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АНГЛИЙСКИЙ ЯЗЫК

Практическое пособие

для студентов специальностей
1-31 04 01 02 «Физика (производственная деятельность)»,
1-31 04 01 03 «Физика (научно-педагогическая деятельность)»

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Целью практического пособия является развитие навыков чтения и говорения на основе учебного материала специальных текстов. Тексты предназначены как для аудиторной, так и для самостоятельной работы студентов.

Издание адресовано студентам 1 и 2 курсов физического факультета специальностей 1-31 04 01 02 «Физика. Производственная деятельность», 1-31 04 01 03 «Физика. Научно-педагогическая деятельность»

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ОГЛАВЛЕНИЕ

ПРЕДИСЛОВИЕ

Данное практическое руководство предназначено для студентов физического факультета специальностей 1-31 04 01 02 «Физика (производственная деятельность)», 1-31 04 01 03 «Физика (научно-педагогическая деятельность)» и ставит целью оказать помощь студентам в развитии навыков чтения текстов по широкому профилю специальности, направленных на формирование умений понимать языковой материал текстов и обеспечение переработки информации прочитанного.

Пособие включает 2 раздела. *Первый раздел* ориентирован на развитие навыков чтения и обсуждения прочитанных текстов, а также на повторение грамматических правил. *Второй раздел* направлен на самостоятельную работу студентов по предложенным текстам.

Тексты предназначены как для аудиторной, так и для самостоятельной работы студентов на занятиях и в качестве домашних заданий.

Тексты отобраны из оригинальной литературы, сопровождаются упражнениями с целью интенсификации процесса обучения чтению, контроля понимания материала, активизации профессионального словаря, развития навыков устной речи, а также совершенствования слухо-произносительных и грамматических навыков.

При подготовке руководства авторы руководствовались программой по английскому языку для студентов специальностей «Физика (производственная деятельность)», «Физика (научно-педагогическая деятельность)» и учитывали специфику изучения языка на неязыковых факультетах.

UNIT 1
TEXTS FOR READING AND DISCUSSING

TEXT 1. WHAT IS PHYSICS?

I. Read the following words.

Phenomenon, phenomena, nucleus, nuclei, molecule, molecular, electron, solid, liquid, plasma, theory, theoretical, atom, atomic, mechanics, mechanical, magnetism, experiment, experimental, concept, accurate, behavior, nature, natural.

II. Define the part of speech of the following words and translate them into Russian.

Physics — physicist — physical, nature — natural, experiment — experimental, theory — theoretical;

definite — definitely, accurate — accurately, primary — primarily, central — centrally, positive — positively, negative — negatively;

to observe — observation, to describe — description, to relate — relation, to transform — transformation, to investigate — investigation.

III. Give the Russian for.

Basic, fundamental, important, various, different, accurate, concept, knowledge, to dependon (upon), to consist of, to deal with, to divide, to describe, to govern, to predict, to merge, to be equal to, to indicate, primarily.

WHAT IS PHYSICS?

Physics is one of the most ancient sciences about nature. The word “physics” takes its origin from the Greek word “phewsis” meaning nature.

Physics is the science studying various phenomena in nature: mechanical motion, heat, sound, electricity, magnetism and light. Physics is one of the main sciences about nature. The development of other sciences depends in many respects on the knowledge of physical phenomena.

Physics divides itself very naturally into two great brandies, experimental physics and theoretical physics. The former is the science of making observations and devising experiments which give us accurate knowledge of the actual behaviour of natural phenomena. On the basis of experimental facts theoretical physics formulates laws and predicts the behaviour of natural phenomena. Every physical law is based on experiments and is devised to correlate and to describe accurately these experiments. The wider the range of experience covered by such a law, the more important it is. Physics is divided into half a dozen or more different fields — mechanics, sound, heat, electricity and magnetism, light, molecular, atomic and nuclear physics. These different fields are not distinct but merge into each other.

In all cases physics deals primarily with phenomena that can be accurately described in terms of matter and energy. Hence, the basic concepts in all physical phenomena are the concepts of matter and energy. Therefore, it is important to determine accurately the characteristics of both matter and energy, the laws that govern their transformations, and the fundamental relations that exist between them.

I. Answer the following questions.

1. What is physics?
2. What phenomena does physics study?
3. From what language does the word "physics" take its origin?
4. Does the development of other sciences depend on the knowledge of physical phenomena?
5. What is experimental physics (theoretical physics)?
6. On what are all physical laws based?
7. What are the basic concepts in all physical phenomena?

II. Find the equivalents.

Actual, on the basis of, to deal with, to cover, to divide, distinct, both... and, to be equal, to exist, to depend on, concept, to revolve

Иметь дело с чем-либо, зависеть от, делить, отчетливый, как... так, вращаться, на основании, охватывать, существовать, действительный, понятие, равняться чему-либо

III. Translate into Russian without using a dictionary.

1. All matter is made up of small particles called molecules. 2. A molecule is so small that it cannot be seen with the most powerful light microscope. 3. But we can count the exact number of molecules in

any given volume more accurately than we count the population of a city. 4. An atom is the smallest particle of art element. 5. A molecule is always the combination of atoms two or more. 6. The elements are all different from one another. 7. These differences must mean that atoms like molecules are made up of smaller particles. 8. Elements differ from one another because of the different number of electrical charges inside their nuclei. 9. In all electrically neutral elements the number of electrons is equal to the number of protons inside the nucleus. 10. They neutralize each other. 11. In all chemical reactions only the molecules change and not the atoms. 12. The earth revolves around the sun. 13. The moon revolves around the earth.

IV. Give the English for.

Основывать, делить, наблюдать, определять, положительный, отрицательный, точный, важный, различный, основной, рассматривать, состоять, зависеть, явление, природа, поведение, теория, закон.

V. Change the following statements to questions beginning with the question words given.

1. Physics deals with relation between matter and energy, (what) 2. Chemistry deals with the composition of matter and reactions between various forms of matter, (what) 3. Both chemistry and physics deal with matter, (what) 4. The science of physical phenomena in space is called astrophysics, (what) 5. This century more and more of the devices and methods of physics have been applied to the study of phenomena in space, (what) 6. The scientist plans experiments and observations to test his hypothesis, (what, who) 7. When a scientific conclusion becomes generally accepted, it is called a law or principle, (when) 8. In physics laws are usually expressed as mathematical formulas, (how) 9. The formula is useful in describing natural events and in predicting future events, (when) 10. Matter is composed of large numbers of very tiny particles called molecules, (what) 11. The chemical properties of molecules depend on their composition, (what) 12. The physical properties of molecules depend on the forces acting between them and the distance between them, (what).

TEXT 2. ENERGY

I. Read the following words.

Natural, gravitational, kinetic, elastic, radiant, nuclear, to govern, to undergo, to involve, to combine, exception, quantity, manifold, formula, pendulum, conservation, conversion, height, proton, gravity.

II. State the part of speech of the following words and translate them into Russian.

Attract — attraction, interact — interaction, add — addition — additional, convert — conversion, conserve — conservation, discuss — discussion, arrange — arrangement, exit — existence, illustrate — illustration, appear — disappear, charge — discharge, connect — disconnect, advantage — disadvantage, place — displace, nature — natural, gravitation — gravitational, period — periodic, produce — production — productive.

ENERGY

There is a law governing all natural phenomena. There is no exception to this law — it is exact so far as we know. The law is called the conservation of energy. It states that there is a certain quantity, which we call energy, that does not change in manifold changes which nature undergoes.

Energy has a large number of different forms, and there is a formula for each one. These are: gravitational energy, kinetic energy, heat energy, elastic energy, electrical energy, chemical energy, radiant energy, nuclear energy, mass energy.

Let us consider a pendulum to illustrate one of the types of energy. If we pull the mass aside and release it, it swings back and forth. In its motion, it loses height in going from either end to the center. Where does the potential energy go? Gravitational energy disappears when it is down at the bottom; nevertheless, it will climb up again. The gravitational energy must have gone into another form. Evidently it is by virtue of its motion that it is able to climb up again, so we have the conversion of gravitational energy into some other form when it reaches the bottom.

We can illustrate the existence of energy in other forms by the following example. If we pull down on a spring, we must do some work, for when we have it down, we can lift weight with it. Therefore in its stretched condition it has a possibility of doing some work. Elastic energy is the formula for a spring when it is stretched. How much energy is it? If we let go, the elastic energy, as the spring passes through the equilibrium point, is converted to kinetic energy and it goes back and forth between com pressing or stretching the spring. Where is the energy when the spring has finished moving up and down? This brings in another form of energy: heat energy.

There are many other forms of energy but we cannot describe them in any more detail just now. There is electrical energy, which has to do with pushing and pulling by electric charges. There is radiant energy, the energy of light, which we know is a form of electrical energy because light can be represented as wigglings of the electromagnetic field. There is chemical energy, the energy which is released in chemical reactions. Actually, elastic energy is, to a certain extent, like chemical energy, because chemical energy is the energy of the attraction of the atoms, one for the other, and so is elastic energy. Our modern understanding is the following: chemical energy has two parts, kinetic energy of the electrons inside the atoms so part of it is kinetic, and electrical energy of interaction of the electrons and the protons — the rest of it, therefore, is electrical. Next we come to nuclear energy, the energy which is involved with the arrangement of particles inside the nucleus, and we have the formula for that but we do not have the fundamental laws. We know that it is not electrical, not gravitational, and not purely chemical, but we do not know what it is. It seems to be an additional form of energy.

Finally, associated with the relativity theory, there is a modification of the laws of kinetic energy, so that kinetic energy is combined with another thing called mass energy. An object has energy from its sheer existence. If we have a positron and electron, standing still doing nothing—never mind gravity, never mind anything — and they come together and disappear, radiant energy will be liberated, in a definite amount, and the amount can be calculated. All we need know is the mass of the object. It does not depend on what it is — we make two things disappear and we get a certain amount of energy. The formula was first found by Einstein: it is $E=mc^2$

It is obvious from our discussion that the law of conservation of energy is enormously useful in making analyses and is very important.

Notes to the text

1) So far as we know — насколько нам известно;

2) so — так, таким образом;
3) so that — с тем, чтобы;
4) and so on — и так далее;
5) must have gone — должно быть перешла (превратилась);
6) by virtue of smth — благодаря чему-либо;
7) to let go — отпускать;
8) to a certain extent — в некоторой степени.

I. Answer the following questions.

1. What law governs all natural phenomena?
2. What does the law of conservation of energy state?
3. Are there any known exceptions to this law?
4. What forms has energy?
5. By what examples can you illustrate the existence of energy?
6. What energy is released in chemical reactions?
7. What is our modern understanding of chemical energy?
8. What fuel is the main source of energy?
9. Can we get energy from uranium?
10. We can get energy from hydrogen, can't we?
11. Solar energy is widely used nowadays, isn't it?

II. Find the equivalents.

To calculate, to conserve, to consider, to consist of, to depend on, to differ, to change, exact, to exist, to form, possible, to release.

Рассматривать, зависеть от, точный, формировать, отличаться, превращать, существовать, сохранять, освобождать, вычислять, состоять из, возможный.

III. Change the following statements to questions beginning with the question words given.

1. Energy is the capacity for doing work, (what) 2. Energy does not weigh anything, and it can be measured only while it is being transformed or while it is being released or absorbed, (when) 3. Stored energy in a substance is called potential energy, (what) 4. Every moving object has kinetic energy, (what) 5. The kinetic energy of an object depends on both the mass and rate of motion of the object, (what) 6. The total amount of energy remains constant when it is transformed from one kind to another, (when) 7. Einstein's formula states that mass and energy are proportional

to each other, that is, when one increases the other also increases, and when one decreases the other also decreases, (what) 8. The mass of an object varies with the speed at which it is moving, (when) 9. When the object is moving, its mass increases, (when) 10. The total amount of matter and energy in the universe remains constant, (what).

IV. Translate into Russian.

1. The theory is based on these experiments. 2. The theory is described in the article. 3. The concept was developed by Einstein. 4. New data were obtained by them. 5. New complicated devices were required to make these experiments. 6. The results are reported in Table 1. 7. The laws of motion were discovered by Newton. 8. This theory was treated by a number of authors. 9. A great deal of information was summarized in this article. 10. They were shown a new laboratory. 11. We were told a lot of interesting things. 12. He was asked many questions. 13. His report was followed by a discussion.

TEXT 3. NEWTON'S LAWS OF DYNAMICS

I. Read the following words.

Dynamics, mystery, to analyse, inertia, precise, approximation, acceleration, to distinguish, to vary, pendulum, oscillator, weight, momentum, numerically, magnitude, velocity, to include.

II. Give the Russian for.

The principle of inertia, to leave alone, to move with a constant speed, to stand still, to slide a block across a table, to affect, to speed up, to slow down, the motion of an object, the speed of an object, less massive, more massive, a certain quantity of mass.

III. State the part of speech of the following words and translate them into Russian.

complete — completely, origin — original — originally, state — statement — restatement, proportion — proportional — proportionally, precise — precisely, exact — exactly, rapid — rapidly, easy — easily, heavy — heavily, actual — actually, numerical — numerically, careful — carefully, inverse — inversely, direct — directly.

NEWTON’S LAWS OF DYNAMICS

The discovery of the laws of dynamics, or the laws of motion, was a dramatic moment in the history of science. Before Newton's time, the motion of things like planets was a mystery, but after Newton there was complete understanding.

The motion of pendulums, oscillators with springs and weights in them and so on, could all be analysed completely after Newton formulated his laws.

Galileo made a great advance in the understanding of motion when he discovered the principle of inertia: if an object is left alone, is not disturbed, it continues to move with a constant velocity in a straight line if it was originally moving, or it continues to stand still if it was just standing still. Of course, this never appears to be the case in nature, for if we slide a block across a table it stops, but that is because it is rubbing against the table.

But how does an object change its speed if something is affecting it? That is the contribution of Newton. Newton wrote down three laws: The First Law is a mere restatement of the Galileon principle of inertia. The Second Law gave a specific way of determining how the velocity changes under different influences called forces. The Third Law describes the forces to some extent.

Here we shall discuss only the Second Law, which states that the motion of an object is changed by forces in this way: the time-rate-of-change of a quantity called momentum is proportional to the force. Let us explain the idea.

Momentum is not the same as velocity. A lot of words are used in physics, and they all have precise meaning in physics, although they may not have such precise meanings in everyday language. Momentum is an example, and we must define it precisely. If we exert a certain push with our arms on an object that is light, it moves easily; if we push just as hard on another object that is much heavier, it moves much less rapidly. Actually, we must change the words from “light” and “heavy” to less massive and more massive, because there is a difference to be understood between the weight of an object and its inertia. (How hard it is to get it going is one thing, and how much it weighs is something else.) Weight and inertia are proportional, and on the earth’s surface are often taken to be numerically equal.

We use the term mass as a quantitative measure of inertia, and we may measure mass, for example, by swinging an object in a circle at a certain speed and measuring how much we need to keep it in a circle. In this way we find a certain quantity of mass for an object. Now the momentum of an object is a product of two parts: its mass and its velocity. Thus Newton's Second Law may be written mathematically in this way:

$$F = \frac{d}{dt}(mv)$$

Now there are several points to be considered. First, we shall start with the Newtonian approximation that mass is constant, the same all the time, and that, further, when we put two objects together, their masses add.

Now let us define force. We think of force as a kind of push or pull that we make with our muscles, but we can define it more accurately now that we have this law of motion.

The most important thing to realize is that this relationship involves not only changes in the magnitude of the momentum or of the velocity but also in their direction. If the mass is constant, then Eq. (1) can also be written as

$$F = m\frac{dv}{dt} = ma$$

The acceleration *a* is the rate of change of the velocity, and Newton's Second Law says more than that the effect of a given force varies inversely as the mass; it says also that the direction of the change in the velocity and the direction of the force are the same. Thus we must understand that a change in a velocity, or an acceleration, has a wider meaning than in common language. The velocity of a moving object can change by its speeding up, slowing down (when it slows down, we say it accelerates with a negative acceleration), or changing its direction of motion.

Ordinarily we think of speed and velocity as being the same, and in ordinary language they are the same. But in physics velocity is not the same as speed. We carefully distinguish velocity, which has both magnitude and direction, from speed, which we choose to mean the magnitude of the velocity, but which does not include the direction.

Notes to the text

1) The time-rate-of-change of a quantity — скорость изменения величины со временем;

2) there is a difference to be understood between the weight of an

object and its inertia — существует разница, которую следует понимать между весом тела и его инерцией;

3) Now there are several points to be considered — Сейчас следует рассмотреть несколько вопросов;

4) first (adv) — сперва, сначала;

5) further (adv) — далее, затем.

I. Answer the following questions.

1. By whom were the laws of motion discovered?
2. Was the motion of things a mystery before Newton's time?
3. What did Galileo discover?
4. What does the First Law state?
5. What does the Second Law state?
6. What does the Third Law describe?
7. Is momentum the same as velocity?
8. What is the momentum of an object?
9. Define mass, speed, acceleration, force.
10. Is velocity in physics the same as speed?

II. Translate into Russian.

1. An object is moving. 2. An object is standing still. 3. It continues to stand still if it was standing still. 4. It continues to move if it was moving. 5. An object changes its speed if something is affecting it. 6. A heavier object moves less rapidly. 7. A light object moves easily. 8. The momentum of an object is a product of its mass and its velocity. 9. The effect of a given force varies inversely as the mass. 10. A moving object changes its direction of motion. 11. We must define this quantity accurately. 12. We distinguish velocity from speed. 13. They are not the same. 14. They vary.

III. Translate Into English.

Законы динамики, законы движения, движение планет, принцип инерции, постоянная скорость, влиять, замедлять, определять, точный, пропорциональный массе тела, скорость тела, величина импульса, изменение направления, направление силы.

TEXT 4. KEPLER'S SIMPLE LAWS

I. Read the following words.

Momentum, momenta, to interact, to conclude, to assume, to calculate, consequence, according, mutual, essentially, explosion, propulsion.

II. Give the Russian for.

Conservation, conversion, attraction, gravitation, illustration, association, addition, discussion, direction, acceleration.

III. Learn the synonyms.

To suppose — to assume, to obtain — to receive, to change — to vary, to continue — to go on, to seek — to search for, to convert — to transform — to change, to define — to determine, precise — exact, common — ordinary, basic —main — chief — principal.

IV. Learn the antonyms.

Simple — complicated, internal — external, negative — positive, similar — different, easy — difficult.

KEPLER'S SIMPLE LAWS

Kepler discovered some very beautiful and remarkable, but simple laws regarding planetary motion. He found that each planet goes around the sun in a curve called an ellipse, with the sun in a curve at a focus of the ellipse. An ellipse is not just an oval, but it is a very specific and precise curve that can be obtained by using two tacks, one at each focus, a loop of string, and a pencil; more mathematically, it is the locus of all points the sum of whose distances from two fixed points is a constant.

Kepler's second observation was that planets do not go around the sun at a uniform speed, but move faster when they are nearer the sun and more slowly when they are farther from the sun.

Finally, a third law was discovered by Kepler much later; this law is of a different category from the other two, because it deals not with a single planet, but relates one planet to another. This law says that when the orbital period and orbit size of any two planets are compared, the periods are proportional to the 3/2 power of the orbit size. In this statement the period is the time interval it takes a planet to go completely around its orbit, and the size is measured by the length of the greatest diameter of the elliptical orbit, technically known as the major axis. More simply, if the planets went in circles, as they nearly do, the time required to go around the circle would be proportional to the 3/2 power of the diameter (or radius).

I. Answer these questions.

1. What did Kepler discover?
2. How does each planet go around the sun?
3. What is an ellipse?
4. Do planets go around the sun at a uniform speed?
5. When do they move faster?
6. What does the third law deal with?

II. Translate the following sentences Into Russian paying attention to the meanings of the verb “to have".

1. Everybody has a centre of gravity. 2. We now have to consider the experimental determination of the individual values of the charge *e* and mass *m* respectively. 3. Newton finally had the answer. 4. His equations showed that the planet’s orbit had to be an ellipse. 5. Here Newton had solved one of the greatest problems astronomy had ever had to face. 6. The problem had been solved and Newton said nothing of it to anyone. 7. Newton had to base his gravitational studies on the facts that were known at that time.

III. Fill in the blanks with the following words.

directly, inversely, to determine, physical, objects, to depend on, constantly, law, to vary, measure, to include, basic, difference, weight, inertia, force, velocity.

1. Matter... the materials in the universe: the matter, the air and so on. 2. We can... physical and chemical properties of matter. 3. The ability of a substance to bum is a... property. 4. The melting point of the substance is a... property. 5. A... property of matter is its mass. 6. The mass of a substance does not... with temperature. 7. Mass is the... of the inertia of an object. 8. The resistance of matter to any changes of its state of rest or motion is called... 9. There is a... between the... of an object and its inertia. 10. Inertia shows itself not only when... are standing still but when they are moving. 11. Weight is a measure of the gravitational... acting on a

substance. 12. The kinetic energy of an object... both the mass and the rate of motion of the object. 13. The total amount of energy remains... when it changes from one kind to another. 14. Momentum can be defined as the product of a mass and its... 15. The weight of an object is... proportional to the mass of an object. 16. The force of attraction between two objects is... proportional to the masses of the objects and... proportional to the square of the distance between them. 17. This statement is known as Newton's... universal gravitation.

IV. Translate into Russian without using a dictionary.

1. A basic property of matter is its mass. 2. The mass of a substance does not change with temperature or location in space. 3. The greater the mass of an object, the greater is the force required to change its motion. 4. The more precisely a specific property is measured, the more accurately matter can be described. 5. The forms of energy are divided into two categories: energy of motion and energy of position. The former is called kinetic energy while the latter is called potential energy. 6. Energy is expressed in terms of the units of the work it performs. 7. Solids have definite shape and definite volume. 8. A gas does not have a definite shape or a definite volume. 9. Matter is composed of large numbers of very tiny particles called molecules.

TEXT 5. ELECTRIC CURRENT

I. Give the Russian for.

Constantly, practically, separately, a variable magnetic field, a variable electric field, an electromagnetic field, a permanent magnet, a charged body, to denote, to designate, to affect, to influence.

II. Give synonyms for the following words.

To denote, to call, to change, to obtain, to convert, to determine, precise, common, different, collision, way.

III. Give antonyms for.

Similar, positive, difficult, slow, good, low, to increase, to appear.

ELECTRIC CURRENT

If two metal spheres on insulating supports are charged with unlike electricity (say, sphere A positively and sphere B negatively) and connected by a metal conductor, electrons will flow from B, where they are in excess, to A where they are lacking. The flow of electrons in a conductor is called an electric current.

If sphere A is continuously charged with positive electricity and sphere B with negative electricity, there will be a continuous flow of electric current in the conductor. While in motion along a conductor, electrons collide with other electrons, atoms or molecules. As a result of these impacts, energy is released in the form of heat, and the motion of electrons along the conductor is impeded. This opposition to the motion of electrons along the conductor is known as the electrical resistance of the conductor.

There are several factors that affect resistance.

Resistance varies with the atomic structure or nature of the conducting material. Good conducting materials such as silver, copper, and aluminium have low resistance. Cast iron and nichrome (an alloy of iron, nickel, and copper) are examples of poorer conducting materials.

The resistance of most metals varies directly with temperature. The resistance of metals increases with increasing temperature, while that of liquids and carbon decreases. There are several metals, however, such as manganin, constantan, nickeline, etc., whose resistance remains practically unaffected by temperature rise.

The resistance of a conductor increases in direct proportion with its length. That is, temperature being constant, the resistance will be doubled if the length of the conductor is doubled.

The resistance of the conductor varies inversely with the cross-section area.

The unit of electrical resistance is the ohm. The resistance in ohms of a conductor 1 metre long and 1 mm^2 in cross-section is called resistivity and is designated by the Greek letter p (rho).

The resistance of a conductor can be found from the equation

$$R = \frac{pl}{S};$$

where *R* — resistance of the conductor in ohms;

p — resistivity of the conductor, ohm-mm^2-m;

l — length of the conductor in metres;

S — cross-section area of the conductor in mm^2.

I. Answer the following questions.

1. What is called an electric current?
2. What is resistance?
3. What factors affect electrical resistance?
4. What is resistivity?
5. How can the resistance of a conductor be determined if its length, material and cross-section are known?
6. Define ohm.
7. What materials have low resistance?
8. Does the resistance of metals increase with increasing temperature?
9. Is the resistance of manganin affected by temperature rise?

II. Find the equivalents.

Simple, to term, to support, to decrease, unlike charges, lack, in terms of, except, to repel, to support, to increase, similar, as regards.

За исключением, поддерживать, увеличивать, отталкивать, что касается, недостаток, называть, простой, на основании, уменьшать, разноименные заряды, поддерживать, похожий.

III. Translate the following words.

Final, coefficient, conductor, metal, opposition, to separate.

IV. Fill in the blanks with a suitable word. Use the correct form.

to repel, to attract, to affect, to increase, to decrease, to depend on, to contain, to vary, to consist of, an excess, a lack.

1. Various factors... the resistance of a conductor. 2. The resistance of metals... with a rise in temperature. 3. The resistance of carbon, semiconductors... as their temperature is raised. 4. How does the resistance of a conductor... with its length? 5. Objects that are similarly charged... each other; those with unlike charges... each other. 6. All matter... both positive and negative charges. 7. An ordinary uncharged atom... the same number of protons and electrons. 8. Resistivity... the material composing the wire and its temperature. 9. The rubber rod becomes negatively charged due to... of electrons and the fur becomes positively charged due to... of electrons.

V. Give English equivalents for the following.

Постоянный ток, единица величины тока, направление, проводить, проводник, проводимость, сталкиваться, столкновение, количество электричества, сечение проводника, сопротивление, температурный коэффициент сопротивления, электрическое поле, магнитное папе, амперметр, повышать, понижать.

TEXT 6. MICHAEL FARADAY

I. Read the following words.

To provide, to employ, to require, to encourage, electrolysis, sulphate, to clarify, to excite, anode, cathode, ion, electrode, chloride, diamagnetism, alloy, diffusion.

MICHAEL FARADAY

Michael Faraday was born in 1791, in a small village near London. He was the son of a blacksmith. Being required to assist his mother in providing for the family, he was engaged in 1804 as errand boy to a bookseller and in the following year he was apprenticed to his employer to learn the art of bookbinding. Faraday made good use of his spare time by reading some of the books that passed through the shop. He was particularly interested in works on science and in connection with his reading he began performing simple experiments.

Aside from his own reading, Faraday's only scientific education consisted in a dozen lectures on natural philosophy and four lectures on chemistry by Humphry Davy in 1812. It was Davy who helped Faraday to become an assistant at the laboratory at the Royal Institute. Being encouraged by Davy, Faraday began original investigations, initially in chemistry and then in electricity. From 1816 to 1819 he published 37 papers. Faraday became interested in electromagnetism in 1821 and made some experiments. Though they were unsuccessful, the phenomenon excited Faraday's interest and he decided to study it. First, he read what had been done by others and repeated many experiments. In the course of these experiments, he observed that, when the magnetic pole was brought near the wire, "the effort of the wire is always to pass off at right angles from the pole, indeed to go in a circle around it". On passing a current through the wire, it revolved continuously around the magnet. This was the first electric motor.

In the summer of 1831, after years of patient and persistent experiments, Faraday discovered the electromagnetic induction. Following this discovery, Faraday devised and tried various electric machines to test and extend his newly discovered principle. But his interest was always in pure science, for he writes: "I have rather, however, been desirous of discovering new facts and relations dependent on magneto electric induction, than of exalting the force of those already obtained; being assured that the latter would find their full development hereafter". Being unacquainted with mathematical symbols and methods, Faraday always sought to explain his discoveries and to extend his researches by purely physical reasoning.

Faraday next turned his attention to proving that "Electricity, whatever may be its source, is identical in its nature." He found, for example, that electricity from a friction machine would deflect a galvanometer and would cause chemical decomposition just as would electricity produced by chemical action. This led him into the field of electrolysis. He found that many substances, such as chlorides and sulphates, are nonconductors when solid but are good conductors when melted, and in the molten state they are decomposed by the passage of current. To clarify description of his experiments, he introduced the terms "electrode", "anode", "cathode", "ion", etc.

Faraday investigated the diffusion of gases through solids, diamagnetism distinction between anode and cathode in the electric discharge through gases at low pressure, alloys of steel and optical glass.

Faraday was one of the greatest figures in the history of experimental physics.

Notes to the text

1) To make use of smth.— воспользоваться чем-либо;
2) spare time — свободное время;
3) to be interested in smth.— интересоваться чем-либо;
4) to be acquainted with — быть знакомым с.

I. Answer the following questions.

1. Where was Faraday born?
2. What was his father?
3. Had Faraday any chance to get an education?
4. What was his first job?

5. When did he read books?
6. Whose lectures did he attend?
7. What problems interested Faraday?
8. By whom was he encouraged in this work?
9. Were his first experiments successful?
10. What did Faraday discover?
11. Was Faraday acquainted with mathematical symbols and methods?
12. When did Faraday discover electromagnetic induction?
13. What terms did he introduce into the English scientific language?
14. Who continued studying electricity and magnetism?

I. Use the gerund in each sentence.

1. He began (to study) optics. 2. He began (to make) experiments. 3. He went on (to perform) experiments. 4. She went on (to study) new phenomena. 5. She continued (to define) the physical properties of the alloy. 6. Faraday started (to make) experiments in chemistry. 7. Then he went on (to study) electricity. 8. Faraday became interested in (to study) electromagnetism in 1821. 9. He was interested in (to investigate) the diffusion of gases through solids. 10. He was fond of (to read) books on science. 11. He started (to make) experiments in connection with his reading. 12. After (to make) a lot of experiments Faraday discovered the electromagnetic induction. 13. After (to listen) to four lectures on chemistry Faraday got interested in this subject. 14. There are several ways of (to solve) this problem. 15. There are several ways of (to determine) these quantities. 16. Faraday could not give up (to make) experiments though they were difficult.

II. Give the Russian for.

To be interested in, to make use of, spare time, in connection with, except, aside from, a lecture on chemistry, to encourage, a paper, a report, to desire, to wish, to cause, to bring about, to introduce, to decompose, to depend on (upon), to be fond of, to prevent from, to insist on, to hear of, to think of, to thank for, to go on, to keep on, to give up, to put off.

III. Supply the correct preposition in the blank where necessary.

1. The scientist found a new method... solving the problem. 2. We are interested... knowing more about his work. 3. Faraday enjoyed... reading books. 4. He kept... making experiments though they were unsuccessful.

5. Faraday was particularly fond... discovering new facts and relations of these phenomena. 6. He was successful... explaining his discoveries by purely physical reasoning. 7. He insisted... finding the new properties of chlorides and sulphates in the molten state. 8. Faraday thanked Davy... giving him the possibility to work in his laboratory. 9. He did not give... reading, perfecting and extending his knowledge. 10. He went... investigating new phenomena. 11. The possibility... applying these results is worth discussing. 12. This process... preparing the samples for the experiment requires improving. 13. This phenomenon is taking place... changing the composition of the substance. 14. Nothing prevented him... finishing his work. 15. It is impossible to extend the research... improving the experimental techniques.

TEXT 7. WAVE AND CORPUSCULAR OPTICS

I. Read the following words.

To attribute, corpuscle, to prefer, corpuscular, to confine, longitudinal, to prevail, to recognize, significant, to abandon, polarization, to predominate, transversal, to account, oscillation, regularity.

II. Give the Russian for these synonyms.

To attribute — to refer, to prefer — to adopt, to consist of — to include, to consider — to regard, to explain — to account for — to interpret, to occur — to happen, to abandon — to give up, completely — fully — thoroughly.

III. Read and remember the plural of the following nouns.

Datum — data, phenomenon — phenomena, quantum — quanta, nucleus — nuclei), spectrum — spectra, radius — radii, momentum — momenta, formula — formulas/formulae.

WAVE AND CORPUSCULAR OPTICS

The history of modern optics is in large measure a history of the struggle of two theories: the corpuscular and wave theories of light. The corpuscular theory, which represents light as a stream of particles (corpuscles), is usually attributed to Newton, although Newton himself made use of both the corpuscular view (which he frequently preferred) add the wave concept. Almost at the same time that Newton formulated the corpuscular theory (1672), Huygens (1678) formulated the wave theory of light. According to Huygens’ views, which held their ground in physics for 140 years, light consists of longitudinal oscillations of an “ethereal matter” undergoing, propagation in space with a certain finite velocity. Using the principle (Hyugens’ principle) which he formulated for the construction of the front of a propagating light wave, Huygens gave a clear explanation of the laws of reflection and refraction of light. However, Huygens’ wave theory did not consider either the phenomenon of diffraction of light then known or the Newton rings; the concept of wavelength was also absent. Thus, this theory was actually confined to geometrical optics and did not deal with the phenomena of physical optics. The fact that the corpuscular theory of light prevailed throughout the eighteenth century is to be explained by the incompleteness of the Huygens’ theory and also by the absence of any significant discoveries in physical optics.

The first blow to the corpuscular theory was dealt in 1801 by Young, who introduced the concept of the interference of light, which is alien to this theory, and explained the Newton rings on the basis of this concept. At the same time, Young found a way of determining the length of light waves by means of the Newton rings. In 1809 Malus discovered the polarization of light; this led Young to the idea of the transversality of light oscillations which was further developed in the experiments of Fresnel and Arago, who showed that rays polarized at right angles do not interfere. An important role in establishing the wave theory of light was played by the diffraction theory of Fresnel based on the Huygens’ principle and the interference of light waves. The wave theory was brought to completion by Maxwell’s electromagnetic theory of light, which became generally recognized through the experiments of Hertz (1818) with electromagnetic waves. Due to the successes of the wave theory, by the start of the twentieth century the corpuscular theory of light was practically abandoned.

However, in this century it was revived on the basis of new discoveries in physics; first among them is the discovery of the photoelectric effect and of quanta of radiant energy. All the experimentally established regularities of the photoelectric effect could not be accounted for on the basis of the wave theory of light and were fully interpreted only by means of the photon theory (Einstein, 1905). Later, this same theory made possible a brilliant interpretation of the Compton effect.

The photon theory did not confine itself to recognizing Planck’s postulate of the quantum nature of absorption and emission of light by advancing the concept of light quanta, the quantum nature of light; in the photon theory, light quanta (or photons) are endowed with corpuscular properties: a definite energy, velocity, mass. The photon theory, or the corpuscular theory of light, which described such phenomena as the photoelectric effect and the Compton effect that could not be accounted for on the basis of the wave theory of light, proved to be helpless in explaining a broad range of optical phenomena, first of all the interference and diffraction of light, which are readily understood in terms of wave concepts. Thus, the wave theory concepts should by no means be rejected as a consequence of the successes of the photon theory. The bulk of information concerning the properties of light compels us to recognize that light possesses both corpuscular and wave properties, but in certain phenomena corpuscular properties predominate, mothers, wave properties. Furthermore, manifestation of the properties is frequently dependent upon the conditions under which the given optical phenomenon occurs.

Notes to the text

1) To hold one’s ground — сохранять свои позиции;
2) first of all — прежде всего;
3) to deal with — рассматривать;
4) to deal a blow — наносить удар;
5) to account for — объяснять;
6) proved to be helpless — оказалась не в состоянии (беспомощной);
7) in terms of — на основе, исходя из;
8) by no means — никоим образом, ни в коем случае;
9) Huygens — Гюйгенс;
10) Fresnel — Френель;
11) Maxwell — Максвелл;
12) Hertz — Герц;
13) Planck — Планк;
14) Compton — Комптон;
15). Einstein — Эйнштейн.

I. Answer these questions.

1. How does the corpuscular theory represent light?

2. Who formulated the corpuscular theory?
3. Who formulated the wave theory of light?
4. Who explained the laws of reflection and refraction of light?
5. Was Huygens' theory confined to geometrical optics?
6. Who developed the electromagnetic theory of light?
7. Was the corpuscular theory abandoned after Maxwell's discovery?

II. Give English equivalents for the following.

На основе, при помощи, никоим образом, использовать, согласно, в соответствии с, явление дифракции света, поляризация света, интерференция света, поглощение света, рассеяние света, длина волны, волновая и корпускулярная оптика, принцип Гюйгенса, закон Малю, явление Фарадея, наблюдения Лраго, опыт Ньютона, эффект Комптона, постоянная Планка.

III. Fill in the blanks with the following words.

To transmit, to absorb, to reflect, to depend on, to explain, to differ, to demonstrate.

1. Color is a property of light which... entirely its frequency. 2. An object is called red if it... all other colors and... only red light. 3. If an object... all colors it receives we say it is white. 4. In 1816 the French physicist A. J. Fresnel demonstrated that the various diffraction phenomena... fully by the interference of light. 5. Many experiments... the correctness of Young's polarization hypothesis. 6. The amount of light an object reflects… the kind of material it is made of, the smoothness of the surface and the angle at which the light strikes the surface. 7. Materials... widely in their reflectance and scattering of reflected rays. 8. The speed of light in air... from the speed of light in a vacuum. 9. Air, glass and water... light readily.

TEXT 8. RADIOACTIVITY

I. Read the following.

Radioactivity, to radiate, to penetrate, to emit, emission, to fission, to decay, to disintegrate, uranium, radium, polonium, rhodon, alpha, beta, gamma, process.

II. Read and remember the following pairs of words.

stable — unstable, like — unlike, known — unknown, changed — unchanged, equal — unequal, charged — uncharged, developed — undeveloped, divided — undivided; complete — incomplete, definite — indefinite, dependent — independent, accurate — inaccurate.

RADIOACTIVITY

The discovery of radioactivity was another major step in the development of the science of the atom structure. At the end of the 19th century the French scientist Becquerel found that the compounds of uranium when placed on a photographic plate, covered with black paper emitted radiations. It was soon discovered that the property of emitting penetrating radiations is not confined to uranium and its compounds. Some other minerals had the same property.

Marie Skladowska-Curie, an outstanding Polish physicist and chemist together with her husband Pierre Curie, discovered the radioactive elements — radium and polonium. From several tons of uranium pitchblende they managed to obtain 1 g of an unknown intensely radioactive mineral, the radioactivity of which turned out to be several million times higher than that of uranium. The metal was called radium.

Radium and other radioactive substances continuously emit energy. When the phenomenon of radioactivity was discovered, the question of the nature of radiation in radioactive substances arose.

Ernest Rutherford, the great British physicist, honorary member of the Russian Academy of Sciences, was the first to solve the problem. In 1899 he discovered alpha and beta radiation of radium. He was also the first to make an experiment in fissioning an atomic nucleus in 1919. Ernest Rutherford suggested that radioactivity was the result of atomic decay. A part of atoms of a radioactive substance disintegrates due to an unknown reason. They seem to explode, with alpha and beta particles constituting the products of the decay — fragments of disintegrated atoms — and gamma rays, an irradiation or in other words light which is produced by the explosion.

Some radioactive substances disintegrate very slowly, others very quickly. Thus, half of the present atoms of uranium disintegrates during several hundred million years and of a radioactive gas rhodon after 3.8 days. There are radioactive substances half the atoms of which decay in a mere millionth of a second.

While disintegrating, certain radioactive substances emit electrons (beta particles). They are produced in the process of atom disintegration. Having yielded an electron some of the neutrons of the nucleus turn into a proton. The nuclei of uranium, radium and other radioactive substances are very unstable. Some of them disintegrate from time to time emitting an electron or an alpha particle. Emission of an alpha particle decreases the mass and positive charge of the nucleus. The mass of the nucleus which has emitted an electron remains practically unchanged, but its positive charge increases.

The nucleus that has emitted a particle becomes a nucleus of another element. Having emitted an alpha particle, a radium nucleus, for example, turns into a nucleus of the radioactive gas rhodon. A piece of radium placed into a soldered test tube turns after some time into radium and rhodon. The latter in its turn is transformed into other radioactive substances. The final product of the decay is lead which is not radioactive and, therefore, cannot disintegrate. Thus, radioactivity is a process in which one element turns into another.

Notes to the text

1) Turned out to be several million times higher — оказалась в несколько миллионов раз больше;

2) in its turn — в свою очередь.

I. Answer the following questions.

1. What did Becquerel find?
2. What did Becquerel choose for the experiments?
3. What did the Curies discover?
4. What did they call the new substance obtained from the pitchblende?
5. Did the new substance liberate heat?
6. Did it electrify the air?
7. Was the radioactivity of radium higher than that of uranium?
8. Do radioactive substances continuously emit energy?
9. Who explained the phenomenon of radioactivity?
10. What do radioactive substances emit while disintegrating?
11. What is radioactivity?
12. Explain the Rutherford-Bohr atomic model.

II. Define the forms and functions of the infinitives and translate the sentences into Russian.

1. I am glad to meet him. 2. I am glad to have met him. 3. I am glad to have passed my exams well. 4. I was lucky to have been asked easy questions at the examination. 5. She likes to ask questions. 6. She likes to be asked questions. 7. We can detect and measure radioactivity. 8. Radioactivity can be measured precisely. 9. He must study English every day. 10. He must be working in the library now. 11. He must have been working there for four hours. 12. She may be telling you the truth. 13. She may have told you the truth. 14. The problem to be solved is very difficult. 15. We have a lot of work to do. 16. The experiments to be made are complicated. 17. Our task is to receive new data. 18. There is one advantage to be noted in this method. 19. There are many difficulties to be overcome in the construction of a reactor. 20. This is what is to be expected.

III. Translate into Russian.

1. If the motion of the body is changed to a new direction a force has been applied sideways. 2. If we begin with zero currents in the coils and increase these currents to some values, we have been adding energy to the system. 3. Then the magnetic moment of the loop — which is normal to its plane — will make the angle with the magnetic field. 4. Now it turns out that if the loop is moving in a uniform field, the total electrical work is zero, since positive work is done on some parts of the loop and an equal amount of negative work is done on other parts. But this is not true if the circuit is moving in a non- uniform field. 5. So the total electrical energy is proportional to the velocity times the time, which is just the distance moved. 6. The electrical energy is not going into the electrons but into the source that is keeping the current constant. 7. Later we will take up in more detail the relativity of electrodynamics. 8. When the coil rotates, its wires are moving in the magnetic field and we will find an emf in the circuit of the coil. 9. The amount of emf is given by a simple rule discovered by Faraday. 10. The negative sign indicates that the emf opposes the change in current — it is often called a “back emf”.

TEXT 9. NUCLEI AND PARTICLES

I. Read the following words.

Nucleus, nuclei, proton, neutron, photon, graviton, to embod, periodic, lepton, pion, meson, neutrino.

NUCLEI AND PARTICLES

What are the nuclei made of, and how are they held together? It is found that the nuclei are held together by enormous forces. What are the forces which hold the protons and neutrons together in the nucleus? Just as the electrical interaction can be connected to a particle, a photon, Yukawa suggested that the forces between neutrons and protons also have a field of some kind, and when this field jiggles it behaves like a particle. Thus there could be some other particles in the world besides protons and neutrons, and he was able to deduce the properties of these particles from the already known characteristics of nuclear forces.

For example, he predicted they should have a mass of two or three hundred times that of an electron. And in cosmic rays there was discovered a particle of the right mass. But it later turned out to be the wrong particle. It was called meson, or muon.

However, a little while later, in 1947 or in 1948, another particle was found, the я-meson, or pion, which satisfied Yukawa's criterion.

Besides the proton and the neutron, then, in order to get nuclear forces we must add the pion. It turns out that the calculations that are involved in this theory are so difficult that no one has ever been able to figure out what the consequences of the theory are, or check it against experiment, and this has been going on now for almost twenty years.

While the theoreticians have been dawdling around, trying to calculate the consequences of this theory, the experimentalists have been discovering some things. For example, they had already discovered this ц-meson or muon, and a large number of other "extra" particles in cosmic rays. It turns out that today we have more than a hundred particles, and it is very difficult to understand the relationships of all these particles.

But we have collected an enormous number of chemical elements and the relationship among these elements which was unexpected, is embodied in the periodic table of Mendeleyev. We have been seeking a Mendeleyev-type chart for the new particles. One such chart of the new particles was made independently by Gell-Mann in the USA and Nishijima in Japan.

The basis of their classification is a new number, like the electric charge, which can be assigned to each particle, called its “strangeness”, S. This number is conserved, like the electric charge, in reactions which take place by nuclear forces.

The table at least shows how much we do not know. Underneath each particle its mass is given in a certain unit, called Mev. One Mev is equal to 1.782×10^{27} gram. More massive particles are put higher up on the chart. We see that a neutron and a proton have almost the same mass. Several particles have been emitted from the table. These include the important zero-mass, zero-charge particles, the photon and the graviton.

Just as Mendeleyev’s chart was very good, except for the fact that there were a number of rare earth elements which were hanging out loose from it, so we have a number of things hanging out loose from this chart-particles, which do not interact strongly in the nuclei, have nothing to do with a nuclei interaction, and do not have a strong interaction. These are called leptons, they are the following: there is the electron, which has a very small mass on this scale, only 0.510 Mev. Then there is that other, the meson, the muon, which has a mass much higher, 206 times as heavy as an electron. So far as we can tell, by all experiments the difference between the electron and the muon is nothing but the mass. Everything works exactly the same for the muon as for the electron, except that one is heavier than the other. Why is there another one heavier? We do not know. In addition, there is a lepton which is neutral, called neutrino, and this particle has zero mass. In fact, it is now known that there are two different kinds of neutrinos, one related to electrons and the other related to muons.

Thus we are confronted with a large number of particles, which together seem to be the fundamental constituents of matter.

Notes to the text

1) Besides — помимо, кроме;
2) beside — рядом;
3) except for — за исключением;
4) to accept — принимать;
5) to have nothing to do with — не иметь ничего общего с;
6) in addition (to) — в дополнение, вдобавок, кроме того.

I. Answer the following questions.

1. What are the nuclei made of?

2. How are they held together?

3. What did Yukawa suggest?

4. What was he able to deduce?

5. What did Yukawa predict?

6. What was found in cosmic rays later?

7. How many particles are known today?

8. Is it difficult to understand the relationship among these particles?

9. Who established the relationship among elements and embodied it in the periodic table?

10. Have the scientists made such a table for the new particles?

11. What is the basis of their classification?

12. What does this table show?

13. Who proposed the chart of subatomic particles?

14. Why are not all particles listed in this chart?

15. Why are some particles called "strange"?

16. Why did it take twelve years to discover the meson after its existence was predicted by Yukawa?

17. Is it possible to see subatomic particles with a bubble chamber?

18. What is the advantage of the bubble chamber over the cloud chamber?

19. Do you know other detection instruments?

II. Open the brackets using the correct form of the verb.

1. Physicists (to observe) more than 160 subatomic particles. 2. As more and more subatomic particles (to discover), it (to become) evident that a Mendeleev type chart for the particles could be made. 3. In 1957 such a chart (to propose) by Gell-Mann and independently by Nishijima. 4. Not all particles (to list) in the Gell-Mann-Nishijima chart. 5. The names and symbols of subatomic particles (to take) from Greek words and letters. 6. The names (to refer) to masses: baryon (to mean) heavy, meson (to mean) medium, and lepton (to mean) small. 7. Baryons and mesons sometimes (to call) hadrons which (to come) from a Greek word meaning bulky 8. The four major divisions of the chart (to base) largely on masses. 9. The masses of the particles (to base) on a rest mass of 1 for the electron. 10. Neutrinos and photons (to give) a mass of zero. 11. With a few exceptions each of the fundamental particles (to have) a corresponding anti-particle. 12. Spin is responsible for the direction in which particles (to emit) in nuclear interactions. 13. Particle interactions (to classify) as

follows: strong (nuclear) interactions, electromagnetic interactions, weak and gravitational interactions. 14. Geiger counter (to use) for the detection and measurement of radioactivity. 15. The positively charged central part of an atom (to call) the nucleus.

III. Translate into Russian.

1. Nuclei consist of protons and neutrons collectively called nucleons. 2. The number of protons in nuclei of the same element is equal to the atomic number Z. 3. The number of neutrons varies. 4. Most naturally occurring atoms have stable nuclei. 5. Artificial nuclei arc produced by bombarding stable nuclei with high energy charged particles such as protons, deuterons. 6. Elementary particles are classified by a set of quantum numbers describing their intrinsic properties: spin, charge, parity, strangeness. 7. Particles can be divided into groups according to the kinds of interactions they participate in, 8. Hadrons are subject to the strong interaction. 9. Leptons are subject only to the weak interaction. 10. The photon takes part in neither strong nor weak interactions. 11. Neutrinos are thought to have zero mass and according to the theory of relativity must always travel at the speed of light.

UNIT 2
SUPPLEMENTARY READING

TEXT 1. THE HISTORY OF PHYSICS

I. Read and translate into Russian the following words.

Basic equation, differential equation, diffusion equation, easily solvable equation, field equation, first-order equation, fundamental equation calculus of vectors, integral calculus, operational calculus, matrix calculus.

THE HISTORY OF PHYSICS

The most advanced science at present, and the one which seems to give the most light on the structure of the world is physics. It is useful to have some idea of not only what the up-to-date development of physics is but also how we came to think in that way and how the whole of modern physics is connected with its history. In fact, the history of this science begins with Galileo, but in order to understand his work it will be well to see what was thought before his time.

The scholastics, whose ideas were in the main derived from Aristotle, thought that there were different laws for celestial and terrestrial bodies, and also for living and dead matter. There were four elements, earth, water, air and fire, of which earth and water were heavy, while air and fire were light. Earth and water had a natural downward motion, air and fire upward motion. There was no idea of one set of laws for all kinds of matter, there was no science of changes in the movements of bodies.

Galileo — and in a lesser degree Descartes — introduced the fundamental concepts and principles which were enough for physics until the present century. They showed that the laws of motion are the same for all kinds of dead matter and probably for living matter also.

Galileo introduced the two principles that made mathematical physics possible: the law of inertia and the parallelogram law. The law of inertia, now familiar as Newton's first law of motion made it possible to calculate the motions of matter by means of the laws of dynamics alone.

Technically the principle of inertia meant that causal laws of physics should be stated in terms of acceleration, i.e. a change of velocity in amount or direction or both which was found in Newton's law of gravitation. From the law of inertia it followed that the causal laws of dynamics must be differential equations of the second order, though this form of statement could not be made until Newton and Leibniz had developed the infinitesimal calculus. Most of what students do on the mathematical side of physics may be found in Newton's *Principia.* The basic idea of dynamics, the equations of motion, the ideas of momentum, of inertia, of muss and of acceleration were applied by Newton to large bodies like the Earth and the Moon to explain the structure and the motion of the universe. From Newton to the end of the nineteenth century, the progress of physics involved no basically new principles. The first revolutionary novelty (новшество) was Planck's introduction of the quantum constant *h* to explain the structure and behaviour of atoms in the year 1900. Another departure from Newtonian principles followed in 1905. When Einstein published his special theory of relativity. Ten years later he published his general theory of relativity which was primarily a geometrical theory of gravitation showing that the universe is expanding.

In fact, when modem science was growing up from the time of Galileo to the lime of Newton, all the sciences were very much joined together. A single man could do absolutely first-class research in pure mathematics, in physics, in chemistry and even in biology. Towards the end of that time the sciences were beginning to separate and after that they continued to separate more and more.

Just at this moment we can see a great convergence of all sciences. Physics is increasingly penetrating all the other parts of science and this is evident in the names of the new hybrid subjects. We have long had physical chemistry; now we have chemical physics, which is different not so much in the proportion of physics and chemistry, but in its central interest of extending the range of physics. A biologist cannot do without knowledge of modem physics while a physicist must know something of biology, as he may find a great deal of his work will be concerned with biophysics. The mathematical aspect of physics is also becoming much more evident especially now that we are having a growing symbiosis between physics and mathematics in computational physics.

Our job in physics is to see things simply, to understand a great many complicated phenomena in a unified way, in terms of a few simple principles. You cannot predict what will happen in future, but you have to be ready to meet it.

I. Find in the text the sentences which explain.

– физические понятия, в которых выражали свое миропонимание средневековые схоласты;

– физические понятия, которые ввел в науку Галилей;

– заслуги Ньютона в области физической мысли.

II. Find English equivalents to the following words and word combinations in the text.

Современное развитие; для того чтобы понять; в основном; небесные и земные тела; живая и неживая материя; движение вниз; движение вверх; ряд (множество) законов; причинные законы физики; уравнения движения; постоянная квантования; первоклассное исследование; это очевидно; расширить диапазон; не может обойтись без; будет связана с; в терминах нескольких простых законов.

III. Answer the following questions.

1. What is the text concerned with?

2. What was the first step in theoretical physics?

3. What physical concepts did Galileo introduce into theory?

4. What did Galileo explain by these concepts?

5. Was it possible to explain the structure and the motion of the universe by Galileo's law of inertia?

6. Why?

7. What did Newton develop to explain the structure and the motion of celestial bodies?

8. What physical concepts did he introduce into his *Principia?*

9. What two departures from Newtonian principles followed at the very beginning of the 20th century?

10. What did Planck want to explain by his constant?

11. What is this branch of physics called?

12. What did Einstein try to explain?

13. What are his theories called?

14. What new knowledge did physicists gel from these discoveries?

TEXT 2. INTERNATIONAL SYSTEM OF UNITS

I. Read and remember.

x — times / multiplied by;

: — divided by;

= — equals/is equal to/is/makes;

Example: 3x3 = 9 Three times three equals nine.

12:4 = 3 Twelve divided by four makes three.

Decimal fractions:

0.2 — zero point two/naught point two;

1.15 — one point one five;

64.598 — sixty-four point five nine eight.

INTERNATIONAL SYSTEM OF UNITS

With a few exceptions nearly all the nations of the world use the metric system. The value of the MKS (metre-kilogram-second) system is that its various units possess simple and logical relationships among themselves, while the British system (the f. p. s. — foot-pound-second) is a very complicated one. For example, in the British system 1 mile is equal to 1,760 yards; 1 yard is equal to 3 feet, and 1 foot is equal to 12 inches. In the English system converting one unit into another is a hard and monotonous job, while in the MKS system conversions of one unit to another can be carried out by shifts of a decimal point (comma in Russian writing).

The standard meter of the world was originally defined in terms of the distance from the north pole to the equator. This distance is close to 10.000 kilometers or 10^7(ten to the seventh power) metres. By international agreement the standard metre of the world is the distance between two scratches (штрих) made on a platinum-alloy bar. It is kept at the International Bureau of Weights and Measures in France.

The square metre (m^2) is an MKS unit of area while the cubic metre (m^s) is an MKS unit used to measure volume.

In fact, the SI Units is an internationally agreed coherent system of units derived from the MKS system. The seven basic units in it are: the metre (m), kilogram (kg), second (s), ampere (a). Kelvin (K), mole (mol), and candle (свеча) (cd).

I. Find English equivalents to the following words and word combinations in the text.

И в процессе упорядочения; с одной стороны; точно указать, воспроизвести заданные условия; получить желаемый результат; истинная наука; признанные этапы (шаги); связаны с; объем — произведение трех длин; выводятся из; за небольшим исключением; преимущества метрической системы; преобразование одной единицы и другую; сдвигом десятичной точки; на основании расстояния

II. Choose the right word.

1. Unit is a *(quality* / *quantity)* adopted as a standard of measurement.

2. Foot is a unit of *(area / length)* in the English system of measurement.

3. Inch is *(more* / *less)* than foot is.

4. There are 12 *(yards / inches)* in 1 foot.

5. Velocity is length *(multiplied/divided)* by time.

6. The second is a unit for measuring time in *(MKS system / all the systems).*

7. *(Dimension* / *division)* is a mathematical operation.

8. The square metre is an MKS unit of *(area/ volume).*

9. 11,500 cubic feet is the measure of *(area / volume* / *mass).*

III. Answer the following questions.

1. What are the recognized steps in real science?
2. Why are classification and measurement so important in real science?
3. What is unit?
4. What are the three fundamental units?
5. What systems of measurement are widely in use all over the world nowadays?
6. Why is the metric system widely in use all over the world?
7. What are the units of length in the MKS / British system?
8. How was the metre originally defined?
9. Where is it kept?
10. What standard unit is used for measuring area / volume / mass / time?

IV. Say it in English.

a) In the British system:

mile (mi) = 1,760 yd; 1 yd = 3 ft; 1 ft = 12 in;

b) In the metric system:

1 km = 1000 m; 1 m = 100 cm; 1 cm = 10 mm;

c) Do you know that...

1 inch = 25.3995 mm? 1 ft = 30.479 cm? 1 yd = 9144 m? 1 mile = = 1.6093 km?

V. Write down the following problems in words and solve them.

36 : 3 = 27 : 3 = 75 : 5 = ;

5 x 5 =2 x 22 = 14 x 5 = .

TEXT 3. THE UGLY NATURE OF THE EARTH'S TWIN SISTER

I. Translate the words and remember their meanings.

To attract — attraction, to repel — repulsion, to interact — interaction, to investigate — investigation, to radiate — radiation, to distribute — distribution.

THE UGLY NATURE OF THE EARTH'S TWIN SISTER

Venus wouldn't be a comfortable planet to live on: it is hot enough to melt lead, the air is thick enough to swim in, and there are never-ending electrical storms. Venus is closer to the Sun than the Earth is, and the sunlight reaching Venus is twice as powerful as that reaching the Earth. However, it has also been found that Venus might not be too hot to support life, and even to picture it as the home of some mysterious fair-haired Venusians.

Unfortunately, this attractive idea does not stand up to close examination. Instead of spinning anti-clockwise like most other planets, Venus revolves clockwise, and it turns so slowly that the Sun rises in the west and sets in the east 59 days later. This means that during the long Venusian "day" the temperature has time to reach 450 degrees Centigrade easily hot enough to melt tin or lead. Moreover, the polar axis is almost vertical, so there are no seasons.

But the real shock comes when we consider the atmosphere. Normally, you expect that the closer a planet is to the Sun, the less atmosphere it will be able to retain. Venus, however, has an atmosphere about 100 times as dense as ours. The air is much too thick to run in and you would rather have to swim and not to walk in it. On the other hand, the atmosphere is so thick, that you could fly through it without any problem. The winds are very slow; the Russian spacecraft *Venera 10* measured on landing a maximum air flow of seven miles per hour, yet the atmosphere is so dense that a seven mile per hour wind could be strong enough to knock down a tall building.

Most of Venus is permanently covered in clouds of sulphur and sulphuric acid, and these clouds absorb so much of the Sun's light that on the surface of the planet there is no more than a dark reddish gloom. The Russian spacecrafts *Venera 9* and *Venera 10* found that there was enough light to take TV pictures. This light, however, came not from the Sun, but from flashes of lightning given off by continual electric storms.

All in all, then, Venus turns out to be a dramatic though extremely inhospitable place, and, along with Mars, Jupiter and Saturn has to be added to the list of planets that are quite incapable of supporting human life.

I. Find English equivalents to the following words and word combinations in the text.

В два раза сильнее; светловолосый; к сожалению; привлекательная идея; тщательное изучение; по часовой стрелке; против часовой стрелки; более того; его раз плотнее нашей; с другой стороны; темно-красный мрак, вспышки молнии; в целом; негостеприимное место; вместе с.

II. Fill in the gaps with suitable words.

1. Unlike most other planets Venus is spinning...
2. Instead of running or walking on Venus you would have to... or to...
3. The temperature on the planet is hot enough to...
4. The atmosphere is so... that a 7 mile/h wind would be strong enough to...
5. The sunlight reaching Venus is... however, on the surface of the planet you could see only...
6. There was enough light to take TV pictures on Venus, though this light came not from... but from...

III. Answer the following questions.

1. Why might you expect the surface of Venus to be fairly cool?
2. Why, in fact, is the surface of Venus hot?
3. If you tried to walk on Venus, what problem would you have?
4. Why might you expect the surface of Venus to be bright?
5. Why is there in fact, very little sunlight on the surface?
6. How did the spacecrafts manage to take TV pictures?
7. What is the most unusual thing about Venus compared with the other planets?
8. What makes the Earth's nature so beautiful and the Venus’ nature so ugly?
9. What mysterious and as yet unexplained features does Venus possess?

TEXT 4. THE REVOLUTION IN PHYSICS

I. Find the equivalents.

To repel, to possess, length, to denote, to attract, to propagate, to regard, unlike charges.

Притягивать, распространять, обладать, разноименные заряды, длина, рассматривать, обозначать, отталкивать.

THE REVOLUTION IN PHYSICS

Nineteenth-century physics was a majestic achievement of the human mind. To many who were working in science this achievement seemed to be moving towards a certain completion of the picture of the operation of natural forces on the secure basis of the mechanics of Galileo and Newton.

However, this picture was shattered al the very outset of the twentieth century and was lo be replaced by another one. The revolution in physics broke out unexpectedly. In November 1895 the general direction of world research was sharply changed by an accidental and altogether unforeseen discovery.

Konrad von Rontgen (1845–1923), then professor of physics had bought a new cathode-ray discharge tube with the object of studying its inner mechanism. Within a week he had found that something was happening outside the tube; something was escaping that had properties never before imagined in Nature. That something made fluorescent screen shine in the dark and could fog photographic plates through black paper. These astonishing photographs showed coins in purses (кошелек) and bones in the hand. He didn’t know what that something was, so he called it the “X-rays”. This scientific discovery was atop press news all over the world. It was the subject of innumerable music-hall jokes and within a few weeks almost every physicist of repute was repealing the experiment for himself and demonstrating it to admirable audiences.

The immediate value of X-rays was great, particularly to medicine, however, their importance was much greater to the whole of physics and natural knowledge, for the discovery of X-rays provided the key not only lo one, but to many branches of physics. This discovery was followed by a number of unexpected discoveries like that of radioactivity in 1896, of the structure of crystals in 1912, of the neutron in 1932, of nuclear fission in 1938, and of mesons between 1936 and 1947. This revolutionary development includes great theoretical achievements of synthesis like Planck’s quantum theory in 1900, Einstein’s special relativity theory in 1905 and his general theory in 1916, the Rutherford-Bohr atom in 1913 and the new quantum theory in 1925.

The period from 1895 to 1916 might be called the first phase of the revolution in physics, the so-called heroic, or in a different aspect, the amateur stage of modem physics. In it new worlds were being explored, new ideas created, mainly with the technical and intellectual means of the old nineteenth-century science. It was still a period primarily of individual achievement: of the Curies and Rutherford, of Planck and Einstein, of the Braggs and Bohr. Physical science, particularly physics itself, still belonged to the university laboratory, it had few links with industry, apparatus was cheap and simple, it was still in the “sealing-wax-and-string” stage.

I. Find English equivalents to the following words and word combinations in the text.

Великое достижение; человеческий разум; на прочной основе; в самом начале; разразилась внезапно; непредвиденное открытие; каждый уважающий себя физик; восхищенная аудитория; непосредственная ценность; ядерный распад; действие природных сил; экстренные сообщения в газетах; на примитивном уровне лабораторных средств исследования.

II. Fill in the gaps with suitable words.

1. The late nineteenth-century physics seemed to many scientists to come to a certain...

2. However, the ways in the world research were sharply changed by...

3. The rays discovered by Rontgen showed the unknown before properties of...

4. Unable to explain these properties Rontgen called them...

5. The X-rays proved to be the key to such branches of physics as...

6. The new unexpected discoveries were followed by great theoretical achievements like...

7. The earliest period in science revolution might be called... because...

III. Answer the following questions.

1. Why can the 19th-century physics be called a majestic achievement of the human mind?

2. What branches of physics were developed in the 19th century?

3. What great discoveries of the 19th century could you name?

4. Why could some of the late nineteenth-century physicists think that the physical science was moving to a completion?

5. When did the revolution in physics break out?

6. What discovery initiated this revolution?

7. Could you describe the situation of this discovery?

8. Why were the rays called X-rays?

9. What was the value of this discovery for physics?

10. What branches of physics began developing after this discovery?

11. What other unexpected discoveries followed later?

12. What great theoretical breakthroughs did these discoveries lead to?

ЛИТЕРАТУРА

1. Курашвили, Е. И. Английский язык для студентов-физиков : Первый этап обучения: учеб. пособие / Е. И. Курашвили. – 3-е изд., перераб. – М. : Астрель: АСТ, 2002. – 317 с.

2. Курашвили, Е. И. Английский язык для студентов-физиков : Второй этап обучения : учеб. пособие / Е. И. Курашвили. – 2-е изд., перераб. и доп. – М. : Астрель : АСТ, 2005. – 189 с.

3. Сикорская, Н. П. Английский язык для физиков : учеб. пособие / Н. П. Сикорская. – 2-е изд., перераб. и доп. – Минск : БГУ, 1981. – 301 с.

4. Вахитова, И. А. Специальные тексты по английскому языку : для студентов физико-математического факультета / И. А. Вахитова. – Уфа : Вагант, 2005. – 84 с.

5. Holzner, S. Physics for Dummies / S. Holzner. – Indianapolis, Indiana : Wiley Publishing, Inc., 2006. – 368 p.

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