МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

ГОСУДАРСТВЕННОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ
ВЫСШЕГО ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ
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Сборник содержит тексты из оригинальной литературы, в которых рассматриваются основные физические явления. Профессионально-ориентированные тексты для чтения предназначены для изучения специальной терминологии на английском языке в области физики. Практические задания способствуют формированию умений смыслового анализа и представляют стратегии запоминания профессиональной лексики.

Рекомендован для бакалавров и магистров специальности «Физика».

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Text 1

1. Vocabulary:

ancient – древний старый
to depend on – зависеть от
to divide – делить, классифицировать
the former – первый (из двух вышеназванных)
to predict – предсказывать, прогнозировать
to devise – придумывать, разрабатывать
to merge – поглощать, сливать
to deal with – заниматься чем-либо, иметь дело с чем-либо
to determine – определять
hence – отсюда
to exist – существовать

2. Read and translate the text.

WHAT IS PHYSICS?

Physics is the science studying various phenomena in nature: mechanical motion, heat, sound, electricity, magnetism and light.

Physics is one of the most ancient sciences about nature. The word "physics" takes its origin from the Greek word "phew-sis" meaning nature.

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 branches, 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.

3. Questions:

1) What phenomena is physics studying?
2) What are two great branches of physics?
3) What do you know about experimental physics?
4) What does theoretical physics formulate?
5) What are the basic concepts in all physical phenomena?

4. What is the main idea of the text?

Text 2

1. Vocabulary:

to believe – верить, считать, полагать
substance – вещество
to consist of – состоять из
compound – состав, смесь, соединение
to arise – возникать, появляться
to mean – значить
common – общий, широко распространенный
to achieve – достигать
quantity – количество
property – свойство
rapid – быстрый

2. Read and translate the text.

A LESSON IN THE HISTORY OF LITTLE THINGS

Until the beginning of the seventeenth century mankind had little understanding of the structure of the material world. Man believed that stones were stones, fire was fire, and water was simply water. Now we know that all kinds of substances consist of very small invisible particles – atoms. They make up all the elements and compounds that exist in the world, the air that man breathes, the ground on which he walks, man's food. Their interactions provide the energy that man uses.

In this connection, the question at once arises: what are atoms like? The determination of the exact nature of nature was a very difficult and interesting problem. For a hundred years some of the best men of science on earth thought of it, and today many scientists do a lot of research.

The word atom came from the Greek and means "indivisible". The ancient Greeks studied the structure of matter and noted that it is possible to divide and further subdivide a stone until the particles become like powder, which they thought was the limit of divisibility. The same was true for other common substances, such as wood or water or minerals. They called these smallest particles atoms. But since the Greeks were philosophers and not experimenters, they had no real understanding and knowledge of the true structure of matter.

It was at the beginning of the nineteenth century that the scientists first established experimentally the atomic theory of the structure of matter. They found that the simple forms of matter were chemical elements which consisted of atoms – particles of very small size.

At the end of the nineteenth century scientists achieved a great quantity of information on the atomic structure of matter and the general nature of the atom. They discovered most of the chemical elements and found that the atoms of each element were different in chemical and physical properties from the properties of other elements.

A further discovery was that the atoms combine in small numbers and form units of matter or molecules and that in all substances the atoms and molecules are in a state of rapid motion. Besides, some fundamental chemical characteristics became clear. One of these was that atoms group according to their atomic weights into eight groups the chemical properties of which are similar.

3. Questions:

1) What did people know about the structure of the material world some centuries ago?
2) What was a very difficult and interesting problem?
3) What does the word "atom" mean?
4) When did the scientists establish the atomic of the structure of matter?
5) What did they discover then?

4. Give a brief summary of the text.

Text 3

1. Vocabulary:

connection – связь, соединение
to continue – продолжать
to contain – содержать
close – близкий

attraction – притяжение
to change – изменять
shape – форма
therefore – поэтому
solid – твердое тело
liquid – жидкость
definite – определенный

2. Read and translate the text.

STATES OF MATTER: SOLIDS, LIQUIDS AND GASES

To understand the various states of matter and their connection to each other, we must understand the meaning of the word molecule.

We can divide a piece of material into small parts and then subdivide each of these small parts into still smaller parts. We shall continue this process of division until the parts become very, very small. In the end they will become so small that it will be impossible to divide them further. We call these smallest particles atoms. They are the fundamental building blocks of all materials and they have a definite attraction for each other.

Atoms combine into molecules and molecules may contain one, two, three and more atoms. In metals there is only one atom in a molecule, for example.

The molecules of a solid are very close together and have a great attraction for each other. The closer, they are together, the heavier is the solid; however, the molecules are in a state of continual vibration. In this state their attraction for each other is very great, and that is why it is very difficult to change the shape of a solid.

Now, if we heat the solid, the molecules begin to vibrate more and more and therefore there is less attraction for each other. Thus, a solid expands when we heat it. When the molecules are quite far apart from each other, the solid changes into a liquid.

If we continue to heat the liquid the molecules begin to vibrate so strongly and they move so far apart from each other that they will have very little attraction for each other. Now the liquid becomes a gas which has no definite size.

The three states of matter – solid, liquid and gaseous – are very close to each other and more heat or less heat will change the substance from one state to the other. Ice, water and steam are examples of this change of state.

3. Questions:

1) What are the fundamental building blocks of all materials?
2) How many atoms may the molecule contain?
3) Why is it very difficult to change the shape of a solid?

4) When does the solid change into a liquid?
5) What states of matter do you know?

4. Sum up the contents of the text.

Text 4

1. Vocabulary:

possible – возможный
mixture – смесь
compound – соединение
equal – равный
to differ – различаться
a number of – ряд, количество
vessel – сосуд
within – внутри
an attractive force – сила притяжения
waporisation – испарение
to change – изменяться

2. Read and translate the text:

MOLECULAR MOTION AND THE STATES OF MATTER

We live in an ocean of air. There is a great quantity of gas around our planet our planet: we call this gas air and experiments show that it is a mixture of several gases Oxygen, nitrogen, carbon dioxide, water vapour and others. When we think of the substance which we call water, we commonly think of it as a definite liquid. It does not mean however, that that is the only possible state in which water can exist. The liquid state is the normal state for the substance which we call water, but water can exist also as a gas and as a solid; in the gaseous state it changes to steam of water vapour, and in the solid state it becomes ice. Many substances can and do at various times exist in more that one of these three possible states.

A lump of salt may consist of a number of grains of salt. If we divide the lump into some small parts we still have. Further subdivision will in the end bring us to a single grain of salt. We may divide the grain of salt again and again; still the pieces will all have the characteristics of the compound that we call salt. The last particle which still has the characteristics of the original compound is a molecule of salt. In general, substances consist of molecules; molecules are therefore the building blocks of the physical world, though not the fundamental blocks, for molecules consist of atoms.

There is an equal number of molecules of the same kind in a pound of water as in a pound of steam or in a pound of ice. Why, then, do the various states exist and why do they differ so greatly? The answer to this question lies in the very fact that the molecules move differently in the three states.

In gases we find that the gas molecules are free to move and they are quite far apart. We find that gas molecules move rapidly and continually, spread and occupy every portion of the vessel which contains them. A body of gas therefore has no definite volume or shape, but takes the volume and shape of the vessel.
A solid, on the other hand, has both volume and shape. The molecules of a solid are also in motion, but they can move only a small amount because the atoms are very close together. The closer the molecules are together, the less free they are to move.

The liquid state is between the gaseous and solid states. The molecules of a liquid are less free to move than the gas molecules, but are more free to move than the molecules of a solid. A molecule is able to move within the body of the liquid from point to point and there exists an attractive force between the molecules. If a molecule moves very fast, it may overcome the force of attraction and will become a molecule of vapour; such a process is typical of the phenomenon which we know as the vaporization.

3. Questions:

1) How do we call the gas around our planet?
2) Is air single gas or a mixture of several gases?
3) In what possible states can water exist?
4) What are the buildings blocks of the physical world?
5) How do the molecules of gas move?
6) Does a solid have volume and shape?
7) Can you describe the liquid state of water?

Text 5

1. Vocabulary:

to have a clear understanding – иметь ясное представление
to make up – составлять, выдумывать
nucleus – ядро
apart – обособленно, в отдалении
to move – двигаться
the same – тот же самый, одинаковый
to leave – покидать, оставлять

2. Read and translate the text.

STRUCTURE OF MATTER

To understand the electronic theory, it is necessary to have a clear understanding of the structure of matter. In elementary physics we are taught that matter consists of very small particles called molecules. These molecules are the smallest physically divisible parts of matter – physically divisible because they can be further subdivided by other means into smaller particles, for instance, by chemical means.

A molecule of water consists of three of these particles: two of hydrogen and one of oxygen. These smaller particles are called atoms.

A molecule of water is, therefore, made up of three atoms. Similarly, any substance can always be subdivided into atoms. In some elements, the atom is the same as the molecule.

The atom is still further divisible into smaller kinds of particles which are nothing but particles of positive and negative electricity. Each atom has a nucleus electrically positive and consisting of particles of which the main are the proton, and the neutrons. Outside the nucleus and very far apart from it move electrons, which are negative particles of electricity. All the protons and electrons are the same in all kinds of atoms and the properties of matter are dependent on the way in which they are arranged.

The atom as a whole is neutral, since in any atom there are as many protons as there are electrons, so if one of the electrons leaves the atom, it becomes positively charged.

3. Questions:

1) What does matter consist of?
2) What are molecules?
3) Is the atom the same as the molecule?
4) How many atoms are there in the molecule of water?
5) What does each atom have?
6) Where do the electrons move?
7) In any atom there are as many protons as there are electrons, aren't they?

4. What is the main idea of the text?

Text 6

1. Vocabulary:

condition – состояние, условие
to affect – воздействовать, вредить
fine – мелкий
to dissolve – растворять
to evaporate – исчезать, испаряться
to subject – подчинять, подвергать
entirely – всецело, вполне, единственно
to cause – вызывать, быть причиной
artificially - искусственно
to occur – случаться, происходить
to distinguish – различать

2. Read and translate the text.

PHYSICAL AND CHEMICAL CHANGES

Transformations are of two kinds, known as physical and chemical changes. Physical changes are those which affect the state or condition of matter without changing its composition. There is no change in the composition of a substance when it is transformed from the liquid to the gaseous state by heating, or from the liquid to the solid state by cooling, and vice versa. Thus, in all three states, steam, water, and ice are all the same substance made up of the simpler substances, hydrogen and oxygen. The state, but not the composition is affected by the process of heating or cooling.

By changes in the condition of a substance are meant changes such as when a solid mass is made to fine powder, salt or sugar are dissolved in water. It is clear that such transformations like the changes from one state of matter to another, do not affect the composition of the material. The fine powder of a substance may be made solid again, and we get back the salt or sugar unchanged by evaporating the water.

Chemical changes, however, are those matter changes in which a change of composition does take place and the new substance formed will not return to its original state, unless it is subjected to another chemical change. Thus iron, when it is affected by moist air, is slowly transformed into iron rust entirely different in its properties from the original iron. The new substance will not become iron again when it is allowed to stand, although the iron can be obtained from it if it is subjected to the proper conditions.

Thousands of physical and chemical changes take place in nature, and in a laboratory it is possible to cause many other changes artificially which do not occur naturally. For example, by subjecting air to very great pressure and cooling it is possible to transform it to the liquid state — a physical change; while by means of changing the materials which are combined, or the conditions under which they are combined, many substances will be produced by the chemist, some of which are formed in nature while others are not. In observing these transformations, it is important to be able to distinguish between physical and chemical changes.

3. Questions:

1) What kinds of transformations do you know?
2) What are physical changes?
3) Is there any change in the composition of a substance when it is transformed?
4) What are chemical changes?
5) Give the examples of chemical changes.

4. What is the main idea of the text?

Text 7

1. Vocabulary:

to consider – рассматривать, полагать, считать
to break – ломать, разбивать
no matter – неважно, все равно
to account for – объяснять
tremendous – ужасный, громадный
to belong to – принадлежать
to obtain – получать
to possess – обладать
like – подобный, похожий

2. Read and translate the text.

THE ELECTRON

It has been known for a very long time that matter is composed of atoms and that every substance consists of mixtures or combinations of a limited number of atoms. Each atom is considered as the smallest piece of the substance, which can exist independently. No further subdivision of a chemical element can be made, without completely destroying its identity.

Seeing an atom has been, however, impossible, not even under the most powerful microscopes; but one can get very near to seeing them by photographing the traces where atoms have been. Atoms are electrically neutral, having no electric charge in their normal state.

The electrical nature of atoms is only seen when one starts breaking them into pieces, electrons and others. There are dozens of ways of liberating electrons from atoms and no matter how it is done, no matter from what material they are obtained, each electron is like every other electron.

An electron is very small and it has a very small mass, many times smaller than the atom it came from; its most important property is that it is electrically charged. This property accounts for negative electric charges. But there is another kind of electric charge we call positive and the usual form it takes, is called the proton. The size of the proton is almost the same as that of an electron, many times smaller than an atom, but its weight is comparatively speaking tremendous, being about two thousand times that of an electron. It makes up nearly the whole weight of the atom it belongs to.

And here one must note a remarkable fact. The amount of electricity on any proton is exactly the same as that on an electron.

All the atoms, no matter how many electrons they may possess, are electrically neutral. They must contain therefore as many protons as electrons; as many units of positive charge as units of negative charge. The weight of all the protons is always less than the weight of the atom. Only in hydrogen the nucleus contains but one proton. The difference in weight is made up by neutrons. This is the role of the neutrons, inside the central nucleus of each atom.

3. Questions:

1) What does every substance consist of?
2) How is each atom considered?
3) What can you say about the electrical nature of atoms?
4) What is the most important property of electron?
5) What do you know about the size and the weight of the proton?
6) All the atoms are electrically neutral, aren't they?
7) What is the role of neutrons?

4. Sum up the contents of the text.

Text 8

1. Vocabulary:

manifold – разнообразный, многочисленный
to undergo – испытывать, подвергаться
pendulum – маятник

to pull – тянуть, дергать
to lose – терять
to disappear – исчезать
bottom – дно, нижняя часть
to climb – подниматься
by virtue of – посредством
to reach – достигать
arrangement – расположение, расстановка
to involve – включать в себя, вовлекать
associated – Действующий совместно, взаимодействующий
radiant – излучающий, лучистый
to liberate – освобождать, вызволять

2. Read and translate the text.

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? Gravitatfonal 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 compressing 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*

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

3. Questions:

1) How do we call a law, governing all natural phenomena?
2) What are the different forms of energy?
3) Give an example of conversion of gravitational energy into some other form.
4) When is elastic energy converted to kinetic energy?
5) What is chemical energy?
6) What do you know about nuclear energy?
7) The law of conservation of energy is enormously useful and very important, isn't it?

4. Sum up the contents of the text.

Text 9

1. Vocabulary:

to confine – ограничивать
pitchblende – уранит, урановая смолка
intensely – чрезмерно
to solve the problem – решить проблему
fission – расщепление, деление, распад
to suggest – предлагать
decay – распад
to constitute – назначать, составлять
mere – единственный, всего лишь
emission – выделение, излучение
to decrease – понижать, уменьшать
to increase – повышать
the latter – последний из двух выше названных

2. Read and translate the text.

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 Sklodowska-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 U. S. S. R. 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 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 change 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.

3. Questions:

1) When was radioactivity discovered?
2) Who discovered the radioactive elements?
3) What do you know about radium?
4) What did Ernest Rutherford discover?
5) How do radioactive substances disintegrate?
6) When do certain radioactive elements emit electrons?
7) What is radioactivity?

4. Reproduce the main points of the text.

Text 10

1. Vocabulary:

to move – двигаться
to project – выбрасывать, проектировать
to set up – устанавливать, обеспечивать, помещать
interplay – взаимодействие
to cancel – отменить, аннулировать
measure – мера, размер, степень
to enable – делать возможным, позволять
magnitude – величина
flux – поток, постоянное движение
uniform – равномерный, постоянный
equal to – равный, соответствующий

2. Read and translate the text.

THE ELECTRIC FIELD

Each electric particle project into space a field of electric force, and as the particles move along a wire, the lines of force move with them. It is the motion of these lines of electric force that sets up a magnetic field transverse to them. A variable electric field is always accompanied by a magnetic field and conversely, a variable magnetic field is accompanied by an electric field. The joint interplay of electric and magnetic forces is called an electromagnetic field.

Modem physics defines the electromagnetic field as a distinct form of matter possessing definite properties: it is distributed continuously in space; in a vacuum it propogates at the speed of light (300,000/km sec).

The theory of the electromagnetic field was stated by the Scotch physicist James Clerk Maxwell in his "Electricity and Magnetism" published in 1873.

In the case of a stationary charged body the magnetic field, built up by the elementary charges constantly moving inside it cancel each other, and there is practically no magnetic field. The same is true of a stationary permanent magnet which only displays a magnetic field and has no electric field. This condition enables us to investigate electric and magnetic fields separately. We shall regard the electric field as one of the aspects of the electromagnetic field.

A measure of the strength of an electric field is given by the mechanical force per unit charge experienced by a very small body placed in this field and is denoted by the letter E.

By definition

$$E = \frac{F}{q}$$

If the strength of an electric field is the same both in magnitude and direction at any point in space, the field is called uniform.

It is relevant to note that quantities which have both magnitude and direction are called vectors, as distinct from quantities which have only magnitude and are called scalars. Typical vectors are force, velocity, acceleration, while typical scalars are temperature, quantity of matter, energy, power.

An inertialess charge placed in an electric field would follow a path called a line of force. The total number of lines of electric force through a surface placed in an electric field is called the electric flux and is denoted by the letter N. For a surface S normal to the vector of a uniform field of strength E, the flux is

$$N=ES$$

For a nonuniform field the flux is determined in a different way.

We have already defined a line of electric force. Placing a positive charge at different points in the field set up by a positively charged spherical body, we obtain set a of such paths, or lines of electric force. Obviously, any number of lines of electric force can be imagined in an electric field. In order to represent its strength, there is a well-established convention to draw as many lines of electric force through every square centimetre of area normal to the lines at a field point, as will be equal to the field strength at that point. Consequently, the density of lines of force will give a graphic idea of the field strength.

We know that like charges repel one another. Therefore, on any conductor the electric charge will concentrate only on its surface. The quantity of electricity per unit area is called the surface charge density. It depends on the quantity of electric charge on a given body and on the shape of the latter.

3. Questions:

1) Is a variable electric field always accompanied by a magnetic field?
2) How does modern physics define the electromagnetic field?
3) What do you know about the theory of the electromagnetic field?
4) What enables us to investigate magnetic and electric fields separately?
5) What are vectors and scalars?
6) What is the electric flux?
7) How many lines of electric force can be imagined in an electric field?

4. Reproduce the main points of the text.

Text 11

1. Vocabulary:

discharge – разгрузка разрядка
to extend – распространять, простираться
to emit – испускать, выделять
to reflect - отражать
to diffract – преломлять отклонять
to embed – вставлять, врезать
surface – искусная

2. Read and translate the text.

X-RAYS

In 1895, when Rontgen was experimenting on the discharge of electricity through gases, he found that if a discharge tube was evacuated to the stage at which the cathode-ray beam extended along its length, then certain materials became fluorescent when placed in the neighbourhood of the tube and also that photographic plates were darkened. Moreover these effects persisted when the tube was covered with materials such as black paper. They were evidently due to something which seemed to emanate from the places where the cathode rays hit the walls of the tube, and the unknown agent was called X-radiation or X-rays. In addition to the above mentioned properties X-rays were found to produce strong ionization in gases.

X-rays are produced when the fast moving electrons of the cathode stream are suddenly stopped. The X-rays are emitted in all directions from the spot on which the electrons are focused, and the surface of the target is cut obliquely so that some of the rays pass out of the side of the tube. Less than one per cent of the energy of the electrons is converted into X-rays, the remainder appearing as heat in the target. This is why the latter must have a high melting-point. Sometimes the target was a comparatively small piece of metal embedded in the surface of a lump of copper, advantage being taken of the high thermal conductivity of the latter metal to dissipate the heat. In very powerful X-ray installations, using anything up to a million volts, so much heat is generated that it has to be removed by the circulation of liquid.

In the early stages of the study of X-rays the terms "hard" and "soft" came to be used to indicate differences in penetrating power; hard rays can pass through greater thickness of matter, that is to say they are less strongly absorbed. The greater the potential difference through which the electrons move (that is to say the greater their energy) before being stopped by the target, the harder are the X-rays.

The nature of X-rays was established several years after their discovery. The fact that magnetic and electric fields have no effect on them indicated that they were more likely to be waves of radiation than streams of charged particles. On the other hand the apparent contrasts between their behaviour and that of light and other radiations, namely, the seemingly impossibility of causing them to be reflected or refracted, or to be diffracted by ruled gratings made it difficult to believe that they were a form of wave motion.

But the wave nature of X-rays was finally established: X-rays were found to be waves of exactly the same nature as light but of smaller wavelength. ' X-rays are widely used in medical diagnosis and in industry.

3. Questions:

1) When was Rontgen experimenting on the discharge of electricity through gases?
2) When the fast moving electrons of cathode stream are suddenly stopped, X-rays are produced, aren't they?
3) What do you now about a high melting-point?
4) What were the terms "hard" and "soft" used for?
5) When was the nature of X-rays established?
6) What can you say about the wave nature of X-rays?
7) Where are X-rays widely used?

4. Give a brief summary of the text.

Text 12

1. Vocabulary:

to deflect – изменять направление, отклонять
evident – очевидный, явный
to employ – предоставлять работу; использовать, применять
to turn out – оказываться
equilibrium – равновесие
to pick up – собирать, находить, приобретать
stream – поток
as regards – что касается, в отношении
range – ряд, серия, предел
to eject – выбрасывать, извергать
value – значение

2. Read and translate the text.

ALPHA, BETA AND GAMMA RAYS

Alpha rays are not true rays, like light and X-rays. Passing through an electric field alpha rays are deflected towards a negatively charged plate. They are also deflected by a magnetic field. From the character of these deflections, it is evident that they have a positive charge. The ratio of the charge to the mass of the alpha particles can be determined from observations of the deflections of the rays in electric and magnetic fields.

The velocity of alpha particles, is known to be of the order of 2 x 10 cm per second. The velocity and the value of E/M for alpha rays were determined by Rutherford by means of a modification of the usual method in which magnetic and electric fields are employed. The ratio of charge to mass, E/M, was found to be almost exactly half as large for the α-particles as it is for atoms of hydrogen. Additional observations were then necessary to determine E and M separately.

Rutherford and Geiger counted the number of particles emitted per second by a given quantity of radium C^1. The total charge carried by the particles was then determined too with the special apparatus. Division of the observed total charge by the known number of the α-particles then gave the charge on each one. This turned out to be twice as great as the electronic charge. From this result and the previously found value of E/M, the mass of α-particle was found to be approximately four times that of a hydrogen atom. Thus the α-particle must be the nucleus of a helium atom. Rutherford's observations led to the conclusion that 1 gram of radium in radioactive equilibrium would emit 1.3×10^{11} alpha particles per second, and that these, after becoming neutralized by picking up electrons, would, in 1 year form 0.16 cc of helium gas.

Because of its double charge and great mass, an alpha particle produces an enormous number of ions as it passes through matter. Since energy is lost in producing these ions, and also in exciting many molecules without ionizing them, the alpha particle rapidly loses velocity, until finally it is moving too slowly to produce any ions at all.

The total length of path, along which an alpha particle causes ionization is called its range. Since the range increases with increasing initial energy, it is commonly used as a measure of the initial energy of the α-particle. Various methods have been used to measure the range of alpha particles.

Beta "ray" are also streams of particles. These particles are negatively charged, as shown by their deflection in a magnetic field, which is opposite to that of the alpha particle. They are called electrons and are identical as regards mass and charge, whatever atom emits them. The mass of the electron is about 1/1.845 of the mass of the hydrogen atom.

Electrons, or beta particles, are emitted by radioactive substances with very high velocities. The velocity of the electrons emitted from any radioactive element is not constant.

Elements whose atoms eject beta particles during radioactive disintegration almost always emit gamma rays. Each element gives the complete gamma-radiation spectrum, but each also gives certain characteristic wavelengths.

Gamma rays do not carry a charge of electricity and are not deflected by either an electric or a magnetic field. They are like the most penetrating type of X-rays. When their intensities are large enough, they produce, a luminosity on a fluorescent screen and affect a photographic plate. Their wavelengths have been measured and are found to be less than the wavelengths of the most penetrating X-rays.

3. Questions:

1) Are alpha rays?
2) Are they also deflected by a magnetic field?
3) Who determined the velocity and value of E/M for alpha rays?
4) What are beta "rays"?
5) Beta particles are emitted by radioactive substances, aren't they?
6) Do gamma rays carry a charge of electricity?
7) What are they like?

4. Sum up the contents of the text.

Text 13

1. Vocabulary:

visible – видимый
frequency – частота
to occur – случаться, происходить
dangerous – опасный
to deal with – иметь дело с ч-л; сталкиваться с ч-л
scattered – разбросанный; рассеянный (физ)
to extend – протягивать, простираться, распространять
to find – находить, обнаружить, открывать
aerial – воздушный
indispensable – необходимый, незаменимый
ultimate – окончательный, основной

2. Read and translate the text.

ULTRAVIOLET AND INFRARED

Visible light covers only a very small part of the electromagnetic spectrum. Just above and below the visible light range are ultraviolet and infrared light. The "ultra" in ultraviolet tells us that this light lies at frequencies higher than that of violet light; and the "infra" in infrared tells us that this light lies at frequencies lower than red.

With the wave lengths, however, it is the other way round. Ultraviolet has a shorter, and infrared a longer wave length than visible light. These radiations were discovered long before anyone thought of electromagnetism. When light was passed through a prism and formed a spectrum on a screen, scientists found that heating effects occur beyond the edges of the visible light spectrum.

Ultraviolet radiation produces many effects, some useful and some unpleasant. A certain amount of ultraviolet radiation is good for our health. It helps to form vitamin D in the skin. Ultraviolet light also kills microbes, and for that reason it is used in hospitals and to sterilize food.

Direct ultraviolet radiation is very bad for the eyes. This is one reason why it is dangerous to look directly at the sun. On the other hand, the human eye is quite capable of dealing with normal doses of scattered ultraviolet light.

Certain materials give off visible light when ultraviolet radiation falls on them. Such substances are called "fluorescent". In fluorescent lighting ultraviolet radiation falls on a special substance and produces light.

Infrared rays are heat rays, every object being a natural radiator of invisible infrared energy.

Infrared is the portion of the electromagnetic spectrum starting at the deep red (hence its name —"beyond red") and extending to the microwave radar region. It bridges the gap between visible light and the microwaves used for radar.

Infrared energy is being used in automatic regulation of chemical and biological processes, temperature measurement and control during manufacture of textiles, plastics and metals. New applications are appearing in navigation and aviation, weather research and numerous scientific projects. Other applications for infrared are found in photography aerial mapping, communications and control techniques.

Infrared energy is in use all around us. Infrared techniques are of great value in many industrial applications and are considered indispensable in many others. The possibilities of its application appear to be limited only by the imagination and skill of the user.

Research and development are constantly improving the slate of infrared technology as infrared takes its place among the tools of science. Whatever the ultimate goal of infrared may be there is no doubt that it will play an important role in industrial electronics.

3. Questions:

1. What can you say about "Ultra" and "Infra"?
2. What effects does ultraviolet radiation produce?
3. Is ultraviolet radiation good for our health?
4. What substances are called fluorescent?
5. Where is infrared energy used?
6. What new applications of infrared energy do you know?
7. What is the role of infrared?

4. Reproduce the main points of the text.

Text 14

1. Vocabulary:

to generate – порождать, вызывать, образовать
spark – искра, вспышка, световой разряд
amperage – сила тока (в амперах)
to hit – ударять, достигать
arching – искрение, образование (горение) дуги
to overrun – переходить пределы, быстро распространяться
moist – влажный
to cause – быть причиной, заставлять
resistance –сопротивление, противодействие
to smash –ломать, уничтожать
conductor –(эл.) проводник, молниеотвод
to descend – спускаться, снижаться
obvious –явный, очевидный

2. Read and translate the text.

LIGHTNING

What is Lightning? Just how lightning is generated we can't say for sure. But we know that it's the world's most colossal spark, created by the discharge of colossal amounts of static electricity. It can carry a punch of hundreds of millions of volts, a current of 1000 to 100,000 amperes or more.

We also know that there are two basic types of lightning. The so-called "cold" variety has extremely high voltages, combined with relatively low amperages. It hits and disappears within 1/10,000th of a second. It doesn't often start fires, but the enormous pressure of its passage can literally explode whatever it hits. "Hot" lightning, on the other hand, has extremely high amperage but relatively low voltage. With a temperature as high as several thousand degrees, this is the type that almost invariably starts fires.

Like all electric sparks, lightning results when the potential between negative and positive charges becomes great enough to cause arcing. In some cases, the arcing goes through a barrier of air between the negative charge in a storm cloud and the positive charge of the earth. While we don't know the exact mechanics by which this potential is built up, we do know the rough sequence of events.

A thunderstorm is generated when a layer of cool air overruns a mass of low-lying, moist, warm air. The warm air tends to rise through the cool air, causing its moisture to condense into water droplets. This movement of air current against air current — and possibly of droplet against droplet — generates large quantities of static electricity.

Lightning going through such non-conductors as wood or brick meets with tremendous electrical resistance. But the massive electrical energy contained in the lightning smashes through this resistance. In the process it generates enough heat to set fire to — or perhaps even melt — the structure it hits.

Protection System. If the lightning hits a good electrical conductor, however, it takes the path of least resistance, and its energy is carried harmlessly into the ground.

The objects which shorten the gap between the descending negative stroke leaders and the earth's positive potential form the ideal basis for a protection system. In fact, the obvious thing to do is to make part of that system the highest point on the house.

This highest point is familiarly known as the lightning rod. The modern version of Benjamin Franklin's invention is a far cry from the large creations of earlier days. It even goes by a different name — the air terminal. Today's air terminal is pencil-thin and pointed, designed to be as small as possible.

3. Questions:

1) What types of lightning do you know?
2) What is the difference between so-called "cold" and "hot" lightning?
3) When does lightning result?
4) How is a thunderstorm generated?
5) What form is the ideal basis for a protection system?
6) What can you say about the lightning rod?
7) Do you like to see the lightning?

4. What is the main idea of the text?

Text 15

1. Vocabulary:

to combine – объединять, смешивать, соединять.
to consider – принимать во внимание, полагать, рассматривать.
to survive – выжить, уцелеть
to boil – кипеть.
to require – требовать.
to supply – снабжать, восполнять, поставлять.
to contain – содержать, вмещать.
store – запас, резерв
suitable – подходящий, соответствующий.
measurement – измерение, размер.
to explore – исследовать, выяснять, выявлять.
in accordance with – в соответствии с чем-либо.
quantity – количество.

2. Read and translate the text.

ARE THE PLANETS HABITABLE?

Ever since it was known that the planets were bodies more or less like the earth, people have asked: "Are there living things on them, too?". This is a hard question to answer, but by combining the resources of most of the sciences, we can give a rather good answer.

First let us consider life on our earth. All living things are absolutely dependent on water. Moreover, this water must be liquid — neither ice nor gaseous water vapour, but ordinary liquid water. Nothing grows while it is frozen. And no living thing would survive if the water were boiled out of it. Hence it is necessary that the temperature on a habitable planet should be above freezing part of the time, and below the boiling point all the time.

Light is necessary too. Practically all the food in the world is produced by green plants. Plants get the energy they require for their growth from sunlight.

There is good reason to believe that the vast store of oxygen in the air has all been supplied by plants. It there were no plants, there would be no food to eat, nor oxygen-containing air to breathe.

If we inquired-whether other planets were habitable, we should then try to find out whether their temperatures were suitable for life, whether they had water and atmosphere on them, and if so, whether oxygen and carbon dioxide were present.

Measurements of planetary heat have shown that Mercury, which is the nearest planet to the sun, has a noonday temperature of about 327° Centigrade.

For the remoter planets the temperatures range from 150°C to 200°C below zero. All these planets are evidently unhabitable by any form of life known to science.

The Moon, as is well known to everybody, is unhabitable, it. neither atmosphere nor water. This celestial body been systematically explored in accordance with the space programme.

The Moon's surface was explored, by the self-propelled vehicle in accordance with the research programme: the physico-mechanical properties of the lunar soil were measured, its chemical composition was determined by means of an X-ray

Now only Venus and Mars are left for consideration. Venus has a large quantity of carbon dioxide in her atmosphere, hut too little oxygen or water vapour. In all probability there is no life on the planet.Mars has a thin atmosphere , so that we can see the planet clearly. Different observations show thet there is little water vapour in the atmosphere. This indicates, too , that there is at present very little oxygen on Mars. Whether animal life has ever existed on Mars and whether it has been able to survive it at present impossible to find out.

3. Questions:

1. What do people want to know about the other planets?
2. All living things are absolutely dependent on water, aren't they?
3. What temperature should be on a habitable planet?
4. What is the role of plants?
5. What can you say about Mercury?
6. How the Moon surface explored?
7. Why isn't there life on Venus?

4. What is the main idea of the text?

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