharkov, he and his friend and former student, Evgeny Lifshitz, began writing the Course of Theoretical Physics, ten volumes that together span the whole of the subject and are still widely used as graduate-lewel physics texts.

The minor planet 2142 Landau discovered in 1972 by Soviet astronomer Lyudmila Chernykh is named in his honor. The lunar crater Landau is named in his honor.

Landau kept a list of names of physicists which he ranked on a logarithmic scale of productivity ranging from 0

to 5. The highest ranking. 0.5, was assigned to Albert Einstein. A rank of 1 was awarded to 'historical giants' Isaac Newton. Satyendra Nath Bose, Eugene Wigner, and the founding fathers of quantum mechanics, Niels Bohr, Werner Heisenberg, Paul Dirac and Erwin Schrodinger. Landau ranked himself as a 2.5 but later promoted himself to a 2. David Mermin, writing about Landau, referred to the scale, and ranked himself in the fourth division, in the article «My Life with Landau: Homage of a 4.5 to a 2».

UNIT 8

Text 1. OUR ELECTRONIC WORLD

Electronics is the tool of today. It has given us radar, automation, space vehicles . radio telescopes, and a host of other inventions that have transformed our lives.

Electronics means putting electrons to work. An electron is one of the particles in an atom, and travels at incredible speed round the nucleus.

Also of the first importance are the facts that the electrons has a negative charge, the nucleus a positive one.

Many devices are used in our life. For example, transformers, transform or change one voltage to another, or perform other useful functions.

A transistor is a device made from semiconductor material, e.g. a tiny slice of germanium or silicon. It allows a small current (between base and emitter) to control a large current (between emitter and collector). It is used in TV, in computers, and in many other devices

In cathode ray tubes, an electron beam is deflected by electric or magnetic field, and passes over the face of the tube. These tubes are employed in TV receivers, oscilloscopes and other equipment.

Electronic devices can send us information from satellites and space vehicles. Radio telescopes scan the heavens, gathering information from satellites and space vehicles Radio telescopes scan the heavens, gathering information from distances far beyond the range of visual observation.

Radar bounces radio signals off distant objects, and uses the echo to give information on their distance and direction. Sonar in ships uses sound-wave echoes for depth sounding.

Solar cells produce current when they are illuminated, giving power for space instruments. Light-sensitive diodes and transistors respond to light-pulses, and control electrical circuits by light. Other diodes produce light under the influence of an electric current. In fact, the skill of the electronics engineer makes of electrons in motion an almost magical tool.

The science of electronics has revolutionized science and industry. It is bringing ever wider and faster changes. Computers can digest masses of statistics almost on the instant, or perform mathematical calculations with breathtaking speed Electronic devices can soar with space vehicles through unimaginable distances, can probe and examine and send back pictures and reports from outer space. Everywhere electronics is at work – for example, in medicine, building, accountancy, metallurgy, telecommunications, manufacturing, industry – calculating, checking, testing, stopping, starting, watching, etc.

Electronics is a fascinating world which electronics engineers are eager to explore as they carry on their researches.

Words to be learnt:

- vehicle – (n) средство передвижения (доставки);
- incredible – (adj) невероятный;
- nucleus – (n) ядро атома;
- charge – (n, v) заряд; заряжать;
- semiconductor – (n) полупроводник;
- tiny – (adj) очень маленький; крошечный;
- slice – (n) тонкий слой; ломтик;
- emitter – (n) излучатель; эмиттер;
- collector – (n) коллектор, сборник; токосниматель;
- ray – (n, v) луч; излучать;
- tube – (n) трубка; электроннолучевая трубка; электронная лампа;
- deflect – (v) отклонять; изменять направление;
- bounce – (v) здесь отсылать;
- distant – (adj) отдаленный; удаленный;
- sound – (n, v) звук, звучать; давать сигнал;
- cell – (n) эл. элемент, батарейка;
- circuit – (n) (электрическая) цепь;
- influence – (n) воздействие; влияние;
- instant – (adj) мгновенный.

Exercise 1. *Give the Russian equivalents to the follow word combinations.*

To travel at incredible speed; negative charge; to transform or charge one voltage to another; semiconductor material; cathode ray tubes; beyond the range of visual observation; solar

cells; to digest masses of statistics; to perform mathematical calculations; to carry on researches.

Exercise 2. *Complete the following statements by choosing the answer which fits best.*

1. An electron is one of the particles in an atom:

a) which travels at high speed within the nucleus;

b) which has no charge;

c) which moves very fast around the nucleus;

d) the mass of which is about one ten thousandth the size of an atom.

2. A transistor is a device that:

a) can send us information from space vehicles;

b) allows a small current to control a large current;

c) transforms one voltage to another;

d) produces a current when it is illuminated.

3. Electronics has revolutionized science and industry because:

a) it means putting electrons to work;

b) it is a fascinating world which engineers are eager to explore;

c) it has given people a host of inventions and devices that have changed their lives;

d) it can gather information from distances far eyond the range of visual observation.

Exercise 3. *Find in the text the English equivalents for the following word combinations.*

Крошечная пластинка германия или кремния; электронный луч отклоняется; магнитное поле; радиосигналы с отдаленных объектов; солнечные батарейки; под воздействием электрического тока; расстояние и направление; вырабатывать электрический ток.

Exercise 4. *Identify ing-forms. Analyse them. (Whether they are gerunds or participles).*

Exercise 5. *Look through the text again and answer the following questions.*

1. Why is electronics the tool of today?
2. What electronic devices are described in the text?
3. What does a transistor allow to do?

4. Where are transistors employed?
5. How are radars and sonars used?
6. When do solar produce current?
7. How can electronic devices be used for for exploring space?
8. Where is electronics at work now?

Exercise 6. *Put questions to the underlined words.*

1. An electron travels at incredible speed round the nucleus.
2. A transistor is made from semiconductor material.
3. Radar bounces radio signals off distant objects.
4. Solar cells produce current when they are illuminated.
5. Computers can perform mathematical calculations with extreme speed.
6. Electronics has revolutionized science and industry.

Exercise 7. *Translate the text below in writing. Use the dictionary if necessary.*

In 1833 Michael Faraday reported that silver sulfide exhibited a negative temperature coefficient of resistance Another interesting date is 1873, when a technical assistant of W. Smith, testing underwater telegraph cables, found that the high resistance he was using varied considerably according to the amount of light falling on it.

The resistor was made of semiconductor selenium. And so it was discovered that selenium conducts electricity better in light than in darkness. The late nineteen twenties and middle thirties saw the appearance of selenium power rectifier. The nineteen thirties end early forties witnessed the development of thermistors, several types of diodes, rectifiers and photocells, and the greatly increased application of all these devices. A real contribution to the study of semiconductor physics has been made by the prominent Soviet and Russian scientist academician A.P. Yoffe. It was in 1930 that Yoffe and his co-workers started a systematic research of semiconductor physics. Yoffe put forward the supposition that semiconductors could be used for the direct conversion of heat and light into electric power.

Text 2. THOMAS ALVA EDISON

Read the text and render it in English.

The date of Edison's invention was August 12, 1877. But it was not until November 17 of that year news of it came to the world in an article in a magazine ailed Scientific American' In December, Edison gave a demonstration of his talking machine in the office of the magazine and news of it spread very quickly.

The first phonograph was not at all like a record player of our time. It not only looked very different, it both recorded and played bade, so that in this sense it could be said to have resembled the present – day tape recorder. It was a tinfoil phonograph, which was put around a metal cylinder. By turning a handle, the cylinder was made to rotate while a needle cut a groove into the tinfoil.

Next Edison became interested in the invention of an electric – light bulb for lighting streets and buildings by electricity instead of by gas.

First he learned that platinum wire, which would melt in the open air and give a light of five candle – power would give a light of twenty-five candle – power and bum a little longer in an all – glass bulb. This vacuum bulb was Edison's first real step towards his success.

It had taken Edison and his assistants thirteen month toproduce the incandescent lamp.

Thomas Alva Edison was born on February 11, 1847, in Milan, Ohio, USA. Tom was one of those children who are always asking «why?». If hi had an idea he had to try it.

At seven Tom entered school but left it after three months, because the teacher thought that he was a dull boy. His mother than became his teacher. The boy loved books and had a wonderful memory. His mother gave him a book on science and he began to study. It gave him ideas for all kinds of experiments.

Edison began to work when he was twelve years old His first job was a newspaper boy on a train.

Edison's inventions include the phonograph, or gramophone, the megaphone, the cinematograph, the improved lamp of incandescent light, many greatly improved systems of telegraphic transmission and numerous other inventions.

UNIT 9

Text 1. SILICON AND GERMANIUM

There are several hundred materials which have been studied and identified as semiconductors. Among the semiconductors will be found some of the elements themselves, such as silicon, germanium, selenium and boron. Many metallic oxides, sulphides, arsenides and some other binary compounds as well as variety of mixed metallic oxides are semiconductors.

Germanium and silicon are known to be the moat important of present semiconductors. Silicon and germanium are both fourth column elements having the diamond structure. Generally speaking, the two substance* are much alike. But silicon has a smaller atomic weight and fewer extra nuclear electrons than germanium. This fact leads to a number of differences in their properties. Whereas germanium is bright silvery in appearance, silicon is darker in hue, although polished specimens still have a metallic lustre.

The lattice constant of silicon is 5.430 A, somewhat smaller than that ' of germanium. Its high melting point (about 1420 °C) accounts for many difficulties to make it in a pure form. Silicon turns out to have high chemical reactivity at this temperature, so it is rather difficult to prevent impurities from contaminating the molten silicon.

Silicon has a smaller dielectric constant than germanium This has a definite effect on the electric properties. For example, the ionization energy of silicon is larger than that of germanium. Third- and fifth-column impurities in silicon have an ionization energy of about 0.045 eV whereas the values for germanium are about 0.01 eV.

Since the ionization energies are greater in silicon than in germanium this can be done at the temperatures of liquid hydrogen it appears possible to obtain photoconductors when silicon is doped with gallium and indium.

Silicon like germanium shows abrupt changes in its properties when subjected to bombardment by electrons or nuclear particles.

Silicon and germanium are most widely studied from the research point of view, partly because of their commercial importance, partly because of their high purity, good crystal structure, and interesting properties that they exhibit.

Words to be learnt:

- arsenid – (n) арсенид (соединение мышьяка с металлом);
- semiconductor – (n) полупроводник;
- diamond – (n, adj) ромб; ромбовидный алмаз;
- substance – (n) вещество; субстанция;
- extra – (adj) добавочный; дополнительный;
- appearance – (n) внешний вид;
- hue – (n) оттенок; цвет;
- polish – (n) полировать; шлифовать;
- luster – (n) блеск; глянец; лоск;
- specimen – (n) образец; пробный экземпляр;
- lattice – (n) решетка; сетка;
- melt – (v) плавить(ся); расплавлять(ся); растворять(ся);
- melting point – точка плавления;
- pure – (adj) чистый; беспримесный;
- prevent – (v) предотвращать; предохранять;
- impurities – (n) примеси; включение; загрязнители;
- contaminate – (v) загрязнять; заражать;
- dope – (v) добавлять; заправлять; делать присадку;
- abrupt – (adj) резкий; внезапный; крутой; обрывистый.

Exercise 1. *Give the Russian equivalents to the follow word combinations.*

Binary compounds; the most important of present semiconductors; bright silvery in appearance; polished speciment; a smaller atomic weight; darker in hue; when silicon is doped with gallium and indium; commercial importance; high purity and good crystal structure.

Exercise 2. *Find in the text the English equivalents for the following word combinations.*

Два вещества очень похожи; ряд различий; предотвращать от загрязнения; оказывать определенное воздействие на; высокая точка плавления; резкие изменения;

жидкий водород; когда подвергается; в чистом виде; расплавленный кремний.

Exercise 3. *Agree or disagree with the following statements.*

1. Silicon differs fom germanium only in a smaller atomic weight.
2. These substances are much alike.
3. Germanium has the same dielectric constant as silicon.
4. Germanium and silicon are considered to be the most important of present semiconductors.
5. The ionization energies are greater in silicon than in germanium.
6. Silicon is bright silvery in appearance.
7. Germanium and silicon have commercial importance.

Exercise 4. *Identify the Infinitive Constructions in the text. Translate these sentences.*

Exercise 5. *Render the following sentences in English.*

1. Кремний и германий очень похожи.
2. В то же время существует несколько различий в их основных свойствах.
3. Кремний более тугоплавкий, чем германий.
4. Германий обладает большей диэлектрической константой, чем кремний.
5. У кремния атомный вес меньше, чем у германия.
6. Изучение свойств кремния и германия очень важно с исследовательской точки зрения.
7. Кремний и германий показывают резкие изменения своих свойств, когда их бомбардируют электронами или ядерными частицами.

Exercise 6. *Skim the text and compare he properties of silcon and germanium:*

a) Similar properties;
b) Different properties.

Exercise 7. *Read the text below at home and find out what factors influence conductivity and resistivity of semiconductors.*

CONDUCTIVITY OF SEMICONDUCTORS

Electrical conductivity of semiconductors is one of the most varying of all physical properties.

The individual materials begin showing great variability in resistivity according to the conditions of temperature, pressure and the mixture of the component substances.

If a minute trace of gallium or arsenic (one part per billion) is added to pure germanium, its conductivity will be increased by three orders of magnitude (nearly 1,000 fold) and will rather make it suitable for using in transistors. A tiny farther addition of the impurity can increase the conductivity 100,000 fold, converting germanium to a conductor. Similarly silicon and metal oxides such as nickel and titanium dioxide are lowered in resistivity by introducing of appropriate impurities. Indeed nickel oxide, which is an insulator m the pure state, is reduced in resistivity by 13 orders of magnitude by adding only one per cent of helium. We know of great changes being produced by changes in temperature.

Thus a semiconductor can be made a conductor by heating it to a high temperature or it can be made an insulator by cooling it to a low temperature In contrast, the resistivity of a pure metal is much less increased by heating and reduced by cooling.

In contrast, the resistivity of a pure metal is much leas increased by heating and reduced by cooling.

In some cases the change is very abrupt. For example, above 150 kelvin vanadium is a semiconductor, when it is cooled its resistivity suddenly jumps and it becomes a good insulator. Some semiconductors and insulators are extremely sensitive to light Thus upon illuminating, their conductivity may be several orders of magnitude higher than it is in the dark. This phenomenon is called photoconductivity. How can all these facts be explained? What principles account for the great differences in conductivity between metals and insulators, the peculiar properties of semiconductors? All these questions, of course, could be answered. Many scientists are trying to give definite answers, but still many problems remain to be solved.

Text 2. PYOTR LEONIDOVICH KAPITSA

Read the text and render it in English.

Kapitsa was bom of Polish parents m the city of Kronstadt and graduated from the Petrograd Polytec hnical Institute in 1918. He worked for over ten years with Ernest Rutherford in the Cavendish Laboratory in Cambridge. He was made a Fellow of the Royal Society in 1929 and was the first director (1930–1934) of the Mond Laboratory in Cambridge. In the 1920s he originated techniques for creating ultrastrong magnetic fields by injecting high current for brief periods into specially constructed air-core electromagnets. In 1928 he discovered the linear dependence of resistivity on magnetic field for various metals in very strong magnetic fields.

In the 1930s he turned to low temperature research, beginning with a critical analysis of the existing methods for obtaining low temperatures. In 1934 he developed new and original apparatus (based on the adiabatic principle) for making significant quantities of liquid helium.

In 1934, on a professional visit to the Soviet Union, his passport was removed and he was not alloweCtP leave the country. Kapitsa was required to form the Institute for Physical Problems, which be did with equipment which the Soviet Government bought from the Mond Laboratory Cambridge (with the assistance of Rutherford, once it was clear that Kapitsa would not be permitted to return).

In Russia Kapitsa began a series of experiments to study liquid helium, leading to the discovery in 1937 of its superfluidity (not to be confused with superconductivity). He reported the properties of this new state of matter in a series of papers, for which he was later awarded the Nobel Prize in Physics "for basic inventions and discoveries in the area of low-temperature physics". In 1939 he developed a new method for liquefaction of air with a low-pressure cycle using a special high-efficiency expansion turbine. Consequently, dining World War II he was assigned to head the Department of Oxygen Industry attached to the USSR Council of Ministers, where he developed his low-pressure expansion techniques for industrial purposes. After the war he turned to a ouite new range of physical problems: he invented high power mi-

crowave generators (1950–1955) and discovered a new kind of continuous high pressure plasma discharge with electron temperatures over 1,000,000 K.

Immediately after the war a group of prominent Soviet scientists (incfading Kapitsa in particular) lobbied the gov-ernmen t to create ft new technical university, the Moscow Institute of Physic and Technology. Kapitsa taught there for many years. From, 1957 he was also a member of the presidium of the Soviet Academy of Sciences and until his death in 1984 was the only presidium member who was not also a member of the Communist Party.

In 1978 Kapitsa won the Nobel Prize in Physics for the work in low temperature physics. He shared this prize with Arno Allan Penzias and Robert Woodrow Wilson.

Kapitsa resistance is the thermal resistance (which causes a temperature discontinuity) at the interface between liquid helium and a solid.

A minor planet 3437 Kapitsa, discovered by Soviet astronomer Lyudmila Georgievna Karachkina in 1982, is named after him.

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