МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ЧЕРНІГІВСЬКИЙ ДЕРЖАВНИЙ ТЕХНОЛОГІЧНИЙ УНІВЕРСИТЕТ

Англійська мова

Методичні вказівки до практичних занять та самостійної роботи для студентів денної форми навчання напряму підготовки 6. 050802 «Електронні пристрої та системи»

ЗАТВЕРДЖЕНО
на засіданні кафедри
іноземних мов
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Англійська мова. Методичні вказівки до практичних занять з граматики та самостійної роботи для студентів напряму підготовки 6. 050802 - «Електронні пристрої та системи» денної форми навчання / Укл.: Струтинська В.В. – Чернігів: ЧДТУ, 2013. – 28 с.

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Зміст

English on Electronics

Передмова

Методичні вказівки “Англійська мова” до практичних занять та самостійної роботи складені у відповідності до вимог програми викладання англійської мови професійного спілкування (Київ, 2012 р.) та призначені для студентів 1-го та 2-го курсів денної форми навчання напряму підготовки – 6.050802 – “Електронні пристрої та системи” немовних вузів, які продовжують вивчення англійської мови на базі знань, отриманих в середній школі. Головна мета вказівок – розвиток навичок розуміння й аналізу текстів, накопичення словникового запасу, уміння вести бесіду, брати участь у дискусіях англійською мовою, формувати позицію фахівця у галузі електроніки.

Методичні вказівки включають 2 основних розділів, які містять тексти, пов’язані з головними поняттями в галузі фізики та електроніки. До кожного тексту додаються вправи, які значно сприяють опрацювання професійно спрямованого матеріалу та граматики.

Тексти додаткового матеріалу, пов’язані з інноваційними пошуками в галузі електроніки, призначені для самостійного опрацювання і спрямовані на збагачення знання лексики науково технічного спрямування та полегшення мовленнєвої здібності.

1 THE BINDING ENERGY OF A NUCLEUS

1.1 Read and translate the text.

We shall now discuss how nuclei are built up of neutrons and protons. In particular, we are interested in the energy with which neutron and proton are held together in any given nucleus, i. e. in the binding energy of the nucleus. These binding energies are very large. They are conveniently measured in millions of electron volts. A million electron volts (Mev) is the energy which an electron would acquire if it were allowed "to fall" through a potential difference of one million volts. Such potential difference can actually be established, and either by using large potential differences or by other means, protons, electrons, and other charged particles can be accelerated to energies of many millions of electron volts and can the be used for nuclear experiments.

Concerning the unit of energy, it should be noted that one million electron volts is 1.6 x $l0^6$ erg, which appears to be not very much energy. However, one nucleus is also not much matter. If one considers instead all the nuclei contained in a gram of matter, then if each has one million electron volts, all of them together would have an energy content of about 10^{18} ergs, or 25 million kwhr, and this of course is a great deal of energy.

The binding energy of nuclei is determined experimentally in various ways. One of the simplest is by means of Einstein's relation between mass and energy, i. e. by measuring the mass of a nucleus. This is done by placing an ion of an atom in an electric and a magnetic field. Then its mass can be determined by the amount of deflection. Another way of determining the mass of nuclei is to measure the energy released in a nuclear transformation; this method will be discussed further on.

1.2 Exercises

1.2.1 Answer the questions. Use the preposition *at* with the words: temperature, energy, speed, velocity, voltage, rate, pressure, intensity.

E x a m p l e : When do the collisions of molecules become violent? (high temperature).
The collisions of molecules become violent at high temperature.

a. When do the molecules of a gas disrupt? (high temperature).
b. How was the experiment carried out? (normal pressure).
c. When do atoms act as elementary particles? (low energies).
d. In what way is electric current carried by long transmission lines? (voltages as high as 250,000).
e. When does the reaction go slowly? (low temperature).
f. How does light travel? (the speed of 300,000 km per sec.).

g. When does superconductivity occur? (low temperature).
h. How does the neon lamp operate? (a rather high voltage).
i. In what way is the light from fluorescent lamp emitted? (low intensity).
j. When does the reaction rate increase? (elevated temperature).

1.2.2 Insert the right preposition: *at* or *under*

a. The collisions of molecules become violent ... high temperatures.
b. A state of equilibrium is achieved … certain circumstances.
c. Electrons reach practically the velocity of light ... energies of millions of electron volts.
d. The stars revolve around the galactic centre … a rate of about 300 km per second.
e. This assumption holds true … certain conditions.
f. Cryogenic physics is the physics of matter … low temperatures.
g. The body is kept … pressure.
h. The experiment was carried out ... normal pressure.
i. The molecules get ionized … the influence of high temperature.
j. The Hall electric current increases … the action of magnetic field.
k. The rate … which the speed of an object changes is called acceleration.
l. Gases … normal conditions are poor conductors of electricity.

1.2.3 Translate into English.

a. Спостереження проводилися при кімнатній температурі.
b. Вимірювання були зроблені при високих енергіях.
c. Світло рухається (travels) зі швидкістю 300 000 км / сек.
d. Досвід проводився при нормальному атмосферному тиску .
e. Радіосигнали посилалися з постійною частотою.
f. Машина їхала з великою швидкістю.

Under

g. У нашому досвіді газ. перебував під великим тиском.
h. Властивості плазми вивчалися за певних умовах.
i. За яких обставин це сталося?
j. Світло відхиляється під впливом гравітаційного поля.
k. Спостереження проводилися у важких умовах.
l. В рослинах (plants) неорганічна речовина може перетворитися в органічну під дією сонячного світла.

At or *Under*

Надпровідність виникає (occurs) при дуже низьких температурах.

m. При деяких умовах матерію можна перетворити в (to transform into) енергію.

n. Реакція протікає (proceeds) при нормальному тиску і кімнатній температурі.

o. Відкриття було зроблено при наступних обставинах.

p. Електрони досягають швидкості світла при дуже більших енергіях.

q. Цей закон справедливий лише за деяких умовах.

r. Неонові лампи працюють при досить високій напрузі.

1.2.4 Translate into Russian paying attention to the verbs followed by the prepositions *to* and *into*.

To

a. The compound *has been subjected to* a preliminary heating.
b. Our eyes *react to* a much smaller range of light than our ears to sound frequencies.
c. In our experiment the body *is exposed to* ultraviolet light.
d. We shall *confine* our discussion *to* four main points.
e. The paper is *devoted to* the properties of plasma.
f. Maxwell *applied* the ordinary laws of mechanics *to* the molecules.

Into

g. The water *is decomposed into* hydrogen and oxygen *by* means of electric current.
h. Electrical energy *can be turned into a* number of forms.
i. Solids can be made *to diffuse into* each other.
j. Potential energy *can2 change into* kinetic and kinetic into potential
k. The beam from radium sample *splits into* three parts: alpha, beta and gamma rays.
l. Heat energy *is transformed into* mechanical energy by means of steam engine.
m. Atoms *can be broken into* simpler substances.
n. Energy can *be classified into* mechanical, heat and chemical kinds of energy.
o. The gas engine *converts* heat *into* mechanical energy.

1.2.5 Insert prepositions *to* or *into*.

a. A molecule becomes ionized if exposed … rough treatment.
b. By adding heat to a solid body we transform it … a liquid.
c. In our experiment we bring a hot body … contact with a colder one.
d. The substance was subjected … ultraviolet, light.

e. During ionization some of gas molecules split … ions and electrons.
f. The first chapter is devoted … plasma physics.
g. During recombination ions and electrons recombine … a molecule.
h. In completely ionized plasma all the molecules are divided … ions and electrons.
i. The apparatus was sensitive … all changes of atmospheric pressure.
j. These data can be classified … two groups.
k. The law of reflection applies … light as well as … sound.
l. Potential energy can be converted … kinetic energy.
m. Heat from the sun is transferred … the earth.
n. The light emitted by a galaxy is subjected … spectroscopic analysis.

1.2.6 Translate into English.

a. Якщо молекула піддається дії X-променів, вона руйнується..
b. Плазма повністю іонізується, коли всі молекули розпадаються на іони і електрони..
c. Фотографічна пластинка (пластини) чутлива до світла.
d. Потенційна енергія може перетворюватися в кінетичну.
e. Даний (the above) метод можна застосовувати до рідини і газів.
f. Отримані дані можна поділити на дві групи.
g. Під час реакції одна речовина переходить в іншу.
h. Під впливом світла хімічний склад (composition) молекули змінився..
i. Я хочу обмежити своє повідомлення двома питаннями.
j. Речовина підлягала обробці.

k Конференція присвячена фізиці плазми

2 THE KINETIC THEORY OF HEAT

2.1 Read and translate the text.

There are three fundamental states — the solid, the liquid, and the gaseous. We know that any substance in nature can be brought into each of these three states. Even iron evaporates at several thousand degrees, and even air free-zes into a solid block at sufficiently low temperatures. Thus, the difference between the solid, liquid, and gaseous state of a given body depends upon its thermal condition.

By adding heat to a solid body we transform it into a liquid. By adding still more heat we transform the liquid into a gas. But what is heat?

According to the molecular theory of matter a hot body differs from a cold body only in the state of motion of its particles. The molecules of every material body at normal temperature are in a state of permanent motion; and the faster they move, the hotter the body seems. If we bring a hot body into contact with a colder one, the fast-moving molecules of the first will collide, on their common boundary, with the slower-moving molecules of the second and transfer to them a part of their kinetic energy.

Thus, the fast molecules will gradually slow down, and the slow ones speed up, until a state of equilibrium is reached in which the molecules in both bodies have equal average energies. We say then that both bodies possess the same temperature and that the «flow of heat» from one into the other has ceased.

Thus, it follows at once that there should exist a lowest possible temperature, or an absolute zero, at which the molecules of all material bodies are completely at rest. At this temperature the constituent particles of any sub-stance will stick together, because of intermolecular cohesive forces, and demonstrate the properties of a solid.

As the temperature rises, and the molecules begin to move, there comes, sooner or later, a stage when the cohesive forces are no longer able to keep the molecules rigidly in their places, though still strong enough to prevent them from flying apart. The body ceases to be rigid but still keeps its finite volume, and we then have matter in the liquid state. At still higher temperatures, the molecules move so fast that they tear apart from each other and fly off in all directions, thus forming a gas with a tendency toward unlimited expansion.

2.2 Exercises

2.2.1 Answer the questions. Use *to be able to*.

E x a m p 1 e: When did you complete this work?
I was able to do it in summer (last week, two days ago, before holidays, after all).

a. When did you present your paper?
b. When did you obtain these data?
c. When did you perform this experiment?
d. When did you make this analysis?
e. When did you get these results?
f. When did you begin to study semiconductors?
g. When did you resume your work?
h. When did you do research in plasma?
i. When did you write this article?

2.2.2 Supply extended answers.

E x a m p l e : Are you ready with your report?
Not yet. I have not been able to finish it. I am afraid I won't be able to finish it before Monday (by six o'clock).

a. Are you through with your work?
b. Have you completed the experiment?
c. Are you ready with your task?
d. Have you finished your paper?
e. Have you already written this article?
f. Are you ready with your thesis?
g. Have you made the measurements?

2.2.3 Recast the following sentences using the conjunction *the… the*+an adjective or an adverb in the comparative degree. The link verbs *to be, to become, to grow* are usually omitted.

E x a m p l e s : 1) As the nucleus becomes heavier, the energy levels are denser.
The heavier the nucleus, *the denser* the energy levels.
2) As a substance burns faster, it gives off more heat.
The faster a substance burns *the more* heat it gives off.

a. As the magnetic field becomes stronger, the radio radiation is faster.
b. As the molecules move faster, the body seems hotter.
c. As the excitation energy grows higher, the energy levels are denser.
d. As the subject is examined further, the problem seems more complex.
e. As the plasma density becomes greater, the annihilation is faster.
f. Аз the temperature of a substance becomes higher it burns faster.
g. As the magnet becomes stronger, the distance at which its influence may be detected is greater.
h. When the molecules are smaller, the mean free path becomes longer.
i. As a wire becomes thicker, its resistance is less.
j. As the kinetic energy grows higher, fewer particles are emitted.

2.2.4 Answer the following questions.

E x a m p l e : What are the relations between the cross section of a wire and its resistance? (large little).
The larger the cross section of a wire *the less* its resistance.

a. What are the relations between the electromagnetic wave-length and the amount of energy it transfers? (short, much).
b. Is there any relation between the nuclear charge and the mass number? (high, high).
c. In what way does the potential difference affect the strength of electric current? (great, strong).
d. Does the refraction index depend upon the density of a body? (large, great).
e. What is the relation between the velocity of a body and its friction? (great, large).
f. In what way does centrifugal force depend upon the radius of a curvature? (great, little).

2.2.5 Translate into English.

a. Чим довше дріт, тим більше його опір.
b. Я вивчаю фізику плазми, і чим більше я займаюся цією проблемою, тим цікавішою вона мені здається.
c. Цю роботу потрібно закінчити, і чим швидше, тим краще.
d. Чим більше отримано даних, тим важче їх підсумовувати.

Існує певна залежність між щільністю середовища (the density of the medium) та швидкістю) звуку. Чим менше щільність середовища, тим більше швидкість звуку

2.2.6 Recast the following using *according to*.

Example: The molecular theory states that a hot body differs from a cold body only in the state of motion of its particles.
According to the molecular theory a hot body differs from a cold body only in the state of motion of its particles.

a. The molecular theory states that the molecules are in a state of a permanent motion.
b. The molecular theory holds that the faster the molecules move the hotter the body seems.
c. The theoretical analysis suggests that there should exist a lowest possible temperature at which the molecules are completely at rest.
d. The molecular theory maintains that as the temperature rises the body ceases to be rigid.
e. The molecular theory states that at still higher temperatures the molecules move so fast that they tear apart from each other.
f. The author believes that to formulate a general rule is difficult.
g. The author considers that the book in question is a contribution to plasma physics.
h. The observations show that this problem can be approached in several ways.
i. The equation shows that this is the case.
j. The data show that this is not the case.
k. The author believes that considerable progress has been made in this field.
l. The analysis made proves that we are faced with a completely new type of force.
m. The theory of relativity states that no particle of matter can actually attain the speed of light.

2.2.7 Answer the questions using *according to*.

E x a m p l e : How are substances classified? (their properties).
Substances are classified according to their properties.

a. How are semiconductors classified? (their electrical properties).
b. How should the word be chosen? (its meaning).
c. How are the papers in the journal arranged? (their contents).
d. How are the elements in the table arranged? (their chemical properties).
e. How are the pupils organized in groups? (their knowledge).
f. How are the papers distributed among sessions? (their contents).
g. How are these bodies differentiated? (their size and colour).

2.2.8 Translate into English making use of *according to.*

a. Згідно молекулярної теорії, молекули перебувають у постійному русі.
b. За твердженням автора, ця гіпотеза досить сумнівна.
c. Висновки зроблені у відповідності з отриманими данними.
d. Тверді тіла класифікуються за їх електричними властивостями.
e. За словами доповідача, ці факти можна пояснити по-різному.
f. За традицією конференція проводиться щорічно.

Згідно з отриманими відомостями, конференція відбудеться в Москві

3 SEMICONDUCTORS

3.1 Read and translate the text.

One way of classifying a solid is according to its electrical properties. A conductor and an insulator are first distinguished by their extreme values of electrical conductivity. In particular, a conductor has a conductivity of 10^4 to 10^6 ohm^{-1} cm^{-1} whereas insulators are characterizes by conductivities less than 10^{-6} ohm^{-1} cm^{-1}. Second the conductivity of a conductor decreases as its temperature increases while that of an insulator varies slightly (but does increase) with increasing temperature.

In addition to conductors and insulators, there is a class of solids with intermediate values of electrical conductivity (10^{-6} to 10^3 ohm^{-1} cm^{-1}) and whose conductivity increases (more strongly than insulators) with increasing temperature. Such solids which resemble insulators only at temperatures near the absolute zero are called semiconductors. One further marked difference between a conductor and a semiconductor relates to the dependence on the degree of purity of the crystal, on its electrical conductivity.

The conductivity of a good conductor increases with purification (e. g., the elimination of foreign impurities from the crystal), whereas the conductivity of semiconductors generally decreases with purification.

There are two basic types of semiconductors. These are the intrinsic type and the impurity type. An intrinsic semiconductor is usually a pure monatomic or diatomic solid whereas the impurity type has electrical properties that depend on the type and amount of foreign-impurity atoms and/or an excess or deficiency of the normally constituent atoms (i. e. stoichiometric deviations).

Classification of Semiconductors

Type	Typical examples
Intrinsic	Si, Ge, Se, InSb
Impurity:	
Foreign impurity	Si or Ge doped with A1 or P
Stoichiometric deviations:	
(1)Excess metallic	PbS, $Ti0_2$
(2)Excess nonmetallic	PbS, NiO, Cu_20

3.2 Exercises

3.2.1 Give answers to the following questions. Pay attention to the expressions *to be characterized by, to be characteristic of*

E x a m p l e : What *are* solids *characterized by?* (strength and elasticity).
Solids *are characterized by* strength and elasticity.
Strength and elasticity *are characteristic of* solids,

a. What are insulators characterized by? (an extremely small value of conductivity).
b. What are conductors characterized by? (a great value of conductivity).
c. What are semiconductors characterized by? (an intermediate value of conductivity).
d. What are neutrons characterized by? (the absence of charge).
e. What are ionic crystals characterized by? (a relatively strong bond).
f. What is rubber characterized by? (high molecular weight).
g. What is modern physics characterized by? (great progress in nuclear research).
h. What is modern science characterized by? (an enormous amount of information).
i. What are accelerators characterized by? (a number of parameters).

3.2.2 Recast the following sentences making use of the expression *to be characteristic of, to be typical of.*

E x a m p l e : Water expand when freezing.
It is characteristic of water to expand when freezing.

a. Most substance expand when heated.
b. Most substance contact when cooled.
c. Solids have an ordered lattice.
d. Neutrons penetrate natter without interacting with it electrically.
e. The molecules of liquid are in a state of permanent motion.
f. Gas becomes ionized if exposed to ultraviolet light.
g. Ionic crystals have a relatively strong bond.

3.2.3 Insert the necessary preposition.

a. This substance is characterized … a number of properties.
b. The experiments presented are typical … our research.
c. It is characteristic … the present century that new discoveries are put to use very fast.
d. The resent decade is characterized … a great progress in exploration of space.
e. Such approach to the problem is typical … him.
f. It is characteristic … radio-active bodies to radiate energy spontaneously.
g. Molecular crystals are characterized … weak binding.

3.2.4 Translate into English.

a. Досліджувана речовина характеризується великою міцністю.
b. Для сучасної науки характерний великий інтерес до вивчення космосу.
c. Ця тема є типовою для його наукових досліджень.
d. Для проведених вимірювань характерна велика точність.
e. Характерною ознакою всіх провідників є висока електропровідність.
f. Дуже низька хімічна активність типова для всіх інертних газів.
g. Всім радіоактивним речовинам властива висока проникаюча здатність (penetrating power) випромінювання!

3.2.5 Translate the following sentences paying attention to different ways of expressing the idea of likeness.

a. In its construction the direct-current dynamo *is similar to* the motor.
b. Each molecule in a compound *is the same as* all the other molecules in the same compound.
c. Venus *is much like* the earth in size, mass, and distance from the sun.
d. The law discovered in a small laboratory *was identical with* that of nature.
e. These expressions *resemble* each other in form.
f. Electric currents *are analogous* in many ways *to* streams of water.
g. There is *no difference between* the data presented.

3.2.6 Translate into English.

a. Ці рівняння подібні.
b. Спостережуване нами явище аналогічно тому, про який говорив професор П.
c. Всі інертні гази мають між собою подібність.
d. Результати, отримані під час досвіду, ідентичні результатам, передвіщеним теорією.
e. У протона маса приблизно така ж, як у нейтрона.
f. Обидва прилади однакові по конструкції і відрізняються тільки деталями.
g. Викладена точка зору збігається з точкою зору наших колег.
h. Криві, отримані в ході експерименту, не відрізняються від минулих кривих.
i. Властивості синтетичного каучуку (synthetic rubber) схожі з властивостями природного каучуку.
j. Даний метод дослідження подібний методам, що застосовується в спектроскопії.

4 IBM BUILDS THE FIRST GRAPHENE INTEGRATED CIRCUIT

4.1 Read and translate the text.

Graphene, the material made of a single layer of carbon atoms, may be a step closer to reaching its potential: IBM researchers announced that they have created the first graphene integrated circuit In the seven years since its creation, graphene has been praised as the marvelous material that will make cellphones and other electronics even smaller, thinner and faster. The graphene revolution has happened in incremental steps, but this week IBM engineers announced a significant one: They published a paper in Science announcing that they have built an integrated circuit using graphene, bringing graphene-based technology closer to reality.

Graphene is a two-dimensional solid made up of a single layer of carbon atoms. Andre Geim and Konstantin Novoselov won last year’s Nobel Prize in physics for isolating it in 2004. In the seven years since, research into the practical applications of this new material has expanded explosively. People are interested in graphene not only for its small size, but also because of its ability to swiftly transfer information. The arrangement of carbon atoms in graphene causes the material to have a very high electron mobility, meaning that electrons within the material can move at very high speeds, potentially speeding up communication times.

The circuit that study co-author Yu-Ming Lin and other IBM researchers built is an integrated circuit, meaning that all the components of the circuit are concentrated into one place—just as they are on a computer chip. “If you really want to have a high-performance device like your cellphone, you need an integrated circuit,” Lin says.

Previously, circuits that had graphene components were bulky, with different elements of the circuit connected to one another via wiring. The connections between these devices often degraded the signal running through the circuit, making the circuit less effective, in addition to being relatively large. In the context of circuitry, “large” can mean a range of just centimeters. By contrast, the integrated circuit that the IBM team built is less than 1 square millimeter in size. “In a circuit, size matters,” Lin says.

IBM’s integrated circuit is designed to function as a frequency mixer. “A frequency mixer is one of the most important circuits used for wireless communications,” Lin says. Mixers are devices that take in radio frequency signals and mix them together, emitting a different frequency at the end. This conversion is an important part of any modern communications network, turning radio frequency signals into sounds and information. These mixer circuits are used in radios and phones, and were used in analog televisions before the United States switched to digital broadcasting in 2009.

“The graphene function here is a transistor that can modulate a signal,” Lin says. And the researchers’ circuit operated at 10 Ghz, a capacity greater than that of most cellphones today. The circuit also worked at very high temperatures, an important aspect in any computer system in which heat can severely limit a computer’s performance.

“This work is a milestone,” Alexander Balandin says. Balandin is the head of the Nano-Device Laboratory at University of California Riverside, and has been researching the properties of graphene for some time. But while the development of a graphene integrated circuit holds great promise for the communications industry, graphene still has a long way to go before it is usable as a component of computer systems. “At this point, graphene has this one major drawback,” Balandin says: “You cannot turn it off completely.” Turning it off is important for transmitting information digitally, in which data is sent in on-off patterns (the zeros and ones of basic computing). Without this ability, graphene’s small size and high electron mobility remain useless to researchers designing computer chips and central processing units, according to Carl Ventrice, a researcher at the College of Nanoscale Science and Engineering at the University at Albany. “The holy grail would be if you could integrate graphene into the CPU,” he says. It hasn’t been done yet, but this week graphene may be one step closer to the digital world.

Tags: IBM, graphene, computer circuits, electronics, computers

4.2 Exercises

4.2.1 Answer the following questions using *by*+Gerund.

E x a m p l e: How is the binding energy of a nucleus determined? (to measure its mass).

The binding energy of a nucleus is determined by measuring its mass.

a. How is the mass of a nucleus measured? (to place an ion of an atom in an electric and a magnetic field).
b. How are alloys usually prepared? (to melt two or more metals together).
c. How is rubber vulcanized? (to add sulphur).
d. How can solutions be formed? (to dissolve solids in liquids).
e. How can molecules of a gas be disrupted? (to subject them to X-rays).
f. How can a solid be transformed into a liquid? (to add heat).
g. How can a liquid be transformed into a gas? (to add heat).
h. How will you start your paper? (to describe the difference between these two processes).
i. How is celluloid made? (to treat cellulose with nitric acid).
j. How can charged particles be accelerated? (to use large potential differences).
k. How is oxygen prepared in the laboratory? (to heat mercuric oxide).
l. How can charged bodies be made neutral? (to connect them to the earth).

4.2.2 Change the time clause into the *in*+Gerund construction.

E x a m p l e : He made several mistakes when he was typing the paper.
He made sereval mistakes iii typing the paper.

a. Great difficulties arose when we were applying this method to practice.
b. Several factors should be considered when we evaluate the experimental results.
c. He confined himself to a few general remarks when he was discussing the new program.
d. Different methods can be used when we determine the binding energy of nuclei.
e. When we were selecting instruments, those with low sensitivity were discarded.
f. Some discrepancy was revealed when we were comparing the results of two experiments.
g. He found an error when he was making an additional check.
h. We obtained the desired information when we were analysing our data.
i. Various approaches are possible when we solve this problem.
j. Many factors become important when we consider this question.

4.2.3 Change *the if* clause into the *without* + Gerund construction.

E x a m p l e : You cannot present your paper to the conference if you do not check it carefully. You cannot present your paper to the conference without checking it carefully.

a. We cannot use the chamber for more than a few days if we do not clean it.
b. The work will not be completed if we do not sum up the results.
c. It will be hardly possible to make precise measurements if we do not change the experimental conditions.
d. We cannot obtain the desired information if we do not conduct an additional series of experiments.
e. Charged particles cannot be used for nuclear experiments if they are not accelerated.

f. We cannot make progress in our research if we do not take into account the results of other observers.
g. The project will never succeed if there is no understanding among the participants.
h. He will not be able to study this problem if he does not join the research team.
i. We shall not start the experiment if we do not get all the necessary equipment.

4.2.4 Change the time clause into the *on (upon, after)*+Gerund construction.

E x a m p l e : After we had arranged everything for the experiment we started to work.
On arranging everything for the experiment we started to work.

a. After he had passed his entrance examinations he went to study at Leningrad University.
b. After he had published his paper he received a lot of letters.
c. After he had arrived in Leningrad he received his Doctor's degree and was appointed professor of inorganic chemistry at the University.
d. After they had pursued the problem for almost ten years they collected and synthesized some data on the binding energy of nuclei.
e. After we had changeœ the experimental conditions we repeated the experiment.
f. After charged particles have been accelerated they can be used for nuclear experiments.
g. After we had tried many various samples we selected one.
h. After we had finished the experiment we left everything in proper order.
i. After he had compared some numerical data he could readily obtain new parameters.

4.2.5 Recast the sentences using *either ... or*.

E x a m p l e : I can complete this work to-day or tomorrow.
I can complete this work either to-day or tomorrow.

a. He wants to enter the University or the Politechnical Institute.
b. He will study French or English.
c. I can get this book in translation or in the original.
d. She will read her paper in March or in April.
e. We take readings every day or every two days.
f. I can use copper or silver for my experiment.
g. We observed this phenomenon m night or early in the morning.
h. There is no evidence for or against the idea.

4.2.6 Answer the questions using *neither . . . nor*. Supply additional information.

E x a m p l e s : 1) Can matter be created or destroyed?
It can neither be created nor destroyed.

In fact, its quantity in the universe is constant.
2) Are you a teacher or a doctor?
As a matter of fact I'm neither a teacher nor a doctor. I am a physicist.

a. What kind of sport do you like, skidiving or mountaineering?
b. Do you study solid state physics or plasma physics?
c. Have you received a letter or a telegram from your colleague?
d. Will the conference be held in May or in June?
e. Will you submit to the conference the full text of your paper or only the abstracts?
f. What is the working language of the conference, German or French?
g. Can energy be created or destroyed?

4.2.7 Recast the following sentences using *both ... and*.

E x a m p l e : *a* rays were deflected by a magnetic and by an electric field.
a rays were deflected both by a magnetic and electric field.

a. The theory and the results are too extensive to be given here.
b. Transistor physics and transistor electronics are based upon the properties of semiconductors.
c. This consideration is confirmed by theory and by experiment.
d. Uranium rays discharge positively and negatively electrified bodies.
e. Direct and indirect evidence shows that a rays from all radioactive substances are identical in mass.
f. The deflection of X-rays was observed in a magnetic and in an electric field.
g. The research in plasma is important for theory and for practical applications.

4.2.8 Translate into English.

a. Теорія та практика показують, що новий метод краще.
b. Як спостереження так і дані не підтверджують зроблені (вище) висновків.
c. Не турбуйся (to worry). Або керівник, або твої колеги допоможуть тобі.
d. Гіпотеза не була прийнята або спростована.
e. Цю книгу можна знайти або в бібліотеці, або в читальному залі.
f. Відхилення рентгенівських променів спостерігалося як в магнітному, так і в електричному полях.

5 LIQUID METAL BATTARIES COULD LEAD TO POWER STORAGE BREAKTHROUGH

5.1 Read and translate the text.

Scientists at MIT slice super-cooled liquid-metal batteries in half to study the way the material inside behaves. Thi battery has charged and discharged many times, but the three layers remain intact.

Plans to add renewable power sources to the electric grid have a common problem: weak, expensive and small batteries that can't guarantee there will be juice when the wind isn't blowing or the sun isn't shining. Donald Sadoway, professor of materials chemistry at Massachusetts Institute of Technology, thinks the solution lies in novel batteries that use liquid metals. The battery designed by Sadoway and his team works on the same principle as any other: Two electrodes exchange electrons through an electrolyte to complete a circuit. But by using liquid metals for electrodes and molten salt as an electrolyte, their battery can absorb electrical currents that are 10 times higher than present-day high-end batteries. Only the different densities of the liquids keep them separated inside the battery, which means it would be a poor choice for most mobile applications--but smart for a fixed location, such as an electrical installation. Sadoway's team first made shot-glass-size prototypes to experiment with costly ingredients such as pure magnesium and pure antimony, but is now seeking the right mix of alloys for optimal performance and cheap manufacture. The Department of Energy's idea factory, the Advanced Research Projects Agency--Energy (ARPA-E), is putting $6.9 million behind Sadoway's project. His award is one of the biggest of the agency's first round of funding, released in late 2009. The batteries need external heaters to keep their innards molten at operating temperature. "One of the goals of the ARPA-E-funded project is to determine the smallest size of cell that would not need booster heaters," Sadoway says.

5.2 Exercises

5.2.1 Combine two sentences into one without a conjunction Observe the definite article before the nouns modified by a subordinate clause. Observe also the place of a preposition (B).

A

E x a m p l e : You want to read a book. It is to be found in the Public Library.
The book you want to read is to be found in the Public Library.

a. He reported his data at the conference. They were of great interest.
b. I have bought a book. It has proved very useful.

c. We have used a new method. It will save a lot of work.
d. He has observed a phenomenon. It is quite different from those known before.
e. You are offering an explanation. It can’t be accepted.
f. We have obtained some data. They will be published.
g. Mendeleev developed the Periodic Law of Elements. It became the foundation of modern chemistry.

B

E x a m p l e : I listened to a paper. It was interesting.
The paper I listened to was interesting.

h. He is looking at the watch. It is wrong.
i. I am speaking to a man. He is my adviser.
j. He spoke about an equation. It should be checked.
k. We are now working at a problem. It is very important.
l. She told me about the conference. It will be held in summer.
m. I am looking for a book on theoretical physics. It was published in the late sixties.
n. We have heard of the discovery. It is of great significance.
o. We started from a series of experiments. It gave us the clue to the solution of the problem.
p. He referred to a paper. It was published in Physical Review.
q. You ask me for a book. It contains much information.

5.2.2 Answer the questions as in the example.

E x a m p l e : Are you familiar with these data? (to refer to).
These are the very data I was referring to (These are the data I was just referring to).

a. Do you know that man? (to talk about).
b. Will you go to the concert? (to look forward to).
c. Have you read this paper? (to be going to look through).
d. Did you agree with these terms? (to insist upon).
e. Would you like to have this book? (to look for).
f. Have you any idea of this problem? (to deal with at present).
g. Do you agree with his conclusions? (to object to in my paper).

5.2.3 Translate into English. Observe the absence of a conjunction and the place of a preposition.

a. Проблема, яку нам належить обговорити, досить складна.
b. Доповідь, яку вона згадала, була зроблена в минулому році на міжнародній конференції присвяченій плазмі.
c. Дані, які ми отримали, будуть надруковані.

d. Теорія, яку він запропонував, представляє великий інтерес.
e. Експерименти, про які я хочу розповісти, були проведені в нашій лабораторії.
f. Книга, на яку ви вказали, є в нашій бібліотеці.
g. Спостереження, про які говорив професор П., опинилися дуже цікавими. Точка зору, на якій наполягає (to insist on) мій колега, досить сумнівна

5.2.4 Translate into Ukrainian paying attention to the prefix m*is*-.

to misunderstand	to misprint
to misinterpret	to misinform
to mislead, misleading	to misuse
to mispronounce	to misrepresent
to misspell	

5.2.5 Recast the sentences using the verbs with the prefix mis-.

E x a m p 1 e: You do not understand this problem in a proper way.
You misunderstand this problem.

a. He has not understood me in the right way.
b. You do not interpret these equations correctly.
c. I am sure you have not been informed properly.
d. These results are not leading to proper conclusions.
e. I spelled his name in the wrong way.
f. You printed this word incorrectly.
g. The student did not pronounce the word correctly.
h. He doesn’t use the term in the right way.
i. The speaker didn’t represent the situation in transistor physics properly.

5.2.6 Translate into Ukrainian paying attention to different ways of expressing the idea of consistency.

a. The evidence reported entirely *agrees with* the hypothesis.
b. Whatever we are allowed to imagine in science *must* the *consistent with* everything else we know.
c. The results presented appear *to be in agreement with* the previous observations.
d. Maxwell’s equations *are valid for* superconductors.
e. This relationship *holds for* most chemical reactions.
f. Let us see how certain static phenomena *fit into* the theory.
g. This interpretation *is in line with* our present knowledge.
h. The conclusion made *is in keeping with* the above statement.

6 ADDITIONAL TEXTS FOR READING

6.1 Lithium is lionized.

Silicon has a whole valley named after it. But what about the silent heroes of modern technology? Rare earth elements—a set of 17 related metals, mostly shunted off to a tacked-on lower line of the periodic table—are crucial to the way we live now; responsible for miniaturizing computers powering hybrid cars and more. Increasingly important to technology, they're also playing a larger role in geopolitical maneuvering. Today, more than 95 percent of all rare earth elements come from China, while the United States produces at most 2 percent. That disparity makes some experts twitch. After all, what happens when Chinese industry needs so much of the rare earth elements mined in that country that there's nothing left to export?

With a bill before Congress aimed at restarting America's rare earth industry, and the Defense Department planning to add rare earths to its strategic stockpiles, these too often overlooked elements won't stay in the background much longer. The time has come to get better acquainted with the molecules that make our modern world run.

6.2 Lanthanum: Driving Excitement

"Rare earth elements are neither rare, nor earth," says Stephen Castor, recently retired research geologist with the Nevada Bureau of Mines and Geology. The name dates to the 18th and 19th centuries, when the elements were first isolated out of actually rare minerals. "Rare earth" stuck, but the elements themselves turned out to be pretty common, mixed in small concentrations into rock the world over. Lanthanum, first discovered in 1893, is a great example of this. There's more lanthanum on this planet than silver or lead and it's the second most abundant rare earth element, but there weren't a lot of uses for it in the early days. When Castor worked with mining companies in the late 1970s and early '80s, lanthanum mostly went into stockpile, waiting for the day when it could be sold off for higher prices. That day has come.

Today, every Prius hybrid car on the road carries with it about 10 pounds of lanthanum. And yet, most Prius owners don't even know they use this rare earth element every day. That's because the car's battery is referred to as "nickel-metal hydride." The "metal" in question is lanthanum, but what can we say, rare earth elements get no respect. A big breakthrough in battery technology, nickel-lanthanum hydride batteries pack more power into a smaller space—they're about twice as efficient as the standard lead-acid car battery.

"Toyota is the biggest car company in the world and the Prius is 8 percent of their manufacturing," Jack Lifton, an independent consultant and expert on rare earth elements, says. "Add to that other hybrid cars and the batteries used in small mopeds in

China, and there's not enough lanthanum on the market today. Toyota is the first and only car company to invest in a rare earth mine."

6.3 Europium: Savior of the TV Generation

Sir William Crookes, a 19th century British chemist, once wrote that, "rare earth elements perplex us in our researches, baffle us in our speculations and haunt us in our very dreams." These weren't easy elements to isolate or to understand, and so there was a very long lag time between the discovery of the rare earths, and the discovery of practical uses for them.

It didn't help that individual rare earth elements don't occur by their lonesome—they travel in packs. To get one, you have to mine all of them. At first, industry didn't even bother to separate out individual rare earths, instead using them in a blended alloy called mischmetal. This provided the first commercial applications, says Karl Gschneidner, senior metallurgist at the Department of Energy's Ames Laboratory. In 1891, mischmetal became an ingredient in lamp mantles—devices that were hung above open flames, where they burned and produced a bright, white light you could see and work by.

Europium was the first isolated, high purity rare earth element to enter the public marketplace, in 1967, as a source of the color red in TV sets. There had been color TV before europium, but the color quality was weak. The sets relied on phosphors—substances that glow when struck with struck with electrons or other energized particles—to get their red, green and blue colors, and the early red phosphors couldn't produce a very bright color. Europium phosphors made the picture pop.

At the time, rare earth mining wasn't even a twinkle in China's eye. Up until the 1990s, most rare earth elements came from the United States, especially Mountain Pass, a mine in California near Los Angeles, which supplied most of the late 1960s europium demand. By 2003, Mountain Pass had closed and no rare earths were coming out of the United States at all. The problem, though, isn't supply. The U.S. still has plenty of rare earth elements left to mine—in Mountain Pass and elsewhere. Instead, those mines were simply driven out of business, undercut on price by Chinese companies that had lower labor costs, and also benefited from the fact that they were mining rare earth elements as a byproduct of profitable iron mining.

Today, europium is still used as a phosphor, but as cathode ray tube TVs go the way of the dodo, it's more likely to turn up in white LED-based lights, which could someday be an energy efficient replacement for both incandescent and compact fluorescent bulbs. With this technology, white light is produced by mixing various colored LEDs and europium red happens to be an ingredient in turning out a high-quality, attractive shade of white.

6.4 Erbium: In the Pink

The applications of erbium are both deeply important, and a little silly. For instance, adding erbium to glass is about the only way to create a stable pink shade. So erbium-doped glass pops up in novelty sunglasses and decorator vases. At the same time erbium keeps information flowing around the globe. Add a little erbium to the optical fibers that carry data in the form of light pulses, and those pulses get amplified. It can also be used as part of the gain medium that amplifies light in a laser. When you do this, you end up with a laser that can be used for dental surgery and skin treatments because it doesn't build up much heat in the human skin it's pointed at.

Erbium is a great example of how rare earth elements work in practical applications. You won't find very many places where a solid chunk of a single rare earth element is being used. Instead, they tend to be things that are added, in small doses, to composites and alloys. In that way, rare earth elements work a bit like vitamins, says Daniel Cordier, mineral commodity specialist with the United States Geological Survey. "Rare earths have really unique chemical and physical properties that allow them to interact with other elements and get results that neither element could get on its own," he says.

6.5 Neodymium: Little Giant

Once upon a time, there was no such thing as a convenient way to carry your favorite tunes along on a jog. Rare earth elements changed all that. The key is magnets. Those things are everywhere, from hard drives to headphones to anything that incorporates a small electric motor—basically, if there's a component that needs to spin, magnets are probably involved. Producing a strong magnetic field used to require a big, heavy magnet and, thus, led to big, heavy pieces of technology.

Then, in the late '70s, Sony introduced the Walkman, a (relatively) small, (relatively) portable music player. Why were they able to shrink the form factor? Magnets. Specifically, magnets made from the rare earth element samarium, which were smaller and stronger than anything then available. Today, the samarium-based magnets have largely been replaced by magnets made with neodymium, which are even smaller and even stronger. We have these magnets to thank for the miniaturization of gadgetry. But they're also responsible for making necessarily chunky tech lighter and cheaper—like the turbines that turn wind into electricity, and the drills that search for oil deep below the surface of the Earth.

6.6 6.6 Nuclear Physicist: This Is My Job

James Dunlop is a collision connoisseur, smashing together gold nuclei at nearly the speed of light to simulate the Big Bang. Not a bad way to make a living.

James Dunlop re-creates the big bang. At Brookhaven National Laboratory, he uses the electric fields of a particle accelerator to speed up gold nuclei racing around a 2.4-mile-long track. When the nuclei, guided by the accelerator's powerful magnets, reach 99.9995 percent of the speed of light, Dunlop makes them collide. Each 4 trillion degree Celsius crash shatters the gold particles into quarks and gluons, the tiniest building blocks of a proton. The accelerator's STAR detector photographs the atomic bits and pieces, allowing him to study matter at its most fundamental level. It's not just a desk job, either. "There's also a component when you're going out to the detector with a soldering iron or a roll of duct tape," Dunlop says. "You've just got to make it work."

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