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Учебник английского языка

для технических вузов

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Учебник английского языка для технических вузов предназначен для студентов второго этапа обучения, специализирующихся в электронной технике, электроприборостроении, автоматике, вычислительной и измерительной технике, телемеханике, электротехнике, радиотехнике, системах управления и программировании.

Текстовой материал основного курса и система разработанных к нему заданий предназначены для развития всех видов речевой деятельности, для выработки навыков просмотрового, ознакомительного, изучающего и поискового чтения, а также аннотирования и реферирования текста.

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ПРЕДИСЛОВИЕ

Учебник английского языка для технических вузов составлен в соответствии с требованиями действующей программы по английскому языку для неязыковых специальностей высших учебных заведений и предназначен для второго этапа обучения студентов, специализирующихся в области электронной техники, электроприборостроения, автоматики, вычислительной и измерительной техники, телемеханики, электротехники, систем управления и программирования.

Учебник представляет собой комплекс учебных материалов, организованный в соответствии с конкретными задачами и условиями обучения, имеющий своей целью формирование у учащихся навыков и умений в различных видах речевой деятельности.

Основной целью учебника является обучение чтению и пониманию специального неадаптированного текста на английском языке без словаря (или с ограниченным его использованием) для получения необходимой информации и ведению беседы по специальности.

Тексты учебника взяты из современной технической оригинальной литературы на английском языке по основным профилирующим дисциплинам технического вуза.

Учебник состоит из введения, основного курса и краткого грамматического справочника.

Основной курс состоит из шести глав: Глава I — Электричество и магнетизм; Глава II — Электронные приборы и электронная техника; Глава III — Вычислительная техника; Глава IV — Радиотехнические цепи и измерительная техника; Глава V — Электроавтоматика и телемеханика; Глава VI — Системы управления и программирование.

Каждый урок содержит учебный материал для самостоятельной работы, для классной работы под руководством преподавателя, грамматические упражнения.

Тексты урока тематически взаимосвязаны, что позволяет изучить до 30 новых лексических единиц по каждой теме. Большое внимание в учебнике уделяется выработке навыков и умений в различных видах чтения, которая обеспечивается разработанной системой методических приемов, реализуемых в упражнениях. Это способствует развитию у учащихся умений быстро ориентироваться в текстовом материале и извлекать основную информацию по специальности. Тексты, предназначенные для обучения чтению, ис-

пользуются также и как основа для обучения устной речи при обсуждении, интерпретации содержащейся в тексте информации, схем, применяя денотатные планы высказывания и созданные кафедрой диафильмы.

Раздел Independent Work включает предтекстовые упражнения, тексты для просмотрового и ознакомительного чтения, задания. При просмотровом чтении (Skimming Reading) дается установка на понимание главной идеи текста, на сопоставление отдельных элементов текста с целью научить студентов определять основную информацию и кратко излагать ее. Ознакомительное чтение (Average Reading) предполагает выявление элементов текста, несущих главную и дополнительную информацию. Для обобщения информации и передачи основного содержания текста выполняются соответствующие задания.

Студентам рекомендуется проводить самостоятельную работу в лингафонном кабинете: прослушивание магнитофонных записей предтекстовых упражнений и текстов для просмотрового и ознакомительного чтения с последующим чтением их и выполнением послетекстовых заданий.

Раздел Classwork состоит из предтекстовых упражнений, текстов для изучающего и поискового чтения, заданий. Изучающее чтение (Close Reading) требует от студента тщательного анализа структурных и семантических связей в каждом предложении, выявления отношения автора к изложенному материалу и определения своего отношения к нему. Результатом такого вида чтения должно быть максимально точное понимание содержащейся в тексте информации, составление реферата и аннотации текста. Задания к тексту носят творческий характер.

Поисковое чтение (Searching Reading) предполагает поиск нужной информации: по теме в тексте и дополнительной информации в журналах по специальности. Тексты для поискового чтения рекомендуется использовать для внеаудиторного чтения.

Тексты учебника содержат информацию, в которой освещаются современные достижения в области науки и техники, что возбуждает у студентов профессиональный интерес к изучению текстового материала.

Таким образом по теме урока вводятся тексты для разного вида чтения, начиная с более легких для самостоятельной работы студентов к более сложным для их детального анализа. Такая последовательность ввода учебных текстов рекомендуется современной методикой обучения иностранным языкам (см. работы С. К. Фоломкиной, М. В. Ляховицкого, И. А. Зимней) и практикой обучения иностранному языку в техническом вузе. Учебный материал как для самостоятельной, так и для классной работы рекомендуется проверять преподавателю во время занятий.

Весь методический аппарат учебника (предтекстовые упражнения, задания после текстов) ставит своей целью обучение чтению, говорению, аудированию, письму. Задания активизируют учебную деятельность студентов, развивают умение формировать условно-неподготовленные высказывания на английском языке, создают предметность речевого высказывания, способствуют процессу общения между студентами, максимально приближая его к речевому общению. Задания на реализацию проблемных ситуаций, описание схем и беседы развивают мыслительную деятельность студентов, создают надежную основу для ведения дискуссий по специальности. Приобретенные умения и навыки преподаватель может использовать во время учебной игры по специальности.

Для контроля понимания текста можно использовать денотатные планы (схемы) текстов, в которых в логической последовательности развертывается содержание текста. Они помогают студентам в определении содержания текста, в формировании структуры монологического и диалогического высказывания по теме текста. Преподаватели кафедр иностранных языков технических вузов могут составить денотатные планы к каждому тексту, выделяя необходимые слова и словосочетания по плану высказывания.

Грамматические упражнения предназначены для выработки навыка распознавания и перевода грамматических явлений, встречающихся в текстах учебника. Они могут быть выполнены студентами самостоятельно и под контролем преподавателя. Для консультации при выполнении этих упражнений можно использовать краткий грамматический справочник в конце учебника или любой учебник по грамматике английского языка.

Все тексты уроков и упражнения, предназначенные для обучения устной речи, рекомендуется начитать на магнитофонную ленту квалифицированным диктором.

INTRODUCTION

ENGINEERING RISES TO A NEW STAGE

The 27th Congress of the CPSU points out that acceleration in the growth rate of Soviet engineering is the main direction in the long term development and that it serves as a backbone for progress in science and technology in all branches of the national economy.

Everyone knows about the contribution which Soviet scientists have made to mathematics, mechanical engineering, physics, chemistry, and the theory of automatic control — areas of knowledge which will make up the engineering of the future. This country has made undoubted progress in the peaceful exploration of space and in the branches of engineering producing machines for power engineering, metallurgy, transport, and other industries. Over the past few years new technologies and equipment have been designed for most branches of engineering.

Nevertheless we intend to make further sharp increase in the rate of progress in science and technology, to deepen fundamental research and to speed up the introduction of scientific development in engineering practice.

There are many lines along which the scientific and technological progress will continue in engineering. They all can be grouped together into two main headlines. Firstly, it is automation, including the creation of "unmanned" industries. Secondly, it is raising of the reliability and extending the service life of machines.

In the near future the traditional equipment is to go through substantial changes. It should be modified so that it could operate in tandem with automatic systems and industrial robots. Controlled machines based on microprocessors and microcomputers should be introduced on a large scale. Machines are being designed so as to take into account the changing operating conditions.

The main task now is to "teach" machines to operate without man's presence. They should be able to position the workpieces whose types and sizes can change from hour to hour. They should also be able to select the mode of machining and themselves to control the quality of their own operations.

Intense work is being carried out on new robots. What we need is not merely manipulators which can take up a workpiece and pass it on, but robots which can identify objects, their position in space, etc. We also need machines that would trace the entire process of production. Some of them have been designed and manufactured. They can automate the process of positioning of the workpiece in the machine, give commands at various stages of production and check the precision of manufacture.

The use of a computer is known to provide a vast opportunity for finding answers to many of most complex social problems as well. During the next 20 years computers are expected to make an explosion in the social sciences comparable to that which we saw in the past half of the 20th century in the physical sciences.

To understand these possibilities of the future, we should first consider the tendency of today's computer technology and the nature of the system to be used. These systems will be considerably smaller then today's and they will perform far more complex functions. Their operating speeds will be measured in nanoseconds. A nanosecond is to a second as a second — to 30 years. These computers of tomorrow will respond to handwriting, to images, and to spoken commands. They will communicate with one another over any distance. They will recognize a voice, a face or a symbol among tens of thousands.

A link-up of computers will be accomplished through communication satellites, high-capacity transistorized cables, microwave insulated tubes, as well as standard telephone and telegraph links. In these systems data will move thousands of times faster than in today's. In the future, laser beams will be used to transmit vast quantities of information in the form of light through special cables.

At present scientists are working upon another very interesting problem connected with electronic computers — a chemical memory system which would be better than the electronic memory system. The chemical system will make it possible to store a million bits of information (such as codes, symbols, and formulas) on three square centimetres of paper.

Soviet society is to reach new heights on the basis of accelerating its social and economic development. This means: raising the national economy to a basically new scientific-technological and organisational-economic level, gearing it towards intensive development; achieving the world's highest level in productivity of social labour, quality of output, and efficiency of production; ensuring an optimum structure and balance for the integral national economic complex of the country.

Chapter I. ELECTRICITY AND MAGNETISM

Lesson 1. BASIC CONCEPTS OF ELECTRICITY AND MAGNETISM

I. INDEPENDENT WORK

In the Laboratory

1. Skimming Reading

PRE-TEXT EXERCISES

I. a) Listen and repeat after the speaker. b) Practise the pronunciation of the following.

[ɔ:] law, draw; [ju:] new, few; [au] down, town; [ou] snow, show; [ɔ] was, want; [ɔ:] war, warn; [ə:] work, word.

What, wash, low, drew, drawn, grew, grow, grown, world, ward, blew, window, brown, blow, glow.

II. a) Make sure that you know these words. Say what Russian words help you to guess their meanings. b) Repeat these words after the speaker.

Ma'terial; phe'nomenon [f], (*pl*) phenomena; manife'station [ʃn]; 'magnetism [æ]; in'duction [ʌ]; practical [æ]; period ['piəriəd]; telegraph [f]; telephone [f]; Coulomb ['ku:lɔm]; ma'chine [i:]; as'sociate [ʃ]; chemical [k]; 'concentrate [s]; oxide ['ɔksaid]; sulphate ['sʌlfeit]; pro'portion; arc [a:k]; 'energy [dʒ], nature [tʃə], 'transport [æ].

III. a) Listen, repeat and memorize the following words and word-combinations. b) Check if you know their meanings.

I. Certain [sə:tn] определенный; amber [æ] янтарь; glass [α:] стекло; fur мех; capacity [æ] способность; cork пробка; ability способность; lodestone магнитный железняк; etc. [it 'setrə] и т. д.; quantitative laws [ɔ] [ɔ:] количественные законы; induction индукция; prior to ['praiə] до; increase [s] v. увеличивать; current revolution современная революция; notably ['nəutəbli] особенно; rub v. тереть; silk шелк;

II. Acquire [ə'kwaiə] приобретать; a bit of paper кусочек бумаги similarly подобным образом; iron ores [ɔ:z] железная руда; ancient [ʃ] times древние времена; get weaker [i:] слабеть; investigate v. исследовать; the only единственный; the lightning rod молниеотвод; expend v. увеличиваться (в объеме); ever-increasing control все возрастающее управление.

IV. a) Give English equivalents to the Russian words and word-combinations in brackets and translate the sentences into Russian. b) Check yourself listening to the complete sentences after the speaker.

1. When we rub (определенные) substances, notably (янтарь) and (стекло) with (шелк) or (мех), they (приобретать) the (способность) to attract small (кусочки бумаги) and (пробка). 2. This (явление) is the manifestation of electricity. 3. (Подобным образом), the ability of certain (железная руда) such as (магнитный железняк) to attract small bits of iron is a manifestation of magnetism. 4. All these things were known from (древние времена). 5. Most of the basic (количественные законы) of electricity and magnetism were discovered between 1784 and 1831. 6. Michael Faraday discovered magnetic (индукция). 7. (До этого) the only practical electrical (изобретение) was the (молниеотвод). 8. The practical utilization of electricity (увеличивать) rapidly with the development of the telegraph, the telephone, incandescent lighting and electric motors. 9. Uses of electricity (расширять) to this day with the (современная революция) in microelectronics. 10. Microelectronics gives us (все возрастающее управление) over the machines.

Text A

CHARGING A BODY

I. a) Listen to the text, mind the English intonation. b) Read the text to yourself and grasp the main idea of it.

The only way to charge a body negatively is to add electrons to it, and the only way to charge it positively is to take electrons away from it, leaving an excess of positive electricity.

When the rubber rod was charged negatively by rubbing with cat's fur, some electrons passed from the cat's fur to the rubber rod,

leaving the cat's fur charged positively and the rubber charged negatively. On the other hand, when the glass rod was charged positively by rubbing with silk, some electrons passed from the glass to the silk, leaving the glass rod charged positively and the silk charged negatively.

2. Average Reading

Text B

ELECTRICITY AND MAGNETISM

I. a) Listen to the text. b) Read it (time limit is 3 min.). c) Find the part of it dealing with the descriptions of electricity and magnetism.

When certain substances, notably amber and glass are rubbed with a material such as silk or fur they acquire the capacity to attract small bits of paper and cork. This phenomenon is a manifestation of electricity, one of the fundamental forces of nature. Similarly, the ability of certain iron ore, such as lodestone, to attract small bits of iron is a manifestation of magnetism, another fundamental force.

Although these simple electric and magnetic phenomena have been known since ancient times, most of the basic quantitative laws of electricity and magnetism were discovered between 1784, when Charles Coulomb investigated the forces between charged objects, and 1831, when Michael Faraday discovered magnetic induction. Prior to this 50 year period of discovery, the only practical electric invention was the lightning rod of Benjamin Franklin (1752). After this period, the practical utilization of electricity increased rapidly with the development of the telegraph (1844), the telephone (1877), incandescent lighting (1880) and electric motors (1887). Uses of electricity have continued to expand to this day, with the current revolution in microelectronics giving us ever increasing control over the machines.

ASSIGNMENTS

I. a) Find out the key sentences in the Text A. b) Say what physical phenomenon the text is concerned with.

II. a) Skim through the Text B and find the part of it dealing with the fundamental forces of nature. b) Discuss the information with your fellow-students.

III. a) Find the paragraph in the Text B containing information about the discovering of the basic quantitative laws of electricity and magnetism. b) Discuss it.

IV. Answer the following questions embracing the contents of the Text A and the Text B.

1. What is the way to charge a body negatively or positively? 2. What capacity did amber and glass aquire when rubbed with silk or fur? 3. What is magnetism? 4. When were the basic quantitative laws of electricity and magnetism discovered? 5. When did C. Coulomb investigate the forces between charged objects? 6. When did M. Faraday discover magnetic induction? 7. What was invented by B. Franklin?

V. Be ready to discuss the information obtained from the Text B.

VI. Make a short summary of the Text B.

VII. Speak on the Text A and the Text B according to the following plan:

1. The manifestation of electricity.
2. The most important development in electricity.

VIII. Make up a short dialogue on the following situations:

1. A few students make an experiment with different materials to receive electricity.
2. Professor asks the students about history of electricity and magnetism.

II. CLASSWORK

3. Close Reading

PRE-TEXT EXERCISES

I. Be sure that you know these words.

Associate v. связывать; mention упоминать; application приспособление, применение; act along действовать самостоятельно; own собственный; thin тонкий; solid твердый; event событие; numerous многочисленный; however однако; presence присутствие; yet все же, еще; retain v. удерживать, сохранять; permanent постоянный; liberate v. освобождать; e. g. (for example) например; obvious очевидный; exert v. оказывать действие; heat v. нагревать; surface поверхность.

II. Memorize these words and word-combinations used in their specialized meanings.

Device прибор; sound звук; loud speaker громкоговоритель; lead свинец; purify v. очищать; resistive резистивный, имеющий сопротивление; deposit осаждать; silver серебро; electric fire электрическая печь; electric current электрический ток; copper медь; wire провод; plate v. покрывать; solution раствор.

III. Find these word-combinations and terms in the Text C and translate the sentences containing them.

Lead-acid battery кислотно-свинцовая батарея; fork lightning молния; sufficient to melt достаточно, чтобы расплавить; arc welding дуговая сварка; to glow red hot раскаливать докрасна; candlestick подсвечник; gimlet буравчик.

IV. Give English equivalents to the Russian words in brackets. Translate these sentences.

1. An electric (печь) is the most (очевидный) example of the heating effect of a current. 2. This wire (раскален докрасна) as the current passes through it. 3. If the wire is very (тонкий) it is heated (добела). 4. A great proportion of light to heat is released as in the tungsten (вольфрамовая лампа накаливания). 5. Electrolysis is used (очищать) metals such as (медь). 6. The element of the fire is just highly (pe-

зистивный) wire. 7. During (дуговая сварка) and (молния) large (количество) of electrical energy are concentrated and give temperature (достаточно, чтобы расплавить) metals.

Text C

BASIC ELECTRIC CONCEPTS

I. a) Read the text. b) Find the part of it describing three basic effects of an electric current and examples of electromagnetism and chemical effect of current.

We associate all kinds of events and devices with electric current: electric light, electric transport, electric sound, etc. They are too numerous to mention. However, there are only three basic effects of an electric current and all the other applications follow from them: (a) magnetic effect, (b) chemical effect, (c) heating effect.

The magnetic effect of current is the basis for most electromechanical devices. Near a current there is a magnetic field and this exerts a force on other currents or magnetic materials.

The presence of magnetic materials such as iron can make the forces thousands of times greater than the currents acting alone, and yet it is the current which control the magnet.

Loudspeakers and electric motors are other applications of electromagnetism.

The materials themselves may retain the magnetism and become permanent magnets which exerts their own influence. Permanent magnets are the basis for some of the simpler devices. The compass needle responds to the magnetic field of the Earth which is itself a permanent magnet.

When a lead acid battery is charged the acid becomes more concentrated and hydrogen and oxygen are liberated. As the battery discharges the acid gets weaker and lead oxide on the positive plate is charged to lead sulphate. These processes are examples of the chemical effect of a current, i. e. electrolysis. Electrolysis is used to purify metals such as copper and alluminium and to deposit metals onto surface, e. g., silver plating.

An electric fire is the most obvious example of the heating effect of a current. The element of the fire is just highly resistive wire which glows red hot as the current passes through it.

If the wire is very thin it is heated white hot and a greater proportion of light to heat is released as in the tungsten filament lamp. Hotter still and more dramatic are the effects of arc welding and fork lightning when large amounts of electrical energy are concentrated to give temperature sufficient to melt metals.

ASSIGNMENTS

I. Read the Text C attentively and answer the following questions.

1. What do we associate electric current with? 2. How many effects of an electric current are there? 3. What is the magnetic effect of current? 4. What can make the forces thousands of times greater then the currents acting along? 5. What applications of electromagnetism do you know? 6. What may become permanent magnets? 7. When does the acid become more concentrated? 8. What is the result of the battery discharge? 9. What is electrolysis? 10. What is the most obvious result of the heating effect of a current?

II. Read the text again and ask additional questions embracing its contents.

III. Analyse the sentences containing the main idea of the text.

IV. Comment on the author's attitude to basic electric concepts.

V. Read the text and find the part of it describing three basic effects of electric current and examples of electromagnetism and chemical effect of current.

VI. Pick out and translate the sentences with the Infinitive and Gerund.

VII. Make up a plan of the text using the active vocabulary of the lesson.

VIII. Retell the text according to your plan.

IX. Express your opinion of the text from the point of your knowledge of this topic.

X. Translate the Text C to be sure you understand it well.

4. Searching Reading

PRE-TEXT EXERCISES

I. Match the following English words and word-combinations with the Russian ones.

to be familiar with	прямой угол
temporary magnet	буравчик
permanent magnet	средний палец
observe	правая рука
thumb	менять направление
forefinger	указательный палец
right hand	наблюдатель
reverse	большой палец
gimlet	быть знакомым с
middle finger	постоянный магнит
right angle	магнит с временным магнетизмом (электромагнит)

Text D

1. MAGNETISM

I. a) Read the Text D and say what it is about. b) Review the text.

Anyone working in the field of electricity must be familiar with the principles of magnetism because generators, transformers and motor depend on magnets and magnetism for their operation.

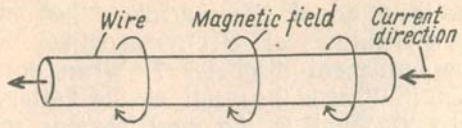

Fig. 1.1. The relation between electricity and magnetism.

A magnet is either permanent or temporary. If a piece of iron or steel is magnetized and retains its magnetism, it is a permanent magnet. A compass is one form of permanent magnet. Others with which you are probably familiar are horseshoe-shaped magnets and bar magnets. Each one of these magnets has a north magnetic pole and south magnetic pole; in fact, all magnets have a north and a south poles.

When current flows through a coil, a magnetic field with a north and a south pole is set up just like that of a permanent magnet. However, when the current stops, the magnetic field also disappears. This type of temporary magnetism is called electromagnetism. Permanent magnets are used for the magnetic field necessary in the operation of small, inexpensive electrical motors.

When electricity flows through a wire or conductor, magnetic lines of force (magnetic flux) are created around that wire (Fig. 1.1). When a piece of wire is passed through a magnetic field (magnetic lines of force), electricity is created in that wire. We then can readily see the relation between electricity and magnetism. In fact, the very existence of the electrical industry is dependent upon magnetism and magnetic circuits.

2. RULES FOR DIRECTION OF CURRENT AND MOTION

II. Read the text and find the part of it describing the methods of determining direction of the lines of force.

To determine the polarity of an electromagnetic solenoid: In looking at the end of a solenoid, if an electric current flows in it clockwise, the end to the observer is a south pole and the other end is a north pole; if the current flows counter-clockwise, the position of the pole is reversed.

To determine the direction of the lines of force set up around a conductor: If the current in a conductor is flowing away from the observer, then the direction of the lines of force will be clockwise around the conductor (the rule of gimlet).

To determine the direction of an induced current in a conductor that is moving in a magnetic field: Place thumb, forefinger, and middle finger of the right hand each at right angles to the other two; if the forefinger shows the direction of the lines of force and the thumb shows the direction of the motion of the conductor, then the middle finger will show the direction of the induced current.

ASSIGNMENTS

I. Answer the following questions embracing the contents of the Text D.

1. Why must anyone working in the field of electricity be familiar with the principles of magnetism? 2. What kind of magnets do you know? 3. What do all magnets have? 4. What is set up in a coil when current flows through it? 5. Where are permanent magnets used? 6. Where is electromagnetism used? 7. How can we determine the polarity of an electromagnetic solenoid? 8. How can we determine the direction of the lines of force set up around a conductor? 9. How can we determine the direction of an induced current in a conductor that is moving in a magnetic field?

II. a) Examine Fig. 1.1 and describe it. b) Answer the questions.

1. What does Fig. 1.1 show? 2. What does electricity flow through? 3. When are magnetic lines of force created around the wire? 4. When is electricity created in the wire?

III. Speak on:

1. The Principles of Magnetism;
2. Rules for Direction of Current and Motion.

IV. Ask some questions on the text.

V. Prepare a dialogue on your own situation.

VI. Express your opinion of the text. Does the text prove that generators, transformers and motors depend on magnets and magnetism for their operation?

VII. Look through the latest magazines and find information on basic electric concepts describing all kinds of devices with electric current.

III. GRAMMAR EXERCISES

I. Analyse the structure of the following words and give their initial forms.

Magnetic, magnetism, to magnetize; movement, movable, remove; direction, directional, director.

II. Give the degrees of comparison of the following words.

High, large, long, wide, big, little, good, small, great, many, much, few, well, bad, far, easy, difficult, different.

III. Change the sentences adding some words and using comparative and superlative degrees of adjectives and adverbs.

Model. This is **an interesting** book.— This book is **more interesting** than that one. (This is **the most interesting** book I have ever read.)
I like to swim **much.** He likes to swim **more** than I. (He likes to swim **most** of all.)

1. The Kiev Metro is beautiful. 2. I like to read much. 3. He knows English badly. 4. Professor explains the material well. 5. The students were answering loudly. 6. A big house was erected nearby. 7. This problem is simple.

IV. a) Translate the following sentences. b) Pay attention to the words and word-combinations in bold type.

1. The education system in the USSR differs greatly **from that** in capitalist countries. 2. The aeronautics is one of the many branches of mechanical engineering, **the one that** is **the most interesting** to me. 3. **The more** I read about this event **the less** I understand it. 4.This problem is not so difficult as **the one that** we solved last time. 5. He studied this subject **as much as possible.**

V. Find Infinitives and Gerunds in the following sentences. State their functions and translate them into Russian.

a) 1. To develop a new device we had to study structures of many other similar devices. 2. To obtain the desired properties of the device the scientist had to continue this experiment. 3. To determine the direction of the lines of force set up around a conductor we must know the rule of gimlet. 4. The above mentioned method is used to determine the polarity of an electromagnetic solenoid. 5. To make an electric current flow continuously along a wire, a continuous supply of electrons must be available at one end and a continuous supply of positive charges at the other. 6. To avoid possible breakdown of the insulation, the practice is to put extra insulation on the end turns.

b) 1. Before switching on current for a test the circuit should be thouroughly checked. 2. On joining the upper ends of the metals with a metal wire we caused the current to flow through the wire. 3. In this case the reading will fall slowly after reaching full load. 4. In making permanent steel magnets we must prepare steel of high quality.

Lesson 2. ELECTRICAL UNITS AND CIRCUITS

I. INDEPENDENT WORK

In the Laboratory

1. Skimming Reading

PRE-TEXT EXERCISES

I. a) Listen and repeat after the speaker. b) Practise the pronunciation of the following.

[eɪ] main, way; [eə] chair, hair; [ɔ:] cause, saw, law; [i:] mean, treat; [e] head, read; [ɪə] hear, ear; [ə:] heard, early.

Exception: [ʌ] aunt; [e] pleasure, treasure, measure, pleasant, but: [i:] to please; [e] threat, dealt, meant, wealth, health, heaven, heavy, weapon; [eɪ] great, break; [ieɪ] create; [i:] to read, to lead, leader; [ɪə] real.

II. a) Repeat after the speaker. b) Find words in the Text A with similar pronunciation.

air, pair, fair, because, automation, applaud, applause, to read, read, to hear, heard, to lead, ready, to mean, meant, to deal, dealt, lead, fear, clear, tear, earn, earth, heart, day, pain, pay, laid, sea, stream, to measure, law, saw.

III. a) Make sure that you know these words. Say what Russian words help you to guess their meanings. b) Repeat these words after the speaker.

Ampere ['æmpeə], ammeter ['æmɪtə], battery [æ], potential [ʃ], experimental [eks,peri'mentl], maximum ['mæksiməm], volt [voult], voltmeter ['volt,mi:tə], voltage ['voultɪdʒ], gene'rator [dʒ], pro'portional, graph [græf], re'sult [ʌ], con'ductor [ʌ], value ['vælju:]-re'sistor [z], watt [wɔt], effect [ɪ'fekt].

IV. a) Listen, repeat and memorize the following words and word-combinations. b) Check if you know their meanings.

I. Stream поток; particle частица; arrangement *зд.* соединение; burn (burnt) v. гореть; calculate v. рассчитывать; circuit цепь; conductor проводник; connection соединение; current ток; deduce v. устанавливать; determine v. определять; define v. определять; mains электрическая сеть; measure v. измерять; match v. сопоставлять, согласовывать; obey v. подчиняться (выполняться); particular отдельный; produce v. производить; quantity количество, величина; ratio отношение; raise v. поднимать; rearrange преобразовывать; resistance сопротивление; equation уравнение; experimental опытный; flow (flew, flown) v. течь; law закон; low value малая величина; to go dim (bright) затухать (разгораться); just below чуть ниже; electromotive force (e. m. f.) электродвижущая сила; light bulb электролампа; stream n. поток; suggest v. предлагать; verification проверка; potential difference (p. d.) разность потенциалов; in series (соединять) последовательно; to be true быть действительным; become significant становиться значительным.

II. set up v. устанавливать; drop v. падать; just as также, как; pressure давление; mean (meant) v. значить; really действительно; force v. заставлять; energy per unit charge энергия на единицу заряда; supply снабжать; liquid жидкость; pipe труба; the same thing то же самое; available в наличии; from one point to another от одной точки к другой; source источник; connect in line соединять последовательно.

V. a) Give English equivalents to the Russian words and word-combinations in brackets and translate the sentences into Russian. b) Check yourself listening to the complete sentences after the speaker.

1. An electric (ток) is a (поток) of charged particles, which flow in (проводник). 2. We have just (определить) the unit of current. 3. A voltage (приложенное) to a conductor in a circuit (создавать)

a current. 4. The (отношение) of U to I for a (отдельный) conductor is called the (сопротивление) of the conductor R. 5. Ohm's (закон) can be (выражен) in the experimental results. 6. In the graph we have seen the (проверка) of Ohm's law. 7. (Преобразуя уравнение) we have $U = IR$. 8. A high resistance (ограничивать) the current to a (малая величина). 9. Values of current (измеряться). 10. A resistor carries a current of 0.2 A when a (разница потенциалов) of 4.0 V is applied across it. 11. Electrons move under the influence of (электродвижущая сила — ЭДС). 12. This equation (справедливо) for resistors (включенные последовательно). 13. These (величины) are (сопоставлять) with the current units. 14. In a parallel (устройство) of resistors the following equation is true.

Text A

CURRENT AND RESISTANCE

I. a) Listen to the text, mind the English intonation. b) Read the text to yourself and grasp the main idea of it.

An electric current (I) is a stream of charged particles. In a conductor the particles that move are electrons which are so small that they can flow past the atoms without resistance. Current I is measured in terms of the quantity of charge Q flowing per unit time — $I = \frac{Q}{t}$.

The charge on a single electron is very small as a unit of charge. Quantity of charge is measured in coulombs (symbol — C) where 1 coulomb $= 6.24 \times 10^{18}$ electron charges. We can now determine the unit of current the ampere (symbol A).

A voltage applied to a conductor in a circuit produces a current. One have found that for some conductors the current I directly proportional to the voltage U, i. e., $I \infty U$.

This is Ohm's law and it can be expressed in the experimental results shown in the graph of Fig. 1.2 *a*.

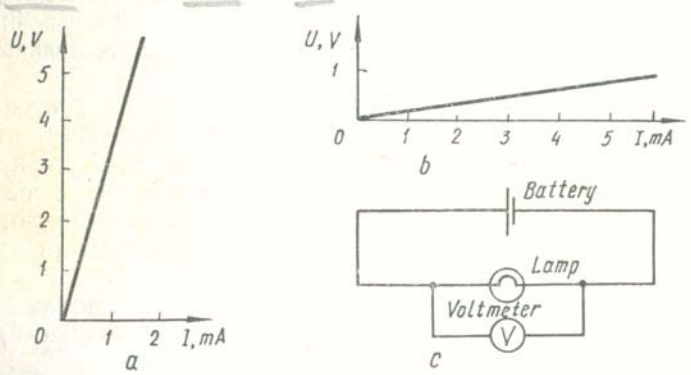

Fig. 1.2. Volt-ampere characteristics *a* for high-resistance; *b* low-resistance; *c* using the voltmeter to measure p. d. across the contacts of a lamp.

The ratio of U to I for a particular conductor is called the resistance of the conductor R: $R = \frac{U}{I}$. The unit of the resistance is the ohm, symbol Ω. The resistance determines how much current flows for a given voltage. Rearranging the equation we must have $U = IR$ or $I = \frac{U}{R}$.

A high resistance restricts the current to a low value. When the resistance is small the current is large (Fig. 1.2 *b*).

2. Average Reading

Text B

VOLTAGE

I. a) Listen to the text. b) Read it (time limit is 3 min.) c) Find the part of it dealing with the source of energy.

The voltage is the force that drives the current around the circuit. The source of energy, e. g., a battery exerts the force of the charges by setting up a positive or high potential at one contact, and a negative or low potential, at the other. The current flows from the positive to the negative contact or expressed another way, from higher to lower potential.

The potential drops around the circuit from positive to negative just as the liquid pressure drops around the pipes from the higher pressure.

The difference in potential between two points is measured in volts. In fact we use the term "voltage" or "voltage drop" or "potential difference" (p. d.) to mean the same thing.

Voltage is really a measure of how much energy is available to force each coulomb of charge move from one point to another. Voltage = energy per unit charge, i. e. volts $= \frac{\text{joules}}{\text{coulombs}}$.

When we are considering the maximum energy per coulomb that a force of voltage can supply, we refer to it as the electromotive force or e. m. f. for short. The e. m. f. of a source is measured in volts. E. m. f. is only used to describe a source potential such as a battery or generator whereas the terms voltage or potential difference (p. d.) may refer to any part of a circuit.

Voltmeters are used to measure potential differences. They are not connected in line with the circuit but parallel to it between the points that are being considered (Fig. 1.2*c*).

ASSIGNMENTS

I. a) Skim through the Text A and find the part of it dealing with the measuring of current and the resistance of the conductor R. b) Discuss the information with your fellow-student.

II. a) Find the part of the Text B containing information about the potential drop. b) Discuss it.

III. Answer the following questions embracing the contents of the Text A and Text B.

1. What is an electric current? 2. What is the size of particles in a conductor? 3. In what terms is current measured? 4. What produces current in a circuit? 5. What is the relation between current and voltage? 6. What is resistance? 7. What is the unit of the resistance? 8. What is voltage? 9. What does the battery exert? 10. How does the current flow? 11. How does the potential drop around the circuit? 12. What units is p. d. between two points measured in? 13. What other terms can we use instead of voltage? 14. What is e. m. f.? 15. What is used to measure the p. d.?

IV. Pick out the key sentences from the Text B. Translate the sentences.

V. Entitle each of the paragraphs of the Text B using the key sentences.

VI. Be ready to discuss the information obtained from the Text B.

VII. Make a short summary of the Text B.

VIII. Speak on the Text A and the Text B according to the following plan:

1. Current and the quantity of charge.
2. Resistance. The unit of resistance.
3. The relation between resistance and current.

IX. Prepare a short dialogue on the following situations:

1. One of the students is Professor who gives to the other students some problems to solve on the blackboard. Professor asks whether their solutions are right or wrong.

2. Professor gives the assignments for multiple choice. (The assignments are given below.).

Problems

1. During 8 seconds 36 coulombs of charge pass a point in a circuit. Calculate the current. (Solution: $I = \frac{Q}{t} = 4{,}5$ A. The current flowing is 4,5 amperes.)

2. A potential of 6 V is applied to a resistor of 2,5 Ω. Calculate the current. (Solution: $I = \frac{U}{R} = 2.4$ A. Current in the resistor is 2.4 amperes.)

3. What voltage applied to a resistance of 40 Ω will produce 2.8 A? (112 V).

4. A resistor carries a current of 0.2 A when a potential difference of 4.0 V is applied across it. What p. d. will produce 0.5 A if Ohm's law is obeyed? (10 V).

Multiple Choice

1. The coulomb is a unit of what quantity?
(a) a current, (b) charge, (c) resistance, (d) voltage.

2. Which of the following equations does not correctly describe Ohm's law?
(a) $U = IR$, (b) $I = \frac{U}{R}$, (c) $R = UI$, (d) $R = \frac{U}{I}$.

3. Which of the following quantities does an ammeter measure directly?
(a) voltage, (b) current, (c) resistance, (d) charge.

4. Which of the following quantities are measured in volts?
(a) voltage, (b) p. d., (c) energy, (d) e. m. f.

5. Which of the following quantities is true for resistors in series?
(a) $U = U_1 + U_2$, b) $I = I_1 + I_2$, (c) $R = R_1 + R_2$, (d) $R = \frac{1}{R_1} + \frac{1}{R_2}$.

6. Which of the following quantities are matched with the correct units?
(a) voltage: joule, (b) current: ampere, (c) resistance: ohm, (d) power: watt.

7. In a parallel arrangement of resistors R_1 and R_2, which of the following are true?
(a) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$, (b) $I = I_1 + I_2$, (c) $U = U_1 + U_2$, (d) $R = R_1 + R_2$.

8. Which of the following are units of electrical energy?
(a) watt, (b) kilowatt hour, (c) joule, (d) ampere.

9. In a parallel connection of light bulbs to the mains when one bulb burns out, what is the effect on the other bulbs?
(a) other bulbs go out, (b) little or no effect, (c) other bulbs go dim, (d) other bulbs go bright.

10. If in question 9 the lamps were in series: what would the effect be?
Multiple Choice Answers: 1 (b), 2 (c), 4 (abd), 5 (ac), (acd), 7 (ab), 8 (bc), 9 (b), 106 (a).

II. CLASSWORK

3. Close Reading

PRE-TEXT EXERCISES

I. Be sure that you know these words:

Overcome v. преодолеть; cause v. заставлять; external внешний; flow n. поток; apply применять; represent представлять; reffer относиться; compare сравнивать; offer предлагать; decrease уменьшать; increase увеличивать; in order to для того, чтобы; cause вызывать; define определять; encounter встречать(ся).

II. Memorize these words and word-combinations used in their specialized meanings.

Pressure давление, напряжение; measure мера, измерять; direct current постоянный ток; alternating current переменный ток; circuit цепь; resistance сопротивление; external force внешняя сила.

III. Find these word-combinations and terms in the Text C and translate the sentences containing them.

Electric pressure электрическое напряжение; the unit strength of an ampere единица силы тока в один ампер; electromotive force электродвижущая сила; power factor коэффициент мощности; resistive circuit резистивная цепь; electrical construction works электрические устройства.

IV. Form nouns using the following suffixes.

-ence: to depend, to exist, to differ; **-ance:** to resist; **-ment:** to develop, to move, to measure; **-(t)ion:** to calculate, to oppose, to conduct.

V. Find nouns with suffixes -ence, -ance, -ing, -ment, -tion in the Text C.

VI. Put questions to the words and word-combinations in bold type. Translate the sentences.

1. **The external force** applied to a circuit to overcome the opposition to the flow of current **is measured** in volts. 2. The voltage is equal to **the current** multiplied **by the resistance.** 3. The electrical current passing through a specified solution of nitrate of silver in water deposits **silver.** 4. **This formula** is read as the voltage squared divided by the resistance. 5. The current **equals** voltage divided by the resistance. 6. Having measured voltage and resistance we can find **the value of the current.** 7. Being learned Ohm's Law **gives the possibility** to measure the current in a circuit. 8. Having been set down the equation can be used **for defining** missing quantity. 9. **When studied well** the problem can be solved successfully. 10. While making experiments the **scientist** discovered **the law of measuring** three basic electrical units.

Text C

FUNDAMENTAL ELECTRICAL UNITS

I. a) Read the Text C. b) Comment on the three basic electrical units.

The three basic electrical units in any electrical circuit are the ampere, ohm, and volt. The ampere is an electrical unit to measure the flow of current in a circuit; the resistance or opposition to the flow of current is measured in ohms; while the external force applied to a circuit to overcome the opposition to the flow of current is measured in volts.

The ampere: The rate at which electricity flows through a conductor is represented by the unit called the ampere and may be compared to the rate of flow of water through a pipe in gallons per second. The unit strength of an ampere is represented when an electrical current passing through a specified solution of nitrate of silver in water deposits silver at the rate of.001118 gram per second.

The ohm: All substances offer resistance to the flow of electricity through them. This opposition, or resistance, is measured with a unit called the ohm. The resistance of all metals increases with the increase in temperature, while the resistance of carbon, insulating materials, and electrolytic solution decreases with an increase in their temperatures.

The volt: In order to overcome the resistance of conductors and cause current to flow, an external force is necessary. This force is commonly called voltage since the unit of measurement is volt. This force is also reffered to as electromotive force or electric pressure. The electromotive force that will cause a current of 1 ampere to flow through a resistance of 1 ohm equals 1 volt. A kilovolt = 1,000 volt; a millivolt = .001 volt; and a microvolt = .000001 volt.

Another important unit of electrical measurement is the watt — the unit of power. Power is defined as the rate at which work is done or the rate at which energy is expanded.

ASSIGNMENTS

I. Read the Text C attentively and answer the following questions.

1. What are the three basic electrical units? 2. What is measured in amperes? 3. What is measured in ohms? 4.What is measured in volts? 5. What is represented by the unit called the ampere?

II. a) Read the Text C again and ask additional questions embracing its contents. b) Combine your answers into a short summary of the text.

III. a) Find the part of the text containing information about the ampere. b) Discuss it.

IV. Read the text closely and pick out the key sentences.Translate the sentences.

V. Look through the text and find the part of it dealing with the electromotive force.

VI. Read the text and pick out all technical terms. Translate them.

VII. Comment on the author's attitude to fundamental electrical units.

VIII. Make up a plan of the text using the active vocabulary.

IX. Review the text in written form.

X. Express your attitude to the fundamental electrical units.

XI. Translate the text to be sure you understand it well.

4. Searching Reading

PRE-TEXT EXERCISES

I. Match the following English words and word-combinations with the Russian ones.

series circuit	цепь управления
parallel circuit	результирующее сопротивление
be connected in tandem	обычные магнитные устройства управления
(with the lines)	контактами
be connected across the lines	неизвестная величина
control circuit	отдельное сопротивление

conventional magnetic contactor controls	величина сопротивления
static controls	статические управляющие устройства
total resistance	решить уравнение
individual resistance	решить задачу
solve a problem	последовательная цепь
set down the equation	соединены параллельно
missing quantity	параллельная цепь
resistance value	друг за другом (последовательно)

II. Give the initial forms of the following words. Translate them.

Physicist, electrical, conductor, resistance, equation, directly, resistive, alternate, alternating, stating, calculation, voltage, combination.

Text D

OHM'S LAW AND ELECTRICAL CIRCUIT

I. Read the Text D and tell about the basic ways of stating Ohm's law. Review the text.

Georg S. Ohm, a German physicist, discovered that the current through an electrical conductor depends upon the amount of pressure (volts) and resistance of the circuit components. These laws or equations are summarized in Fig. 1.3. They are directly applicable to any resistive circuit, any resistive portion of a circuit, any d. c. (direct current) circuit, and any a. c. (alternating current) circuit or portion of an a. c. circuit with a power factor of 100 %.

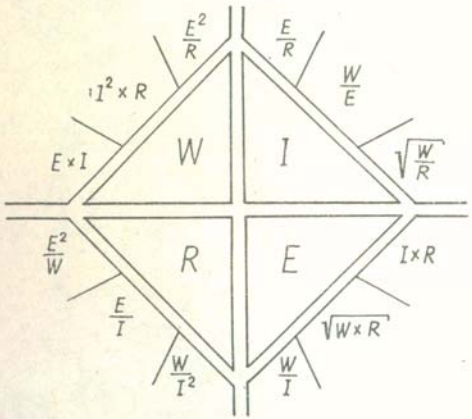

Fig. 1.3. The summary of Ohm's Law.

The basic ways of stating Ohm's Law when I = = amperes, R = resistance in ohm, and E = volts are:

1. $E = IR$ or the voltage is equal to the current multiplied by the resistance.

2. $I = \frac{E}{R}$ or the current equals the voltage divided by the resistance.

3. $R = \frac{E}{I}$ or the resistance equals the voltage divided by the current.

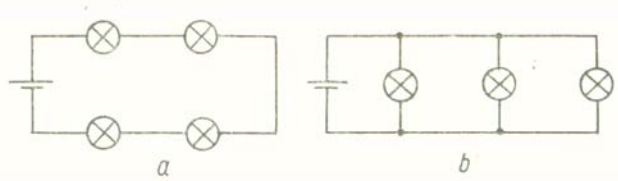

Fig. 1.4. The connections of electrical lamps: *a* in series; *b* in parallel.

The electrical unit for power — the watt — may also be incorporated into Ohm's Law for further calculations. When W = watts, current may be found by the following equations:

1. $I = \frac{W}{E}$ or the wattage divided by the voltage.

2. $I = \sqrt{\frac{W}{R}}$ or the square root of the wattage divided by the resistance.

Voltage may be found by using the following equations:

1. $E = \frac{W}{I}$ or the wattage divided by the current.

2. $E = \sqrt{W \times R}$ or the square root of the wattage times the resistance.

Resistance may be found by the following equations:

1. $R = \frac{E^2}{W}$ or the voltage squared divided by the wattage.

2. $R = \frac{W}{I^2}$ or the wattage divided by the current squared.

The power, in watts, of a circuit may be found by the equations:

1. $W = \frac{E^2}{R}$; That is, the voltage squared divided by the resistance.

2. $W = I^2 \times R$ = the current squared times the resistance.

3. $W = E \times I$ = the voltage times the current.

In order for an electric circuit to be complete, it must provide a path for the electric current. All electrical circuits consist of two distinct types of circuits or a combination of these two circuits, that is, the series circuit and the parallel circuit.

The series circuit (Fig. 1.4*a*) is one in which all components are connected in tandem and is used very often in control circuits — for conventional magnetic conductor controls, static control, and electric controls. The following four rules state the conditions which exist in a series circuit:

1. The current is the same in all parts of series circuit.
2. The total resistance in series circuit is equal to the sum of the individual resistances.
3. The total voltage applied to a series circuit divides between the resistors in direct proportion to their resistance.
4. The sum of the voltage drops across all resistors in a series resistive circuit is equal to the applied (source) voltage.

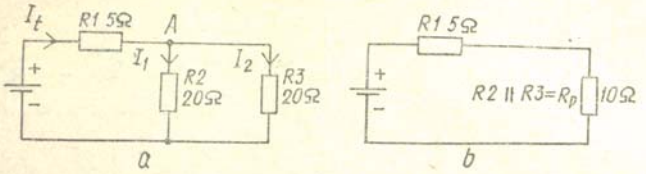

Fig. 1.5. The connections of resistors:
a in series parallel circuit; *b* in series parallel circuit after resistors R_2 and R_3 in *a* have been totalled.

A simple parallel circuit is shown in Fig. 1.4b. Here the electrical components are connected across the lines rather than in tandem with the lines. Most of the circuits encountered on electrical construction work will consist of parallel circuits or a combination of series and parallel circuits.

There are several ways to calculate the total resistance of a parallel circuit, but remember that the total resistance of a parallel circuit is always smaller than the smallest resistor. The three most commonly used equations for resistors in parallel are: $R_t = \frac{R_1}{N}$; $R_t = \frac{R_1 \times R_2}{R_1 + R_2}$; $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

In dealing with the current, voltage, and resistance in a parallel circuit, there are a few simple rules which must be learned.

1. The voltage is the same in all parts of a parallel circuit.

2. The total current in a parallel circuit is the sum of the currents through the separate parts.

To solve the problem for parallel circuits, first draw a circuit diagram of the problem, set down the equation to be used, fill in the equation with the given quantities, then solve for the missing quantity.

The circuit in Fig. 1.5*a* shows the resistors R_2 and R_3 connected in parallel, but resistor R_1 is the series with both the battery and the parallel combination of R_2 and R_3. That in the current flow (indicated by the arrows) leaves the positive terminal of the battery and travels through resistor R_1 and then divides at point A into I_1 and I_2.

The total resistance of this circuit is the sum of R_1 and the resistance of R_2 and R_3 in parallel. Therefore, to find R_t we first need to find the resistance R_2 and R_3 in parallel. Because these two resistors have identical values, we have a resultant parallel resistance R_p of $R_p = \frac{R}{n} = \frac{20 \text{ ohms}}{2 \text{ resis.}} = 10$ ohms.

The circuit now looks like Fig. 1.5*b*, in which R_2 and R_3 have been replaced with R_p. We now have a simple series circuit in which the total circuit resistance R_t is $R + R_p = 5 + 10 = 15$ ohms. The total circuit current I_t supplied by the battery is then $I_t = \frac{E}{R_t} = \frac{30 \text{ volts}}{15 \text{ ohms}} = 2$ amperes.

Because R_1 is in series with the battery, we know that the current through R_1 must be 2 amperes. Since R_2 is equal to R_3, equal currents of 1 ampere must flow through each of these two resistances.

I. Answer the following questions embracing the contents of the text D.

1. What is necessary for an electrical circuit to be complete? 2. What does Fig. 1.4*a* show? 3. What does Fig. 1.4*b* show? 4. What does Fig. 1.5*a* show? 5. What does Fig. 1.5*b* show?

II. Examine Figs. 1.3, 1.4, 1.5 and describe them.

III. Discuss the problems of Ohm's law.

IV. Retell the Text D according to your own plan.

V. Express your opinion of the text. Does the text prove that Ohm discovered the dependence of the current on the amount of pressure and resistance of the circuit components.

VI. Pick out the most interesting problems for your discussion in the group.

VII. Look through the latest magazines, find some articles dealing with Ohm's law and make a summary of the topic.

III. GRAMMAR EXERCISES

I. a) Find in the Text A and the Text B the sentences, containing the following verbs. b) Define their tense-forms and translate the sentences into Russian.

To measure, to call, to determine, to apply, to find, to express, to restrict.

II. Give three forms of the following verbs:

To draw, to show, to use, to concentrate, to conduct, to represent, to flow, to use, to know, to think, to understand.

III. a) Define the forms of the following Participles. b) State the verbs they are formed of. c) Translate them.

Writing; sitting; reading; having read; written; having written; having been written; having asked; having been asked; being asked; asking; taking; having been taken; taken; being taken; given; giving; having been given; having given; done; used; doing; lying; tying; reffering; connecting; connected; preffered; worked.

IV. a) State the Infinitives of the following Participles II of irregular verbs. b) Translate them.

Overcome, found, taken, written, done, read, spoken, known, said, been, given, set out, brought, arisen.

V. Transform the following sentences into the Past and Future.

1. We can solve this problem with the help of Ohm's law. 2. You must calculate these data. 3. May I measure this quantity in volts? 4. They cannot describe Ohm's law correctly.

VI. a) Translate the following sentences. b) Pay attention to the subordinate clauses beginning with "whether" and "if".

1. We do not know whether they have asked this question correctly. 2. They ask if we could describe Ohm's law. 3. He does not know whether electromotive force is measured in volts or in some other units. 4. Professor asked if the resistors were connected in series.