English for students of Physics – Vol 2

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NXB Đại học quốc gia Hà Nội 2007.

Từ khoá: English for students of Physic, Science, Grammar in use, English – Vietnamese translation, Practice, Relative clauses, Noun clauses, Motion, Making macroscopic models, The infinitive, The gerund, Earth's magnetic field, Noun clause, Phase of matter.

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Unit Six

MOTION

READING PASSAGE

Motion, speed, and velocity

Besides the blowing dust and the heavenly bodies, little else moves on the Martian landscape. This lack of movement might seem to be strangest of all, for we humans are used to motion. Almost from birth, infants follow motion with their eyes, and from then on we are continually aware of things moving about, starting, stopping, turning, bouncing. On earth we see liquids flowing, people moving, and the wind stirring the leaves of trees. Although we can not see them, we know that the very atoms and molecules of matter are continuously in motion. Even mosses and lichens that spend their lives fastened to rocks depend on the movements of gases and liquids to bring them the chemicals essential to life and to carry others away. We take part in motion in our daily lives. We describe and compare this motion in terms of speed, acceleration, and direction. The following will discuss the first two matters.

If we just say something moves, someone else will not really know "what's happening". It is one thing to recognize motion but another to describe it. To describe motion accurately, we use rates. A rate tells how fast something happens, or how much something changes in a certain amount of time. An example of rate is a distance divided by a time. Suppose a girl runs a course that is 3 miles long. She might sprint at the beginning but tire and slow down along the way, or even stop to tighten a shoelace, so she won't travel at the same rate for the entire 3 miles. But if she finishes in, say, 30 minutes, then 3 miles/30 minutes = 0.10 miles/minute is the average rate of travel during that time, or her average speed (average speed = total distance covered/time used). The average speed tells little of what happened during her run, however. If we are curious about her speed at one certain time or at a point along the way, we want to know her instantaneous speed, that is, how fast she was moving at one instant (instantaneous speed = the rate at which something is traveling at a specific time). If you say, 'At twelve noon my car was moving at 35 mph', then you have specified an instantaneous speed.

If you ease a car away from its parking place and steady speed, and the road is straight and smooth, the ride is very comfortable. As a passenger, you could read a book or pour a cup of tea and drink it; if you were in a van or large motor home, you could even play a game of darts. But it is not easy to keep a car's speed steady. Even when the road is straight and without any bumps or dips, traffic and the inevitable stop signs and traffic signals make us change speeds. A book you are holding leans forwards if the car slows down and then backward if it speeds up. If there is a cup of tea aboard, it sloshes about. Any deviations from a constant speed affect our bodies, too; we shift backward or forward in our car seats, so we feel these changes in speed. If the speed changes slowly, we hardly notice it, but any quick change in speed is obvious. It is how fast speed changes that matters to us, and that's another rate – the rate of change of speed. We call this rate acceleration (acceleration – along a straight line = change in speed/time required for that change). Just as for speed, this is the average acceleration over a period of time. The instantaneous acceleration tells how fast the speed is changing at any point in time. The word acceleration often brings to the mind an increase in speed. But acceleration is a change in speed over time, so when anything slows down it is also accelerating. To distinguish slowing down from speeding up, we can use the word deceleration. This means deceleration refers to the negative value of acceleration.

(*Adapted from* **Physics, an Introduction** by Jay Bolemon, 1989)

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading passage*

1. Define speed, average speed and instantaneous speed in your own words.

   ……………………………………………………………………………………
   ……………………………………………………………………………

2. State the instantaneous speed of a car.

   ……………………………………………………………………………………
   ……………………………………………………………………………

3. Define acceleration, average acceleration and instantaneous acceleration in your own words.

   ……………………………………………………………………………………
   ……………………………………………………………………………

4. Can human beings sense any changes in speed?

   ……………………………………………………………………………………
   ……………………………………………………………………………

5. What are the measurements of speed and acceleration?

   ……………………………………………………………………………………
   ……………………………………………………………………………

Exercise 2: *Decide whether each of the following statements is 'true' 'false' or 'don't know'. Refer to the reading passage for comprehension. Write (T); (F) or (N)*

1. …………..Anything on earth is in motion.
2. …………..Infants are only aware of motion visually.
3. …………..Any motion can be detected with human senses.
4. …………..Mosses and lichens' lives depend on the chemicals from gases and liquids in the environment.
5. …………..We can describe the motion of two objects in terms of either speed, acceleration or direction.

6. …………..To describe speed at a certain time, we resort to the term instantaneous speed.
7. …………..To keep a car at steady speed is an easy job.
8. …………..Any object has its own acceleration.
9. …………..How fast speed changes deserves our consideration.
10. …………..Deceleration is opposite to acceleration in any aspects.

Exercise 3: *Choose the correct answer*

1. On the Martian landscape, there are
   a. many objects moving.
   b. only dust and heavenly bodies moving.
   c. a few matters in motion.
2. We started to learn of motion when
   a. we are at birth
   b. we were very small
   c. we started to learn physics
3. To describe motion, we use
   a. more than one rate at the same time
   b. a rate
   c. at least three rates
4. When a girl is running, she is supposed to have
   a. one type of speed
   b. more than one types of speed at the same time
   c. average speed and instantaneous speed only
5. When in a moving car,
   a. you can feel any change happening
   b. your body is not affected at all
   c. you can notice the quick change only.

GRAMMAR IN USE:

Noun clauses (1; 2)

A noun clause is the one which can function as a noun or noun phrase in a complex sentence and which begins with conjunction *that* (1), an interrogative word (2) or conjunctionts *if/whether* (3).

Example:

1. We know that the very atoms and molecules of matter are continuously in motion.
2. A rate tells how fast something happens, or how much something changes in a certain amount of time.
3. On a straight and smooth road, we can not feel whether there is any change in your car's speed.

1. That - clause

A that-clause is the one that starts with 'that'. This clause can function in the sentence as follows:

Subject: That all matters are made up of molecules, atoms and other micro bodies has been proven by scientists.

Direct object: We all know that every body is always in motion.

Subject complement: The assumption is that every body continues in its state of rest, or of uniform motion in a right (straight) line (unless compelled to change the state by force impressed upon it) (Newton's First Law).

Appositive: Galileo's assumption, that free-falling objects have the same value of acceleration, was proven by himself with worldwide famous experiment at leaning Pisa Tower.

Adjectival complement: We all know for sure that if we toss our key rings to the air, it will fall back to the ground.

Note: In informal use, 'that' is frequently omitted if that-clause functions as the object or the complement. Thus, we may have:

I'm sure you can learn about motion easily.

or:

You know we can draw the conclusion only when the experiment has been successfully conducted.

Instead of:

I'm sure that you can learn motion easily.

or:

You know that we can draw the conclusion only when the experiment has been successfully conducted.

2. Wh-interrogative clause

Wh-interrogative clause occurs in the whole range of functions available to that-clause, and in addition can act as prepositional complement:

Subject: What Galileo really discovered about motion was clarified by Isaac Newton with his Laws of Motion.

Direct object: Newton's Second Law states how net force changes something's velocity.

Subject complement: Matter's resistance to a change in velocity is what we call inertia.

Appositive: Our plan, when the experiment is conducted, has not been approved yet.

Adjective complement: I'm not certain how the bonding force and the contact force work to hold you up when you stand on firm ground.

Prepositional complement: Frictional force between two solids also depends on how hard the two surfaces press together.

Note:

1. As regards meaning, these clauses resemble wh-questions in that they leave a gap of unknown in information, represented by the wh-element.
2. As for grammar, there is a similarity to wh-questions in that the wh-element is placed first' indeed, apart from the absence of subject-operator inversion in the dependent clause, the structures of the two types of clauses are in all respects parallel. We have, in the wh-interrogative clause, the same choice between initial and final preposition where the prepositional complement is the wh-element.

Examples:

We can not decide **on** which design we should work first. (formal)

or: We can not decide which matter we should work **on** first.

An infinitive wh-clause can be formed with all wh-words except **why.**

Example: The lecturer explained to us how to attack the problem.

1. *Some common adjectives followed by a noun clause:*

afraid	certain	eager	proud
amused	confident	glad	sorry
annoyed	conscious	happy	sure
anxious	convinced	horrified	surprised
aware	delighted	determined	willing

2. *Some common nouns followed by a noun clause*

(the) fact	(the) idea	(the) news	rumor(u)r
pity	wonder	a good thing	miracle

3. *Some common verbs followed by a noun clause*

acknowledge	demonstrate	learn	resolve
admit	determine	make out (=state)	reveal (wh)
advise	discover	mean	say (wh)
agree	doubt	notice (wh)	see (wh)
allege	estimate (wh)	observe	seem
announce	expect	occur to + object	show (wh)
appear	fear	order	state (wh)
arrange (wh)	feel	perceive	stipulate
ask (wh)	find (wh)	presume	suggest (wh)
assume	forget (wh)	pretend	suppose
assure	guarantee	promise	teach
beg	happen	propose	tell (wh)
believe (wh)	hear (wh)	prove (wh)	threaten
command	hope	prove	think (wh)
confess	imagine (wh)	realize (wh)	turn out
consider	imply	recognize	understand(wh)
declare	indicate (wh)	recommend	urge
decide (wh)	inform	emark	vow
demand	insist	remember (wh)	warn
request	know(wh)	remind	wish
			wonder (wh)

Note: Verbs with (wh) are those which can be followed by either a that-clause or wh-interrogative clause.

PRACTICE

Combine each pair of sentences bellow into one sentence using the words given in brackets.

1. Motion is subject to three laws. Newton himself showed this. (that)

   …………………………………………………………………………………
2. "Why does a moving body come to a stop?". We should take up this question. (of)

   …………………………………………………………………………………
3. "What can absolute judgments be made about the nature of motion?". We must figure out this matter. (what)

   …………………………………………………………………………………
4. "How does a net force change something's velocity?" Newton's second law states this. (the fact)

   …………………………………………………………………………………
5. Motions in perpendicular directions are independent of one another. This has been concluded from experiments conducted. (It………that)

…………………………………………………………………………………………

6. "What does tension mean in a technical sense?". Do you know the answer? (what/?)

   …………………………………………………………………………………………

7. "In which cases does a ball come to a stop quickly and in which cases slowly?" We should consider this. (In which cases)

   …………………………………………………………………………………………

8. The smoother the surface on which a body is moving, the father it would roll. We know this perfectly well from our experiences. (that)

   …………………………………………………………………………………………

9. The word *centripetal* is an adjective used effectively in the case of circular motion. It is important to note this. (that)

   …………………………………………………………………………………………

10. "Where does the term inertial come from?". We shall see a bit later. (where)

    …………………………………………………………………………………………

11. The earth does not differ greatly from an inertial frame. The fact is especially important. (the fact that)

    …………………………………………………………………………………………

12. How can we present the velocity of an object at various points around its orbit in circular motion? The figure will show you. (how to)

    …………………………………………………………………………………………

13. A force was needed to keep a body moving at a constant velocity. This idea is very important. (the idea that)

    …………………………………………………………………………………………

14. Earth's gravity affects things near the surface of our planet. Galileo Galilei (1564-1642) was the first to understand this. (how)

    …………………………………………………………………………………………

15. The force causes motion and there is no motion if there is no force applied. This conclusion made by Aristotle was incomplete. (the conclusion that)

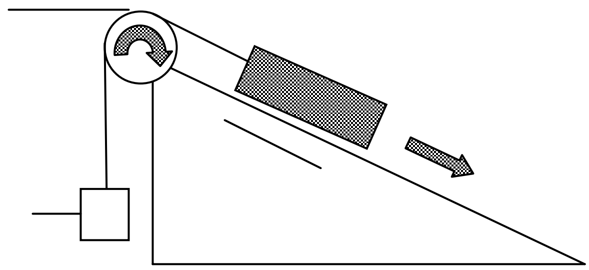
    …………………………………………………………………………………………

PROBLEMS SOLVING

Describing movements and actions

Task one: *Look at the diagram and the description:*

The block rests on a slope. A string is attached to one end of the block and passes over a pulley at the top of the slope. A weight W is suspended from the end of the string.



Label the diagram

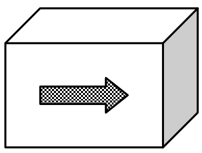
A. *Write out the description, filling in the missing words:*
   a. The block……………………the string.
   b. The string……………………the pulley.
   c. The string…………………….the weight.

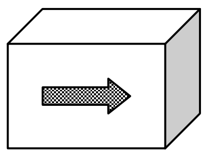
B. *You can develop the above sentences into a short descriptive paragraph. Fill in the blank with suitable words, you'll have the paragraph:*

When the block…………down the slope, it……………the string and……………. the weight. At the same time, the pulley……………..in a clockwise direction.

Task two: *Describe the following actions*

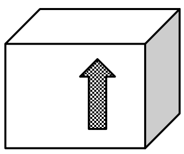
A

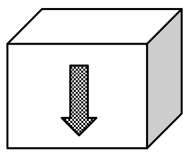




Example: 1. A pulls the block.

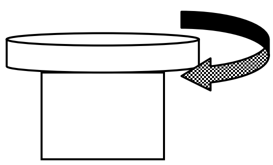
2……………………….............

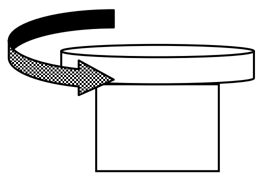




3………………………..............

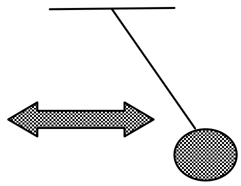
4………………………..............



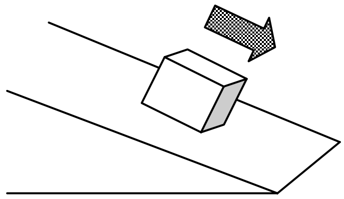


5……………………….................

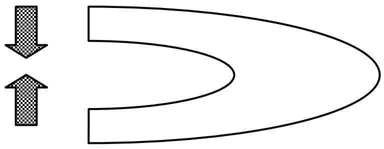
6……………………………......



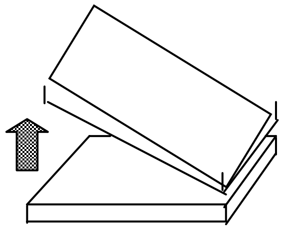
7……………………………...



8 ………………………………...



9……………………………..



10………………………………

TRANSLATION

Task one: *English-Vietnamese translation*

1. In the case of an object moving at steady speed in a circle, we have a body whose velocity is not constant; therefore, there must be a resultant or unbalanced force acting on it.
2. The Earth as it orbits the Sun has a constantly changing velocity. Newton's first law says that there must be an unbalanced force acting on it. That force is the gravitational pull of the sun. If the force disappears, we would travel off in a straight line towards some terrible fate beyond the Solar System.
3. It is important to note that the word *centripetal* is an adjective. We use it to describe a force making something travel along a circular path. It does not tell us what causes this force.
4. Remembering that an object accelerates in the direction of the resultant force on it, it follows that both **F** and **a** are in the same direction, towards the center of the circle.
5. "The horizontal motion and the vertical motion are independent of each other; that is, neither motion affects the other." This feature allows us to break up a problem involving two-dimensional motion into separate and easier one dimensional problems, one for the horizontal motion and the other for the vertical motion.
6. Young children take it for granted that things fall. They are mystified if you ask them to explain it. They also take it for granted that things stay where they are on the ground; they don't think it necessary to talk about two balanced forces. Surely gravity disappears as soon as something stops falling?

Task two: *Vietnamese - English translation*

1. Nguyên nhân làm xuất hiện gia tốc của một vật là tác dụng của các vật khác lên nó, đại lượng vật lý đặc trưng cho loại tác dụng này là lực.
2. Trạng thái đứng yên và trạng thái chuyển động thẳng đều giống nhau ở chỗ là không có gia tốc. Nguyên nhân gây ra các trạng thái đó cũng giống nhau. Điều đó chứng tỏ trạng thái đứng yên chỉ là trường hợp đặc biệt của chuyển động thẳng đều khi vận tốc bằng không.
3. Nguyên nhân nào làm cho các vật tiếp tục chuyển động thẳng đều khi lực tác động vào vật mất đi? Định luật I Niutơn khẳng định rằng nguyên nhân ấy là ở một tính chất của bản thân vật, tính chất đó gọi là *quán tính*.
4. Vectơ vận tốc của vật chuyển động tròn đều có độ lớn không đổi nhưng có phương luôn luôn biến đổi. Đường đi của vật chuyển động tròn đều là một cung tròn có độ dài được tính theo công thức: s=vt
5. Tác dụng giữa hai vật bất kỳ bao giờ cũng có tính chất tương hỗ (tương tác), nghĩa là có tính chất hai chiều. Nếu vật A tác dụng lên vật B thì vật B cũng tác dụng trở lại vật A.

Before you do the translation, make sure that you have analyzed each of the sentences carefully in any grammatical aspects of concern: e.g. what is the subject/ object/ complement/ adverbial(s)/verb(s) and verb tense and any type of clause present in the sentence, etc.

Try your best to find the Vietnamese/English equivalents for the key words and phrases in the sentence.

Then, you refine your translated version to make it sound really comprehensible Vietnamese/English.

KEY TERMS

Acceleration (n) : 1. the rate of change of the speed for a moving body that moves along a straight line. *Gia tốc*

2. a vector that indicates the rate of change of speed and/or direction of a moving object. *Véc tơ gia tốc*

Average speed (n): the distance an object moves in a specific amount of time divided by that time. *Tốc độ trung bình*

Bonding force (n): an attractive force between atoms or molecules, strongest in solids, less in liquids. *Lực liên kết*

Circular motion (n): the motion in which a body moves around a circle. *Chuyển động tròn*

Component vector (n): a vector that is part of vectors adding to give a single resultant (or net) vector. *Véc tơ thành phần*

Constant (adj): unchanged**.** *Có tính không đổi*

(n): *Hằng số*

Contact force (n): the force of repulsion that occurs when molecules or atoms of matter are pressed together. The contact force is always perpendicular to the surface. *Lực tiếp xúc*

Deceleration (n): a negative value for the acceleration, meaning the object's speed is decreasing. *Sự giảm tốc; sự hãm; gia tốc âm***.**

Force (n): a push or pull on an object. *Lực*

G (n): the symbol for the value of the acceleration of gravity at earth's surface, with is about 32 feet per second or 9.8 meters per second. *Ký hiệu gia tốc trọng trường*

Inertia (n): the resistance of matter to any change in its velocity. *Quán tính*

Inertial mass (n): the ratio of force to acceleration when a net force acts on a body. *Khối lượng quán tính; khối lượng ì*

Instantaneous speed (n): the rate of travel that matter has at a particular instant in time (or at particular point in space). *Tốc độ tức thời*

Net force (n): the resultant force when more than one force acts on an object; the total force that causes acceleration. *Hợp lực; tổng hợp lực*

Net or resultant vector (n): the single vector that by itself describes the addition of two or more vectors. *Véc tơ tổng*

Relative speed (n): the speed of an object with respect to something else. *Tốc độ tương đối*

Straight-line motion (n): the motion in which an object moves along a straight line. *Chuyển động thẳng*

Take it for granted (vp): believe that something is true without thinking about it very much or looking for proof. *Coi hiển nhiên đúng*

Terminal speed (n): the limit to a falling object's speed when air resistance on the object equals its weight. *Tốc độ cuối*

Vector (n): an arrow used to represent a quantity that has both magnitude and direction. *Véc tơ.*

Velocity (n): a vector that indicates the speed of a moving object together with its direction of motion. *Vận tốc; Véc tơ vận tốc*

Weight (n): the force of the Earth's gravitational attraction for an object. *Trọng lượng*

Weightlessness (n): the condition whereby an object has no apparent weight relative to any other object. *Không trọng lượng*

FREE - READING PASSAGE

It is advisable that you read the following passage to see how the noun-clause works effectively in an authentic writing. You can do translation practice as well.

When you reach for a glass of water and bring it to your lips, you know what to expect. The glass is at rest, and you accelerate it with your hand-not too fast or you'll spill the water-and you bring it to a halt so you can drink from it. You also know what would happen if it slipped from your grip. More than likely, you would move your feet to avoid the falling glass. Because almost everything you do requires moving something about, whether you're turning a page or merely taking a breath, you know all this a head of time. That is, you have a feeling that is based on experience for how things move.

The Greek philosopher Aristotle took this kind of intuition very seriously. He wrote about motion around 350B.C. Aristotle knew that if he pushed a plate across a table and then took away his hand, the motion of the plate would stop. To describe this, he wrote: "All that is moved is moved by something else". He reasoned that when the push from the "something else" stopped, so did the motion; from this he decided that rest must be the nature of any matter.

But this explanation didn't explain how a spear continues in flight once it leaves the hand, or why an arrow keeps going once it leaves the bow. So Aristotle decided that the front surface of any object moving through the air must compress the air at that surface and cause the air in the space directly behind the object to be rarefied, or thin. He argued that the air from the front must rush to the rear to fill the partial vacuum, and that as the air filled in this space it pushed the projectile along. To explain why an arrow in flight eventually slows, he said the transfer of air was never complete. This false premise led to another wrong deduction, namely, that motion must be impossible in the absence of air.

Aristotle deduced his "laws" just from watching things move. Many of the early Greek philosophers like Aristotle who wrote about motion believed that intense mental concentration and pure thought would solve the riddles of nature and that philosophers should never have to perform experiments to gain understanding. Aristotle said, for example, that heavier bodies always fall faster toward the Earth than do lighter bodies. (Some do, of course, because of the effect of air resistance). And since heavier bodies make no more noise and larger dents when they strike the ground, which was easy to believe. Furthermore, it is harder to lift a heavier body, so it's certainly attracted more strongly towards the ground.

Aristotle's unproved ideas were still taught when the Italian scholar Galileo Galilei (1564-1642) lived and worked. Then Galileo introduced the experimental procedures- *careful observation by measurements* – that made physics a science of accurate predictions. Galileo deduced that all falling objects would move with a uniform acceleration if air were absent. He deduced that force is not necessary to keep things moving, that instead forces of friction bring moving things to a halt. But Galileo fully realized that he had begun to understand motion. He wrote that he "had opened up to this vast and most excellent science of which my work is merely a beginning, ways and means by which other minds more acute than mine will explore its remote corners". Isaac Newton made the next steps and his contributions to physics are so immense that they may be unmatched in greatness in the whole history of science.

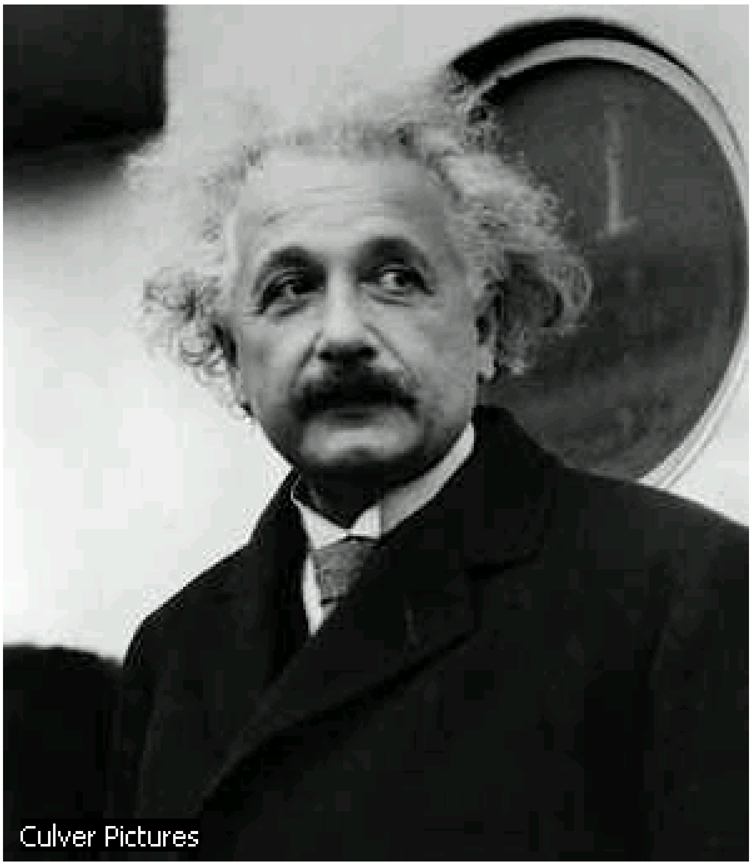
Isaac Newton was born in Christmas Day, 1642, in a stone farmhouse in Lincolnshire, England. He was a premature baby, so tiny that his mother said she could have put him in a beer mug. But as a schoolboy he was healthy and very creative in making things, such as water clocks, sundials, and even a wheelchair. He boldly carved his name in his desk at school, and one of his notebooks, still preserved, has and article he copied – it tells how to get birds drunk! One of his projects, a kite carrying a homemade paper lantern, startled the local populace one night… This dimly lit spectacle hovering in the dark sky very likely summoned rumors of witches and comets rather than UFOs. Although Newton's father had been a farmer, as had his father before him, the local schoolmaster persuaded Newton's mother to let her 18-year-old son enroll at Trinity College in Cambridge.

Newton came along with an exciting time. Seventy years before, the philosopher – writer Giordano Bruno had visited England and had written that lectures at the universities were fine if they were critical of Aristotle's ideas. Indeed, only 20 years before Newton's arrival at Cambridge, Galileo had died under house arrest in Italy for writing that the planets revolve around the sun. Besides his experiments in physics, Galileo built a telescope and turn it skyward. He discovered four large moons orbiting Jupiter, and he saw that Venus was illuminated by the sun, because it showed "phase" like the moon. Galileo's astronomical discoveries were there for anyone to see through a telescope, and his experiments on motion could be checked anywhere. Progressive scholars formed groups such as the Royal Society of London for Improving Natural Knowledge (today, it is known as the Royal Society). But Newton, who was poor, worked part-time jobs and graduated without distinction in 1665.

The summer of college closed, for the plague was raging nearby London, killing over 10 percent of the city's people within three months. Newton returned to his family home and in the peace and quit of the country side devoted to mathematics and "natural philosophy" as physics was called in those days. During 18 months of intense, uninterrupted study, he accomplished wonders. He discovered *how to predict motion*, he began his investigations of gravity and the colors of light, and he invented the methods of calculus. But Newton, being somewhat introverted, kept to himself and did not publish much of this work for some 20 years.

His study led him to the laws of motion, extending, and in a sense completing, the work begun by Galileo. These three laws together tell us how thing move, and today they are known as Newton's laws

(*Adapted from* **Physics, an Introduction** by Jay Bolemon, 1989)



Albert Einstein

In 1905 German-born American physicist Albert Einstein published his first paper outlining the theory of relativity. It was ignored by most of the scientific community. In 1916 he published his second major paper on relativity, which altered mankind's fundamental concepts of space and time.

Unit Seven

GRAVITATION

READING PASSAGE

There is no gravitational *pull* . . . only a *push*!

This hypothesis provides a general model for the mechanics of gravitation. It in no way refutes the observed behavior of gravitation, but merely seeks to explain it. I have based all but a single aspect of this model on established scientific knowledge, and that single aspect is my prediction of ***an unknown***. (So it remains to be proved or disproved.)

The team of medieval physicists stepped out of the time machine and began to examine the strange, new device fastened to the window. They had never before seen a suction cup, so with great enthusiasm, they began to experiment by pulling this mysterious device off the window, then reattaching it. "The glass must attract the device" remarked one of them. They all nodded in agreement.

Next, they found a smaller piece of glass and discovered that the suction cup had the gripping power to suspend it. This new revelation prompted another physicist to remark, "The device must also attract the glass!" Having no real reason to seek a better explanation than this for their observations, the team of medieval physicists unanimously concurred, and a new theory was born: "The device and the glass are attracted one to another, this being a characteristic of space!"

My comparison to medieval science is not an insult to physicists. I merely wish to emphasize mankind's present level of ignorance of the mechanics of our universe. We now know that the suction cup in this example is held to the glass by air pressure. The invisible molecules that make up air constantly bombard the surfaces of the glass and the suction cup. The difference in pressure cause, what appears to be, an attraction. My gravitational hypothesis is somewhat similar. All I ask of you, the reader, is to keep an open, yet discerning mind.

(*From* **http://physicsweb.org**)

EADING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading passage*

1. What does the writer mean by *'this hypothesis'*?

………………………………………………………………………………………………
……………………………………………………………………………………

2. How does the hypothesis work?

   ………………………………………………………………………………………………
   ……………………………………………………………………………………

3. What did the medieval physicists do with the suction cup when they first saw it?

   ………………………………………………………………………………………………
   ……………………………………………………………………………………

4. What did they think happenedto the suction cup?

   ………………………………………………………………………………………………
   ……………………………………………………………………………………

5. What really happens in the case?

   ………………………………………………………………………………………………
   ……………………………………………………………………………………

Exercise 2: *Decide whether the writer would agree to each of the following statements. Write (Y) for the agreed ones, (N) for the disagreed ones and (Mb) for the ones which the writer may or may not agree to.*

1. …………The hypothesis gives a thorough explanation for the phenomenon of gravitation.
2. …………The writer did rely on all the existing knowledge of gravitation to explain the model of experiment.
3. …………The writer has recognized something else about the model.
4. …………The medieval physicists had never known of the force of attraction.
5. …………We, human beings now have not got enough knowledge of the mechanics of our universe.
6. …………It's natural that the glass and the suction cup attract each other.
7. …………The attraction between the glass and the suction cup is due to air pressure.
8. …………We all should have an intuitive mind towards the phenomenon of gravitation.

Exercise 3: *Find the word(s) or phrase(s) in the text with the meaning similar to those given bellow*:

1. operation …………………………
2. factor …………………………
3. already-known …………………………
4. got out of …………………………

5. tied to ....
6. to look into ....
7. to hang ....
8. cause to response ....
9. to agree ....
10. witness ....
11. feature ....
12. to attack ....

GRAMMAR IN USE

A) Modal verbs to express certainty or possibility

1. Certainty

To express certainty (or to say that something is certainly true or untrue), we use **will, must and can't.**

1.1. For present and future situations, we use:

will, must and can't + Verb base

In which:

a. **will** is used when the speaker means that something is certainly true, even though we can not see that it is true.

Example:

1. He has finished his report on the spin-transfer effects. ~ It**'ll** earn him world-wide fame.

2. If a body is at rest, It will remain at rest.

Note: **will** is often used in its contracted form **'ll**

b. Must is used when the speaker sees something as necessarily and logically true.

Example: The glass must attract the device.

The device must also attract the glass.

You can see the contexts of the two above statements from the reading passage.

c. **Can't** is used when the speaker sees it as logically impossible for something to be true. **Can't** and **must** are opposites.

Example: It can't be explained how to measure mass by imagining a series of experiments. ~ There must be some experiments to be conducted.

Or we can use:

will, must and can't +be +V_ing

to lay emphasis on the continuation of the action.

Example:

1. Where's Jane? ~ *She'll be working* in the lab. (I expect)
2. In general, if our standard body of 1kg mass has an acceleration a, we know that the *force F must be acting* on it.
3. The ball can't be moving . It must be at rest because there's no force acting on it.

1.2. For a perfect situation, we use:

will, must and can't + have +P_{II}

Example:

1. The experiment will have been conducted by now.
2. The ball is moving. Someone must have kicked it.
3. Newtonian mechanics can't have worked in that case. The interacting bodies were on the scale of atomic structure.

Note: In questions, we normally use **can** or **will**.

Example: Can it really be true?

How will it be done?

2. Possibility:

2.1. We use: may /might + verb base

to say that something is possibly true or an uncertain prediction.

Example:

1. We may find *g* by simply weighing a standard weight on a spring balance.
2. There might be an error somewhere in the procedures.

Note: There is almost no difference in meaning, but **may** is a little stronger than **might**.

2.2. To lay emphasis on the continuation of the action, we can use

may /might + be + V_ing

Example:

1. He may/might be doing well in Physics because he has borrowed a lot of books on Physics from the library.

2.3. The perfect can be used also:

may /might + have + P_{II}

Example:

1. He may/might have made a lot of observations before reaching such a conclusion.

Note: These two verbs can not be used in questions. **Can** and **will** are used, instead. (Refer to (1))

For all the above verbs, we follow the rule of making negation or interrogation for modal verbs in general.

B) Past perfect tense

Read the following passage:

The team of medieval physicists stepped out of the time machine and began to examine the strange, new device fastened to the window. They had never before seen a suction cup, so with great enthusiasm, they began to experiment by pulling this mysterious device off the window, and then reattaching it. In the second sentence, the writer uses the past perfect tense of the verb to see to mean that this action happens before the actions expressed by to step and to begin which were conjugated in past tense. This is the use of the past perfect tense.

We form the tense with: **had + P_{II}**

To express an action or a state before a past time reference.

Examples: Everything <u>had been good</u> before he put his nose in.

Before quantum physics, the interacting bodies on the scale of atomic structure <u>had not been able to explain</u>.

PRACTICE

Exercise 1: *Fill in the blank with* will; can; must; can't; may *or* might

1. Suppose that Earth pulls down on an apple with a force of 0.80N. The apple_______ then pull up on Earth with a force of 0.80N.
2. A particle of mass m, located outside Earth a distance r from Earth's center, is released, it _____ fall towards the center of Earth.
3. An object located on Earth's surface anywhere except at the two poles _____rotate in a circle about the rotation axis and thus ______ have a centripetal acceleration that points towards the center of the circle.
4. For an object situated in an underground laboratory, force of attraction ______be exerted on it by the internal and external layers of the Earth.
5. A body raised to a height *h* above the Earth possesses a potential energy of *mgh*. However, this formula _____ be used only when the height *h* is much smaller than the Earth's radius.
6. How ______we ensure that a body thrown from the Earth will not return to the Earth?

7. In order for a body of mass m to break away from the Earth, it _______ over- come a gravitational potential energy.
8. Whenever a gravitational field changes appreciably in size and/or direction across the dimensions of a body, there ______be a tidal effect.
9. Cardwell said:" High temperature superconductors – which are oxide in nature – contain predominantly copper, so this ________be a reasonable place to start".
10. The system is not working now. There ______be something wrong with the engine.
11. The limitations of volume as a measure of the amount of matter_________ have been known to people many centuries ago because they developed a method for measuring the amounts of different substances independently of their volumes.
12. The density of a mixture of two liquids usually depends on the ratio in which they are mixed. The same is true for the density of a solution of a solid in a liquid. Thus, knowing the density of a liquid _________ provide useful information.
13. We_________ depend on two properties alone to distinguish between substances. This is particularly true if the measurements are not highly accurate.
14. Perhaps, some substances that hardly dissolve in water _________ dissolve easily in other liquids.
15. You know, of course, from your own experience that you _________ not mix together the products of the dry distillation of wood and get back anything resembling wood.
16. Many reactions, like the reaction of copper with oxygen, are slow. It is difficult in these cases to tell when all of one of the reacting substances has been used up. Because the copper in your crucible changed to a black solid, you _________have assumed that all the copper that was originally present in your crucible had been reacted. This __________ have been an incorrect assumption, as the presence of copper in the black substance has shown.
17. Even with a high-powered microscope we can not see atoms, and so they _______ be very small and there _________ be very many of them in any sample large enough for us to examine.
18. Some pairs of elements form several compounds, whereas others form only one or even none (helium, for example, is not known to combine with any other element). There ________ be some important differences between the atoms of the various elements to account for their different behavior in forming compounds.

Exercise 2: *Put the verbs in brackets in its suitable tense.*

This is what we were going on in our flying laboratory. We (turn) _______ on the jet engine by pressing a button, and suddenly ... the objects surrounding us (seem) _____ to come to life. All bodies which (be made) ______fast were brought into motion. The thermometer (fall) _______down, the pendulum (begin) ______oscillating and, gradually coming to rest, assumed a vertical position, the pillow obediently (sag) _____ under the weight of the valise lying on it. Let us (take) ______a look at the instruments which (indicate) ______the direction in which our ship (start) ______accelerating. Upwards, of course! The instruments (show) ______ that we (choose) ______ a motion with an acceleration of 9.8m/sec^2, not very great, considering the possibilities of our ship. Our sensations (be) _____quite ordinary; we (feel) ___ the way we did on Earth. But why so? As before, we (be) -_____ unimaginably far from gravitational masses, there (be) _______no gravity, but objects (acquire) _______ weight.

PROBLEM SOLVING

Simple experiment description (1)

To describe an experiment or a simple experiment in particular, we should follow the following steps.

First: Describe the apparatus/instruments/devices used to conduct the experiment.

Second: Describe how the experiment is done. In describing simple experiment, this is how the devices work.

Third: State the result

Last: State the conclusion

Or you can divide your writing, instead of four steps, into three by combining the first two into one stage which is to give directions.

Then, your writing would be presented in this way: (1) Directions

↓

(2) Statement of result

↓

(3) Conclusion

Example:

Describing a simple experiment to show that **Air has weight**

(1) **Directions:**

Take a plastic water can.

Make a hole in the cap.

Glue the valve from an old bike tyre into it.

Put the cap back on the can.

Weigh the can on a pair of balances. Pump extra air into the can.

Weigh it again.

(2) **Statement of result:**

The can weighs more after the extra air has been pumped into it than it did before.

(3) **Conclusion**

This shows that air has weight.

Draw the diagrams to illustrate the experiment.

Writing task: Expand each of the following notes into a paragraph

Air exerts a downward pressure

(1) Take a large glass container - half fill - water - put- a cork - surface - a glass - lower - mouth downward- over - the cork - below - water.

(2) The air in the glass - push - part - surface- under - glass - below - surface- surrounding water.

(3) This shows that ______

1. Air exerts an upward pressure

(1) Fill a glass - brim - water -place - a piece of cardboard- over- hold cardboard- against glass - turn glass - upside down- take hand - away -cardboard.

(2) The cardboard remains - glass- water remains- glass

(3) This shows that ______

TRANSLATION

Task one: *English-Vietnamese translation*

1. Galileo Galilei (1564-1642) was the first to understand how earth's gravity affects things near the surface of our planet. From his experiments, he argued that if different objects fell "totally devoid of resistance" (without air or anything else to hinder their downward motion), they would fall with the same acceleration. A rock and a leaf would reach the same speeds if they fell the same amount of time. Although he didn't have the means to eliminate air resistance to prove that hunch, his conclusion were correct.

2. We live our lives with constant experience of gravity. We know that things fall when we let go off them. We know that we return to the ground if we jump up in the air. We can live quite happily without thinking about why this is so. Once we start thinking about the force of gravity, which makes things fall, we may come up with some odd ideas.

3. You have probably learnt to show a stationary object with two forces acting on it: the force of gravity (its weight) and the normal force exerted by the ground. A child does not have this mental picture, but these forces really do exist, as you would discover if you put your fingers underneath a large weight.

4. Note that we measure distances from the center of gravity of one body to the center of gravity of the other. We treat each body as if its mass was concentrated at one point. Note also that the two bodies attract each other with equal and opposite forces. (This is an example of a pair of equal and opposite forces, as required by Newton’s third law of motion). The Earth pulls on you with a force (your weight) directed towards the center of the Earth; you attract the earth with an equal force, directed away from its center and towards you. Your pull on an object as massive as the Earth has little effect on it. The Sun’s pull on the Earth, however, has a very significant effect.
5. Although Newton’s law of gravitation applies strictly to particles, we can also apply it to real objects as long as the sizes of the objects are small compared to the distance between them. The Moon and Earth are far enough apart so that, to a good approximation, we can treat them both as particles. But what about an apple and Earth? From the point of view of the apple, the broad and level Earth, stretching out to horizon beneath the apple, certainly is not like a particle.
6. Gravitation plays a crucial role in most processes on the Earth. The ocean tides are caused by the gravitational attraction of the moon and the sun on the earth and its oceans. Gravitation drives weather patterns by making cold air sink and displacing less dense warm air, forcing the warm air to rise. The gravitational pull of the earth on all objects holds them to the surface of the earth. Without it, the spin of the earth would send them floating off into space.
7. The gravitational attraction of every bit of matter in the earth for every other bit of matter amounts to an inward pull that holds the earth together against the pressure forces tending to push it outwards. Similarly, the inward pull of gravitation holds stars together. When a star's fuel nears depletion, the processes producing the outward pressure weaken and the inward pull of gravitation eventually compresses the star to a very compact size.

(*From* **Fundamentals of Physics** by David Halliday, *Robert Resnick, Jearl Walke, John Wiley & sons, Inc, Newyork, 1997*).

Task two: *Vietnamese - English translation*

1. Hơn một thế kỷ sau khi Niutơn phát hiện định luật vạn vật hấp dẫn, nhà bác học người Anh tên là Cavenđisơ mới dựng được thí nghiệm đầu tiên đo hằng số hấp dẫn. Ông treo vào một sợi dây thạch anh mảnh (gọi là cân xoắn) một thanh với hai quả cầu nhỏ m ở hai đầu, xong đưa lại gần chúng hai quả cầu lớn M bằng chì. Các quả cầu m và M hút nhau làm dây xoắn lại. Căn cứ vào độ xoắn (góc quay) của dây thạch anh có thể biết được lực hấp dẫn. Đo khoảng cách r giữa tâm của hai khối lượng tương tác. Cavenđisơ đã đo được hằng số hấp dẫn G. Về sau, nhiều thí nghiệm chính xác hơn đã được tiến hành để đo G. Kết quả đo G = $6{,}68.10^{-11}N.m^2/kg^2$. Giá trị G mà Cavenđisơ đo được sai lệch với giá trị này khoảng 1%.

2. Nói một cách không chặt chẽ lắm thì nguyên lý tương đương nói rằng sự hấp dẫn và sự gia tốc là tương đương nhau. Nếu một nhà vật lý bị nhốt trong một cái hộp nhỏ thì anh ta không có khả năng nói lên sự khác nhau giữa hấp dẫn và gia tốc. Giả sử rằng nhà vật lý đứng trên một cái cân bàn. Ban đầu cái hộp đứng yên trên trái đất, sau đó được gia tốc qua không gian vũ trụ, với 9,8 m/s^2. Nhà vật lý không thể nói lên sự khác nhau.
3. Trong vật lý học của Newton, sự kiện thực nghiệm rằng mg = m_I có thể được coi chẳng khác gì một sự trùng hợp ngẫu nhiên. Trong thuyết tương đối tổng quát của Einstein, nó nằm một cách tự nhiên trong nguyên lý tương đương: nếu hấp dẫn và gia tốc là tương đương, thì khối lượng đo theo hấp dẫn hay theo gia tốc, phải bằng nhau.

(*From* **Vat li co so**, *Translated from English version by Hoang Huu Thu - Editor in chief*, Educational Publishing House, 1998)

4. Gia tốc là lượng thay đổi tốc độ của một vật đang chuyển dộng được đo bằng mét trên giây bình phương (m/s^2). Vì tốc độ là một đại lượng vectơ (có độ lớn và chiều), một vật di chuyển với tốc độ cố định có thể gọi là thay đổi tốc độ nếu chiều chuyển động thay đổi. Theo định luật Newton thứ nhì về chuyển động thì một vật chỉ thay đổi tốc độ nếu bị tác động bởi một lực không cân bằng hay một tổng hợp lực. Gia tốc trung bình a của một vật di chuyển theo đường thẳng có thể tính theo công thức: a = α v/α t trong đó α v là sự thay đổi tốc, và α t là thời gian thay đổi, hay a = (u - v)/t trong đó u là tốc độ ban đầu của vật, v là tốc độ cuối cùng của của vật, và t là thời gian thay đổi. Trị số âm của gia tốc cho biết là vật đang giảm tốc độ. Gia tốc do trọng lực là gia tốc của một vật rơi tự do bởi tác dụng của trọng trường quả đất; nó ít thay đổi theo vĩ độ hay độ cao. Trị số gia tốc trọng lực được quốc tế công nhận là 9,806ms^{-2}.

(*From* **Pocket Dictionary of Physics**, Publishing House of Science and Technology)

KEY TERMS

Acceleration due to gravity (acceleration of gravity) (n): the acceleration imparted to bodies by the attractive force of the earth; has an international standard value of 980.665cm/s^2 but varies with latitude and elevation. Also known as acceleration of free fall; apparent gravity. *Gia tốc do trọng trường*

Angle of rotation (twist/torsion) (n): the angle through which a part of an object such as ashaf or wire is rotated from its normal position when a torque is applied. *Góc quay; góc xoắn*

Behavior (n): the way in which something acts. *Phản ứng*

Compact (adj): dense. *Đặc*

Dense (adj): a large amount in a small area. *Đậm đặc; chặ***t**

Device (n): an object made for a particular purpose. *Thiết bị; dụng cụ; phương tiện*

General relativity theory (n): the theory of Einstein which generalizes special relativity to no inertial frames of reference and incorporates gravitation, and in which events take place in a curved place. *Thuyết tương đối tổng quan*

Gravitation (n): the mutual attraction between all masses in the universe. Also known as gravitational attraction. *Sự hấp dẫn; trọng lực*

Gravitational constant (n): the constant of proportionality in Newton's law of gravitation, equal to the gravitational force between any two particles times the square of the distance between them, divided by the product of their masses. *Hằng số hấp dẫn*

Gravity (n): the gravitational attraction at the surface of a planet or other celestial body. *Trọng lực; trọng lượng; sức hut; lực hút; sự hấp dẫn*

Mechanics (n): 1. In the original sense, the study of the behavior of physical systems under the action of forces. *Cơ học*

2. More broadly, the branch of physics which seeks to formulate general rules for predicting the behavior of a physical system under the influence of any type of interaction with the environment. *Hiểu rộng hơn, đây là môn học nghiên cứu tìm ra những quy tắc chung trong việc phán đoán phản ứng của một hệ vật bị ảnh hưởng bởi bất kỳ một tương tác nào của hệ với môi trường của nó.*

Pressure (n): a type of stress which is exerted uniformly in all directions; its measure is the force exerted per unit of area. *Áp suất; áp lực*

Principle of equivalence (n): In general gravity, the principle that the observable local effects of a gravitational field are distinguishable from those arising from acceleration of the frame of reference. Also known as Einstein's equivalency principle. *Thuyết tương đương*

Stationary (adj): not moving. *Đứng yên*

FREE-READING PASSAGE

It is advisable that you read the following passage to learn more about gravitation. You can do some translation practice on this passage and pick up some new vocabulary items.

Early ideas about gravitation. The ancient Greek philosophers developed several theories about the force that caused objects to fall toward the earth. In the 4th century BC, the Greek philosopher Aristotle proposed that all things were made from some combination of the four elements, earth, air, fire, and water. Objects that were similar in nature attracted one another, and as a result, objects with more earth in them were attracted to the earth. Fire, by contrast, was dissimilar and therefore tended to rise from the earth. Aristotle also developed a cosmology, that is, a theory describing the universe that was geocentric, or earth-centered, with the moon, sun, planets, and stars moving around the earth on spheres. The Greek philosophers, however, did not propose a connection between the force behind planetary motion and the force that made objects fall toward the earth.

At the beginning of the 17th century, the Italian physicist and astronomer Galileo discovered that all objects fall toward the earth with the same acceleration, regardless of their weight, size, or shape, when gravity is the only force acting on them. Galileo also had a theory about the universe, which he based on the ideas of the Polish astronomer Nicolaus Copernicus. In the mid-16th century, Copernicus had proposed a heliocentric or sun-centered system, in which the planets moved in circles around the sun, and Galileo agreed with this cosmology. However, Galileo believed that the planets moved in circles because this motion was the natural path of a body with no forces acting on it. Like the Greek philosophers, he saw no connection between the force behind planetary motion and gravitation on earth.

In the late 16th and early 17th centuries the heliocentric model of the universe gained support from observations by the Danish astronomer Tycho Brahe, and his student, the German astronomer Johannes Kepler. These observations, made without telescopes, were accurate enough to determine that the planets did not move in circles, as Copernicus had suggested. Kepler calculated that the orbits had to be *ellipses* (slightly elongated circles). The invention of the telescope made even more precise observations possible, and Galileo was one of the first to use a telescope to study astronomy. In 1609 Galileo observed that moons orbited the planet Jupiter, a fact that could not reasonably fit into an earth-centered model of the heavens.

The new heliocentric theory changed scientists' views about the earth's place in the universe and opened the way for new ideas about the forces behind planetary motion. However, it was not until the late 17th century that Isaac Newton developed a theory of gravitation that encompassed both the attraction of objects on the earth and planetary motion.

Problems with Newton's Theory. Scientists used Newton's theory of gravitation successfully for many years. Several problems began to arise, however, involving motion that did not follow the law of gravitation or Newtonian mechanics. One problem was the observed and unexplainable deviations in the orbit of Mercury (which could not be caused by the gravitational pull of another orbiting body).

Another problem with Newton's theory involved reference frames, that is, the conditions under which an observer measures the motion of an object. According to Newtonian mechanics, two observers making measurements of the speed of an object will measure different speeds if the observers are moving relative to each other. A person on the ground observing a ball that is on a train passing by will measure the speed of the ball as the same as the speed of the train. A person on the train observing the ball, however, will measure the ball's speed as zero. According to the traditional ideas about space and time, then, there could not be a constant, fundamental speed in the physical world because all speed is relative. However, near the end of the 19th century the Scottish physicist James Clerk Maxwell proposed a complete theory of electric and magnetic forces that contained just such a constant, which he called c. This constant speed was 300,000 km/sec (186,000 mi/sec) and was the speed of electromagnetic waves, including light waves. This feature of Maxwell's theory caused a crisis in physics because it indicated that speed was not always relative.

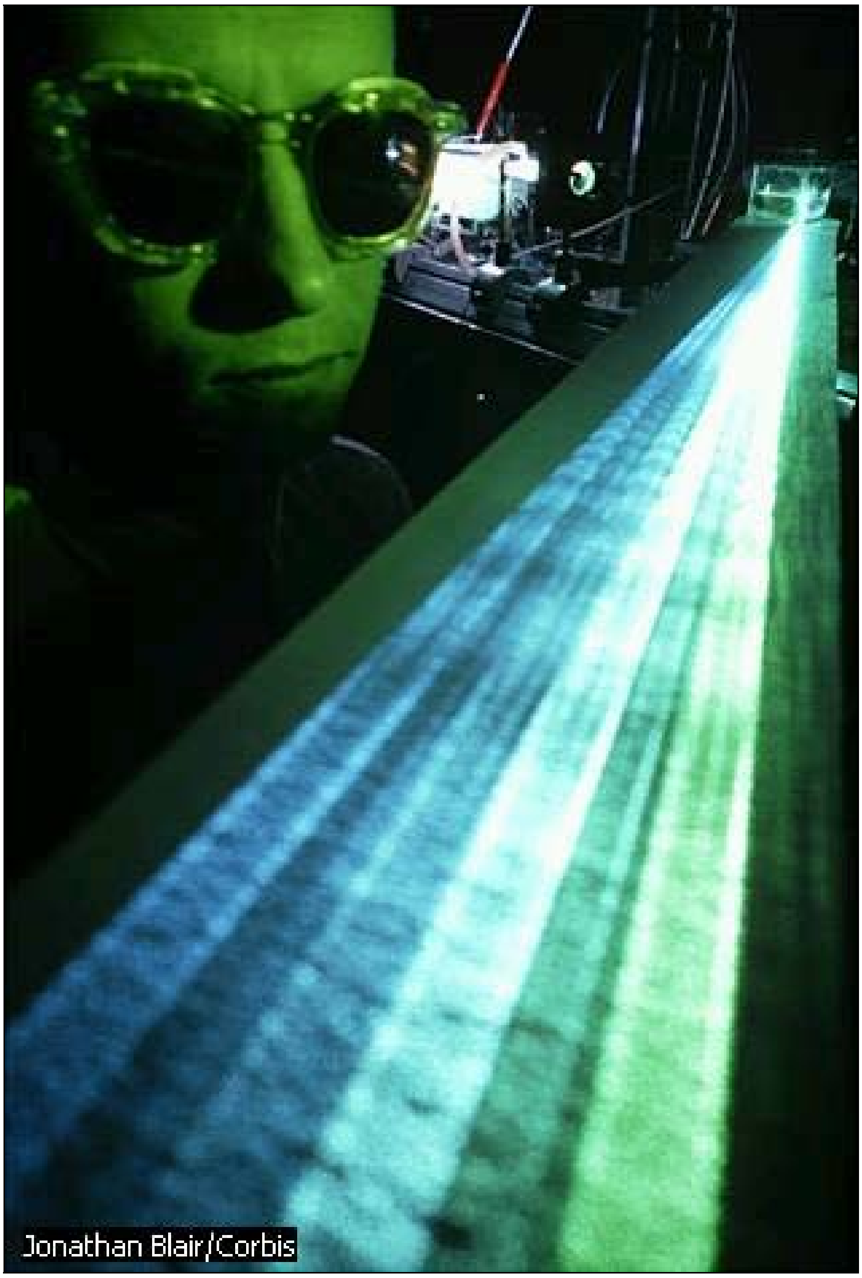
Albert Einstein resolved this crisis in 1905 with his special theory of relativity. An important feature of Einstein's new theory was that no particle, and even no information, could travel faster than the fundamental speed *c*. In Newton's gravitation theory, however, information about gravitation moved at infinite speed. If a star exploded into two parts, for example, the change in gravitational pull would be felt immediately by a planet in a distant orbit around the exploded star. According to Einstein's theory, such forces were not possible.

Though Newton's theory contained several flaws, it is still very practical for use in everyday life. Even today, it is sufficiently accurate for dealing with earth-based gravitational effects such as in *geology* (the study of the formation of the earth and the processes acting on it), and for most scientific work in astronomy. Only when examining exotic phenomena such as *black holes* (points in space with a gravitational force so strong that not even light can escape them) or in explaining the *big bang* (the origin of the universe) is Newton's theory inaccurate or inapplicable.

Einstein’s theory of gravity. In 1915 Einstein formulated a new theory of gravitation that reconciled the force of gravitation with the requirements of his theory of special relativity. He proposed that gravitational effects move at the speed of *c.* He called this theory general relativity to distinguish it from special relativity, which only holds when there is no force of gravitation. General relativity produces predictions very close to those of Newton's theory in most familiar situations, such as the moon orbiting the earth. Einstein's theory differed from Newton's theory, however, in that it described gravitation as a curvature of space and time.

In Einstein's general theory of relativity, he proposed that space and time may be united into a single, four-dimensional geometry consisting of 3 space dimensions and 1 time dimension. In this geometry, called space-time, the motions of particles from point to point as time progresses are represented by curves called world lines. If there is no gravity acting, the most natural lines in this geometry are straight lines, and they represent particles that are moving always in the same direction with the same speed—that is, particles that have no force acting on them. If a particle is acted on by a force, then its world line will not be straight. Einstein also proposed that the effect of gravitation should not be represented as the deviation of a world line from straightness, as it would be for an electrical force. If gravitation is present, it should not be considered a force. Rather, gravitation changes the most natural world lines and thereby curves the geometry of space-time. In a curved geometry, such as the two-dimensional surface of the earth, there are no straight lines. Instead, there are special curves called geodesics, examples of which are great circles around the earth. These special curves are at each point as straight as possible, and they are the most natural lines in a curved geometry. The effect of gravitation would be to influence the geodesics in space-time. Near sources of gravitation the space is strongly curved and the geodesics behave less and less like those in flat, incurved space-time. In the solar system, for example, the effect of the sun and the earth is to cause the moon to move on a geodesic that winds around the geodesic of the earth 12 times a year.

(*From* **http://encarta.com***)*



Argon Laser

*Argon lasers can produce a range of blue-green wavelengths of light. They are used in laser entertainment shows and have many medical uses, such as in ey surgery and hardening dental fillings. Operators use this laser to produce holographic image***.**

Unit Eight

OPTICS

READING PASSAGE

Spectral analysis

We mentioned compounds of calcium, lithium, and strontium without specifying which compounds we were talking about. This may have given you the impression that only the spectrum of one of the elements in a compound can be observed. It is true that the flame of your alcohol burner is hot enough to produce the spectra of sodium, lithium, calcium, copper, and a few other elements, but that is not hot enough to produce the other spectra of elements, such as oxygen and chlorine. However, if we heat a sample of a compound to a sufficiently high temperature (for example, by putting it in an electric arc), the spectra of all the elements in the compound will be observed. Under such conditions, the resulting spectrum is no longer simple. It will most likely contain complicated patterns of many closely spaced lines. Yet each element gives out its own spectrum, which is different from that of any other. It takes accurate measurements of the positions of spectral lines to identify an element. Once this has been done, however, the presence of that element has been definitely established.

With a good instrument, it is observed that the yellow of the sodium flame is not just any yellow. It is a very specific color indeed, which has its own special place in the spectrum. It is a yellow made by no other element. The presence of this particular pair of lines always means that sodium is present in the light source. Even if the yellow color is hidden from the unaided eye by many colors, the spectroscope will show the presence of sodium.

Although calcium, lithium, and strontium give flame tests of nearly the same color, each gives its own set of characteristic spectral lines when viewed through a spectroscope. The spectroscope thus enables us to distinguish one element from another.

Spectral analysis, or spectroscopy, can be done on tiny quantities of matter, such as very small sample of a rare mineral or of a biological material. Spectroscopy can even be used to determine the presence of different elements in distant objects like our sun and other stars.

Analysis of sunlight was one of the very early uses of spectroscope in the study of unknown matter. Most of the spectral lines observed in sunlight could also be produced with known material in the laboratory. However, during a solar eclipse in 1868, a new set of spectral lines was found in the spectrum of the light coming from the edge of the sun. This set of lines had never been seen before and could not be produced with any element known at the time. The lines were therefore thought to be from a new element, which was given the name "helium" after the Greek word for sun. Eventually, the element was also detected on earth through the use of a spectroscope.

During the first few years of spectroscopy, five new elements were discovered that are present on earth in such a small concentrations that they were previously unknown. For example, in analyzing the spectrum of minerals found in the water of a certain spring in Germany, two lines of unknown origin were found in the blue region of the spectrum. This bit of evidence was enough to challenge Robert Bunsen, the German chemist, to search for a new element in the water. In order to isolate some of the pure element, which he named "cesium"; it was necessary to evaporate 40,000kg of spring water! In more recent times, spectral analysis has been one of the tools found helpful in identifying some of the new elements produced by nuclear reactions.

Time after time, this interplay between chemical analysis and spectral analysis has caused complex substances to yield the secret of their composition. Invariably, the results given by these two different methods agree completely.

(*From* Uri Haber-Schaim. et al; Introductory Physical Science; Prentice Hall, Inc; Englewood Cliffs, New Jersey 07632;1987).

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading passage*

1. How are the spectra of all elements in a compound completely observed?

   ……………………………………………………………………………………………
   ………..……………………………………………………………………………

2. Why is the yellow color of a sodium flame not just any yellow but a specific one?

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   ………..……………………………………………………………………………

3. What is the term used to refer to spectral analysis?

   ……………………………………………………………………………………………
   ………..……………………………………………………………………………

4. What is the major function of spectroscopy?

   ……………………………………………………………………………………………
   ………..……………………………………………………………………………

5. In the very present, in which way spectroscopy is more helpful?

   ……………………………………………………………………………………………
   ………..……………………………………………………………………………

Exercise 2: *Decide whether each of the following statements is true* ***(T)*** *or false* ***(F)*** *or without any information to identify* ***(N).***

1. …………. It is impossible to see the spectra of oxygen and chlorine by using alcohol burner.
2. ………….The positions of spectral lines of an element help identify the element.
3. ………….Some elements may have some similar spectral lines.
4. ………….Calcium, lithium and strontium give the same spectra.
5. ………….Applying spectral analysis helps to detect new elements.

Exercise 3: *Matching each of the words/phrases from column I with its definition from column II*

Column I	**Column II**
1. to observe	a. precise
2. flame	b. to tell the difference
3. sample	c. a large amount of something in a small area.
4. pattern	d. a long and pointed stream of burning gas
5. accurate	e. to recognize
7. to identify	f. to discover
8. specific	g. a small amount of a substance scientifically examined and analyzed
9. to determine	h. a particular way for something to be done or to occur
10. to distinguish	i. to watch carefully
11. concentration	k. particular

GRAMMAR IN USE:

The passive

Read the following two paragraphs:

Paragraph one: Sir Joseph John Thomson (1846-1940) is a British physicist and mathematician and was the head of a group of researchers at Cavendish Laboratory in Cambridge. Thompson discovered the electron. He is regarded as the founder of modern physics.

Paragraph two: Electron is a subatomic particle and one of the basic constituents of matter. The electron was discovered by J.J. Thomson. It is found in all atoms and contains the smallest known negative electrical charge.

Compare the two sentences, one from each paragraph

Thomson discovered the electron.

And The electron was discovered by Thomson.

The two sentences have the same meaning but different topics: they are about different things, hence having different implications. In the former one, the topic is Thomson while in the latter one the electron. We say the two sentences have different subjects. So what is the significance of the difference between the two ways of saying? The answer really lies in whether we want to lay emphasis on the doer of the action (we call it the *agent*) or the action (sometimes the result of the action) itself.

In this pair of sentences, the first one is called an active sentence while the second is called passive sentence. Look at the verb phrase of each sentence: "*discovered*" and "*was discovered*"

Therefore, we deduce that the verb phrase in passive sentences is formed by combining the auxiliary verb *to be* and a *passive particle* (exactly the same form as a part participle)

To be + P_{II}

In which the auxiliary verb *to be* bears all the grammatical changes in tenses and aspects and others.

1. Present tenses:

1. Many elements *are not* so easily *identified.*
2. Once this *has been done*, however, the presence of that element *has been* definitely *established.*
3. When the experiment *is being conducted*, there should be no changes in ambient temperature.

2. Past tenses:

1. During the first five years of spectroscopy, five new elements *were discovered* that are present on earth in such small concentrations that they *were* previously *unknown*.
2. This set of lines *had* never *been seen* before.
3. Eventually, the element was also detected on earth through the use of a spectroscopy.
4. While the experiment *was being conducted*, the ambient temperature *was kept* unchanged.

3. With "modal verbs": The passive sentences with modal verbs are formed as follows:

Modal verb + be + P_{II}

a. This may have given you the impression that only the spectrum of one of the element in a compound *can be observed*.

b. Spectral analysis, or spectroscopy, *can be done* on tiny quantities of matter.

c. Spectroscopy *can be* even *used* to determine the presence of different elements in distant objects like our sun and stars.

d. Most of the spectral lines observed in sunlight could also *be produced* with known materials in the laboratory.

e. This set of lines *could not be produced* with any element known at the time.

Note:

1. As for verbs with prepositions or particles, the preposition and particle remain in its position with respect to the verb.

For example: The same volume of hydrogen *is added to* the tube.

2. From the sample paragraphs and all the examples taken out from the reading text, we can deduce that, in writing a science report or description, the use of passive sentences is commonly resorted to. And more commonly, the impersonal passive is used:

Have another look at the passive sentence in the pair of sentences taken out from the two sample paragraphs:

The electron was discovered by J. J. Thomson.

The underlined phrase is called *by-phrase* (forming by **by + agent**). This gives the new information (by whom) to clarify the topic (subject) which is an already -known piece of information (the electron was discovered). However, in science documents, the actions and their result are much more important, the by-phrase becomes little important, hence forming the impersonal passive to be frequently used.

In scientific documents, the following special patterns of passive are taken much use of:

1. *The passive with get*:

Instead of *be*, sometimes we use *get* to form passive sentences:

Example:

1. If the spring is stretched beyond its elastic limit, it will *get deformed*.
2. Everything *gets attracted* to the center of the earth no matter where they are.
3. When you do the experiment, be careful or you *may get burned*.

However, *get* is mainly used in informal English, and it has more limited use than *be*. The passive with *get* expresses action and change, not a state. It often refers to something happening by accident, unexpectedly or incidentally.

2. *The passive with verbs of reporting*

There are two special patterns with verbs of reporting which are frequently used in science writing.

Active: Long time ago, people believed that the earth had a round shape.

Passive: Long time ago, *it was believed* that the earth had a round shape.

Long time ago, the Earth *was believed* to have a round shape.

Thus, we have:

Pattern one: **It + passive verb + finite clause**

More examples:

1. It *is specified* that gravitational potential is also a scalar.
2. It *might be thought* that the force needed to lift something is greater than its weight.
3. It *has been proved* that the force of gravity is an attractive force between any two objects because of their masses.

The following verbs are used in this pattern:

admit	discover*	mention	say*
agree	establish	notice	see*
allege*	estimate*	object	show*
announce	expect*	observe*	specify
assume*	explain	presume*	state
believe*	feel*	promise	suggest
claim*	find*	propose	suppose*
consider*	hope	prove*	think*
decide	intend*	recommend	understand*
declare*	know*	report*	

Pattern two: **Subject + passive verb + to-infinitive**

More examples:

1. Gravitational potential *is shown* to increase by drawing equipotential lines onto a diagram of the field lines.
2. It was about only 100 years ago that a way *was discovered* to separate aluminum from oxygen by electrolysis.

3. Acids *were considered* in the old days to be the substances that were strongly corrosive and had a sour taste.

The verbs which are used in this pattern are those with an asterisk (*) in the above list for pattern one.

PRACTICE

Exercise 1: *Change the following active sentences into the passive ones*

1. We notice that the displacement changes between positive and negative values.

   ……………………………………………………………………………………
   ……………………………………………………………………………

2. We can use the displacement- graph to find the period and frequency of the oscillation.

   ……………………………………………………………………………………
   ……………………………………………………………………………

3. A placement – time graph can represent many oscillating systems.

   ……………………………………………………………………………………
   ……………………………………………………………………………

4. If we compare the displacement –time and acceleration-time graphs, we'll see that they are very similar to one another.

   ……………………………………………………………………………………
   ……………………………………………………………………………

5. We can deduce the velocity graph from the displacement graph.

   ……………………………………………………………………………………
   ……………………………………………………………………………

6. We say that these oscillations are damped.

   ……………………………………………………………………………………
   ……………………………………………………………………………

7. Chemists have shown that if we mix iron ore with coal or charcoal, we'll obtain iron.

   ……………………………………………………………………………………
   ……………………………………………………………………………

8. We can extract elements from their compounds by spectroscopy.

   ……………………………………………………………………………………
   ……………………………………………………………………………

9. We can not decompose the radioactive elements by ordinary heat, electricity, reaction with acids, and the like.

………………………………………………………………………………………
……………………………………………………………………………

10. Since the 1960s, in medical scientists have used lasers in treating many diseases.

………………………………………………………………………………………
……………………………………………………………………………

Exercise 2: *Change the following passive sentences into their active equivalents*

1. Today, many varieties of lasers are made using different atoms and molecular compounds in the solid, liquid, or gaseous states.

………………………………………………………………………………………
……………………………………………………………………………

2. Much more energy is sent into the ruby crystal by the flash lamp.

……………………………………………………………………………………

3. These atoms are struck by the oscillating electrons in the tube and get excited.

……………………………………………………………………………………

4. If the source emits a broad band of wavelengths, a broad band of color will be seen.

……………………………………………………………………………………

5. Even light of several unknown wavelengths can be distinguished and identified by diffraction gratings.

………………………………………………………………………………………
……………………………………………………………………………

6. A standard optical diffraction grating can not be used to discriminate between different wavelengths in the x-ray wavelength range.

………………………………………………………………………………………
……………………………………………………………………………

7. We are surrounded by many every day cases of oscillations.

……………………………………………………………………………………

8. If the source is narrow, and this is viewed through a diffraction grating, a line spectrum is seen.

………………………………………………………………………………………
……………………………………………………………………………

9. The spectra which show the composition of light emitted by hot gases are called emission spectra.

………………………………………………………………………………………
……………………………………………………………………………

10. Absorption spectrum is the one which is observed when white light is passed through a cool gas.

    ……………………………………………………………………………………
    ……………………………………………………………………………

11. After the light has passed through a diffraction grating, the continuous white light spectrum is found to have black lines across it.

    ……………………………………………………………………………………
    ……………………………………………………………………………

12. Absorption spectra are found when the light from stars is analyzed.

    ………………………………………………………………………………….

13. Simple line spectra can be obtained from some gemstones and colored glass.

    ………………………………………………………………………………….

14. The wave model is used to explain diffraction, interference, and polarization of light.

    ………………………………………………………………………………….

15. In particular, when light is absorbed by a metal surface, it behaves as particles.

    ………………………………………………………………………………….

PROBLEM SOLVING

Simple experiment description (2)

In **UNIT SEVEN**, you did learn how to use verb base in describing a simple experiment. It is noted that you use verb base to give directions of how to conduct the experiment (i.e. in an imperative form) without mentioning the subject of the action. (e.g. Take a plastic water can). In such a case, the actions are much more important, no matter who is the doer of the actions, but the instructions must be followed. Therefore, you can use impersonal passive as an equivalent way.

For example:

Instead of: Take a plastic water can.

We say: A plastic water can is taken.

Now you read the following description of an experiment, in which the impersonal passive is well-resorted- to:

The measurement of the volume of irregular solids

Water is poured into the displacement vessel until it overflows through the pipe into the measuring jar. The level of the water surface in the measuring jar is read, and then the solid is lowered into the vessel until it is completely covered by the water. Water is displaced and flows down the pipe into the measuring jar, and the level of water surface in the measuring jar is read again. The volume of the water displaced is equal to the volume of the solid body.

Do the following task

Change the above description into a set of directions as you did in UNIT SEVEN to describe the experiment to measure the volume of irregular solid bodies, using the following frame work:

(1) Directions:

Take a displacement vessel and a measuring jar

…………………………………………………………………………………………
…………………………………………………………………………………………
………………………………………………………………………………

(2) Statement of result:

Water is displaced and flows down the pipe into the measuring jar.

(1) Directions:

………………………………………………………………………………

(2) Statement of result:

The volume of water displaced is equal to the volume of the body.

Directions and *statement of result* are used when the writer wants to give details of how an experiment is to be carried out.

Description as above is used when the writer wants to describe an experiment as a process.

Change the following descriptions into sets of directions and statement of result.

1. Two pieces of platinum foil are connected to a battery, one piece to the positive terminal and the other to the negative. The pieces of platinum are then placed in blue copper sulphate solution contained in a beaker. A test tube is filled with the solution and fixed over the anode and the current is switched on. The copper sulphate solution gradually gets paler as the current passes through it.
2. Two copper plates are connected to a battery, after having been carefully weighed. They are then placed in a glass vessel containing copper sulphate solution. The current is then switched on. After half an hour, the current is switched off and the copper plates are taken out of the solution. After they have been dried, they are weighed again. One plate now weighs more than before and the other weighs less than before, and the weight lost by the one is equal to the weight gained by the other.
3. Two pieces of platinum are connected to a battery and placed in a vessel containing water. When the current is switched on, no reaction takes place. After a

few drops of sulphuric acid are added to the water, however, bubbles of gas begin to form on the electrodes. Those forming on the anode are bubbles of oxygen, and those forming on the cathode are bubbles of hydrogen.

(*Adapted from* **English in Physical Science**, Student's edition by J.P.B.Allen, H.G.Widdowson, Oxford University Press,1997).

TRANSLATION

Task one: *English-Vietnamese translation*

1. By studying the spatial distribution of the scattered alpha particles – some of them were bounced back in directions near the incident beam – the experiments were able to show that most of the mass and all of the positive charge of an atom are concentrated in a small region of the atom which is later called its nucleus.
2. For many years before Rutherford developed the nuclear model of the atom,, Physicists and chemists had observed and carefully measured the various wavelengths of electromagnetic radiation which is emitted or absorbed by different species of atoms. Records of these radiations, which are called spectra, may be obtained using an apparatus called a spectrometer.
3. In a spectrometer, the light which is emitted by atoms that have been excited electrically is passed through a thin slit and then through a prism, which disperses the different wavelengths of the light in different directions. A film strip in the spectrometer records those wavelengths present as lines, which are separate images of the slit. The position of each spectral line corresponds to a wavelength, and the position, or wavelength, can be measured with considerable accuracy. Such a spectral record on the film is called an emission spectrum.
4. In a similar way, absorption spectra of gases may be obtained by passing white light through a sample of gas before the light enters the prism. In this case, the spectral lines which are absorbed by the gas are produced at the same positions as those wavelengths of light which is produced by emission when the same gas sample is excited.
5. Because the line spectra of most elements are extremely complicated, that is, they are composed of complex patterns of a very large number of lines; the search for a theory to explain the origins of spectral lines was concentrated on hydrogen, the simplest element. A large number of wavelengths of the lines of the hydrogen spectrum had been precisely measured considerably earlier than 1900, but no theory was available that could explain the pattern of wavelengths present in the hydrogen spectrum.

(*Adapted from* different sources)

Task two: *Vietnamese – English Translation*

1. Khi đi qua lăng kính, chùm sáng trắng không những bị khúc xạ về phía đáy lăng kính mà còn bị tách ra thành nhiều chùm sáng có màu sắc khác nhau. Hiện tượng này gọi là hiện tượng tán sắc ánh sáng.
2. Hiện tượng có những vạch sáng và những vạch tối nằm xen kẽ nhau và nhất là sự xuất hiện của những vạch tối trong vùng hai chùm sáng gặp nhau chỉ có thể giải thích được bằng sự giao thoa của hai sóng: những vạch sáng ứng với những chỗ hai sóng gặp nhau tăng cường lẫn nhau; những vạch tối ứng với chỗ hai sóng gặp nhau triệt tiêu lẫn nhau. Ta gọi những vạch sáng, vạch tối này là những vân giao thoa.
3. Khi nghiên cứu các bức xạ được phát bởi một electron duy nhất trong nguyên tử hidrô, chúng ta đã thấy rằng sẽ rất thuận tiện nếu chúng ta vẽ sơ đồ các mức năng lượng, trong đó mỗi một mức tương ứng với một trạng thái lượng tử của êlêctron duy nhất đó. Chúng ta đã chọn mốc năng lượng zêro là năng lượng của trạng thái trong đó êlêctron đứng im và đã bị bứt ra khỏi nguyên tử.
4. Nhờ công trình của Moseley, phổ tia X đặc trưng đã trở thành "chữ ký" được mọi người chấp nhận của mọi nguyên tố, nó cho phép giải được nhiều câu đố của Bảng tuần hoàn. Trước thời gian đó (1913) vị trí của các nguyên tố trong Bảng tuần hoàn được ấn định theo trọng lượng nguyên tử, mặc dù có một số trường hợp phải đảo trật tự đó do những bằng chứng hoá học ép buộc. Moseley đã chứng tỏ được rằng cơ sở thực sự để đánh số các nguyên tố đó là điện tích hạt nhân nguyên tử của các nguyên tố ấy.
5. Quang phổ của Mặt trời mà ta thu được trên Trái đất là quang phổ hấp thụ. Bề mặt của mặt trời (quang cầu) phát ra một quang phổ liên tục. Ánh sáng từ quang cầu đi qua lớp khí quyển của Mặt trời đến Trái đất cho ta một quang phổ hấp thụ của khí quyển đó. Điều kiện để thu được quang phổ hấp thụ là nhiệt độ của đám khí hay hơi hấp thụ phải thấp hơn nhiệt độ của nguồn sáng phát ra phổ liên tục.

(*Adapted from* different sources**)**

KEY TERMS

Absorption spectrum (n): The array of absorption lines and absorption bands which results from the passage of radiant energy from a continuous source through a cooler, selectively absorbing medium**.** *Phổ hấp thu*

Continuous spectrum (n): A radiation spectrum which is continuously distributed over a frequency region without being broken up into lines or brands. *Phổ liên tục*

Emission spectrum (n): Electromagnetic spectrum produced when radiations from any emitting source, exited by any various forms of energy, are dispersed. *Phổ phát xạ*

Line spectrum (n): 1. A spectrum of radiation in which the quantity being studied, such as frequency or energy, takes on discrete values. *Phổ vạch*

2**.** Conventionally, the spectra of atoms, ions, and certain molecules of substance in the gaseous phase at low pressures, distinguished from band spectra of molecules, which consist of a pattern of closely spaced spectral lines which could not resolved by early spectroscope. *Phổ vạch của nguyên tử, ion, và một số phân tử ở pha khí tại áp suất thấp.*

Prism (n): An optical system consisting of two or more usually plane surfaces of transparent solid or embedded liquid at an angle with each other. Also known as **optical prism.** *Lăng kính*

Radiation (n): 1. The emission and propagation of waves transmitting energy through some medium; for example, the emission and propagation of electromagnetic, sound or elastic waves. *Sự bức xạ; sự phát xạ*

2. The energy transmitted by waves through space or some medium; when unqualified, usually refers to electromagnetic radiation. Also known as **radiant energy**. *Nhiệt bức xạ*

3. A stream of particles, such as electrons, protons, neutrons, ỏ– particles, or high energy photons, or a mixture of these. *Dòng hạt*

Spectrometer (n): 1. **A** spectroscope that is provided with a calibrated scale either for measurement of wavelength or for measurement of refractive indices of transparent prism materials. *Kính quang phổ được dùng để đo bước sóng hoặc chỉ số khúc xạ của những chát trong suốt có dạng lăng kính***.**

2. A spectroscope equipped with a photoelectric photometer to measure radiant intensities at various wavelengths. *Kính quang phổ có gắn thêm một quang kế quang điện để đo cường độ bức xạ ở các bước sóng khác nhau.*

Spectroscope (n): An optical instrument consisting of a slit, collimator lens, prism or grating, and a telescope or objective lens which produces a spectrum for visual observation. *Kính quang phổ.*

Spectroscopy (n): The branch of Physics concerned with the production, measurement, and interpretation of electromagnetic spectra arising from either emission or absorption of radiant energy by various substances. *Phổ học; phép nghiên cứu quang phổ*

Spectrum (pl: spectra) (n): 1. A display or plot of intensity of radiation(particles, photons, or acoustic radiation) as a function of mass, momentum, wavelengths, or related quantity. *Quang phổ; phổ*

2. The set of frequencies, wavelengths, or related quantities involved in some process; for example, each element has a characteristic discrete spectrum for emission and absorption of light. nhận ánh sáng. *Tập hợp các tần số, các bước sóng hoặc các đại lượng có liên quan trong một quá trình nào đó, chẳng hạn như mỗi một nguyên tố lại có phổ rời rạc đặc trưng đối với quá trình phát và thu*

3. A range of frequencies within which radiation has some specified characteristic, such as audio-frequency spectrum, ultraviolet spectrum, or radio spectrum. *Một giải tần mà trong đó sự bức xạ có một đặc trưng riêng nào đó, ví dụ như phổ tần âm thanh, phổ tia cực tím, hay phổ rađiô*

Wavelength (n): The distance between two points having the same phase in two consecutive cycles of a periodic wave, along a line in the direction of propagation. *Bước sóng*

FREE-READING PASSAGE

It is advisable that you read the following passage to learn more about how the passive is used in an authentic writing. You can do some translation practice on this passage and pick up some new vocabulary items.

Radioactive decomposition

What happens to a radioactive element when it is radiated? This is a hard question to answer. Some elements, such as uranium, radiate so weakly that it is extremely difficult to discover what is happening to them. Other radioactive elements, such as polonium, emit such intense radiation that it is a simple task to determine what happens. However, because of its intense radiation, even a milligram of polonium is a health hazard unless special precautions are taken. Despite the difficulties, both weakly and strongly radiating elements have been studied.

In the case of polonium, spectral analysis reveals the secret. A freshly prepared sample of polonium has a spectrum that is characteristic of polonium. However, if we seal a sample of polonium in an evacuated glass tube and examine its spectrum a few weeks later, the spectrum will be quite different. In addition to the lines of polonium, the lines of helium and lead- two elements that were not present before- can be detected. If we check the spectrum after an additional month or two, we find that the polonium lines get weaker, and the lead and the helium lines get stronger.

Apparently, the radiation from polonium is connected with the change of polonium into lead and helium. Spectral analysis shows that other radioactive elements also change into different elements. In many cases, helium is one of the elements that is produced. We refer to this process as “radioactive decomposition” or “radioactive decay”.

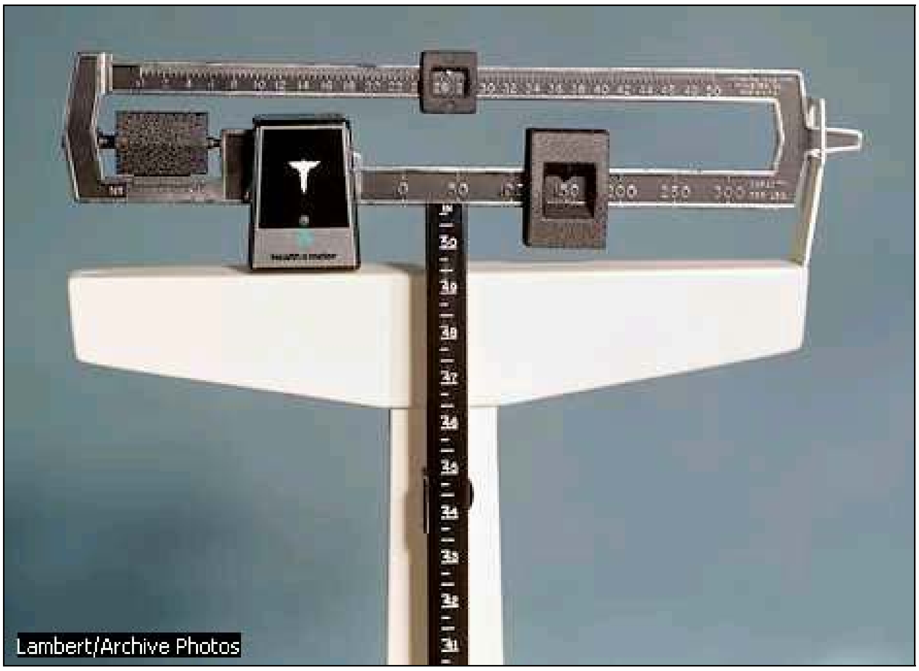
Is radioactive decomposition different from the decomposition of water or other compounds? You remember that the products of the decomposition of water could be recombined to form the original compound. Lime, which Lavoisier thought to be an element, was finally decomposed into calcium and oxygen by electrolysis, but the calcium and oxygen easily recombine. It has been found possible to recombine all the elements that have been obtained from compounds. However, we have not been able to recombine the products of radioactive decomposition by using the methods we have already described to recombine elements into compounds.

What happens to a radioactive element when it is heated? Does heat change the rate at which it emits radiation? In many of the experiments you have done and read about in this course, temperature has had an important effect on what happened and how fast it happened. Wood decomposed when you heated it in a closes tube; the hotter the wood became, the faster it decomposed. Hydrogen does not burn by itself in air, but when it is heated with the flame of a burning match, it catches fire very easily-sometimes explosively.

To find out whether temperature has any effect on the intensity of radiation from radioactive substances, samples of these substances have been heated to very high temperatures, and they have been cooled to very low temperatures in liquid air. But it was found that temperature changes do not affect the radiation from a radioactive substance.

To sum up, the radioactive elements have all the properties of elements that you have studied. The form compounds with constant composition and have their characteristic densities, melting and boiling points and spectra. They can no be decomposed by ordinary heat, electricity, reaction with acids, and the like. They differ from non-radioactive elements in that they affect a photographic film and decompose into other elements. The rate at which they decompose can not be changed by any of the means that affect the rate at which compounds decompose. That is why we call these substances elements; but to set them apart, we call them radioactive elements.

(*From* Uri Haber-Schaim. et al; **Introductory Physical Science**; Prentice Hall, Inc; Englewood Cliffs, New Jersey 07632;1987).



Beam scale

Often found in doctor's offices, the beam scale uses small adjustable weights called poises to balance the load. The weight is measured from markings on the beam.

Unit Nine

WEIGHT AND MASS

READING PASSAGE

Weight and weightlessness

Perhaps nothing is so ingrained in our senses as the perpetual pulling of the earth on our surroundings. It's always there, never changing. It's been hugging solids, liquids and gases to the earth's surface for over 4 billion years. Earth's gravity is built into our descriptions of our world with words like up, down, and weight.

Exactly what is weight? A weight is a force, nothing more. Your weight is the pull of earth's gravity on your body. Likewise, the weight of your car is the force of the earth's attraction for it. The greater the mass is, the larger the attraction. Two identical pickup trucks weigh exactly twice as much as one. But mass and weight are not the same; they are measures of two different things, inertia and force.

For example, consider the rocks brought from the moon's surface by astronauts. Because of the Earth's stronger gravitational attraction, these rocks weigh more on Earth, about six times as much as they weighed on the moon. But their mass, their resistance to a change in velocity, is still the same; they have the same quantity of matter on earth as they did on the moon.

Even though weight and mass are not the same, most of us do not make a distinction between them, suppose someone hands you two books and asks which is the more massive. Almost certainly you would "weigh" one in each hand choose the heavier book. That's okay, because the heavier one does have more mass. But if the two books were on a smooth table, you could just push each book back and forth to see which has the larger inertia. (Their weights don't come into play, being balanced by upward pushes from the table). Even then, pointing to the one that's harder to accelerate, you might from habit still say "That one is heavier". The point here is "that one" is harder to accelerate only because it has greater mass. An astronaut could pick up a large rock on the moon with much less force than required on earth. But if the astronaut shoved the rock in a horizontal direction, it would take just as much of a push to accelerate it at, say, 5 feet/second^2 as it would take on earth. There is a difference between weight and mass.

To measure your weight you can use a bathroom scale, which is a spring that stretches if it is pulled (or compresses if it is pushed). As you step onto the scale, the spring's pointer register a larger and larger force until you are at rest, supported entirely by the scale. The scale then shows you how much force (from the spring) balances gravity's pull on your mass, and this force is equal to your weight. If you step down and drink two cups of coffee and then step back on the scale, you'll weigh about 1 pound more.

But suppose some fellow strapped a small scale to his feet and jumped from the top of the stepladder. You can imagine what would happen, although you should not actually try it. While he was falling, the scale would fall with him- it wouldn't support him, and he couldn't press against it. In this situation, the scale would show a reading of zero. Gravity's pull would still be there, of course, pulling on him as he fell. He would still have weight, the pull of gravity on his body. It's just that nothing would stop that fall, there would be no supporting force opposing the gravitational pull, so he would feel weightless.

To jump with a scale would be awkward (and dangerous). But if you strap on a small backpack stuffed with books and hop down from a chair, you can feel the pack's weight vanish from the shoulder straps while you are falling. Perhaps, you've jumped piggyback with a friend into a swimming pool. If your friend is on your back and you jump, your friend's weight disappears from your back while the two of you are in midair. Nevertheless, the weight of your friend doesn't disappear; it causes your friend to accelerate right along with you, at the rate of g, towards the water. This is why news reporters often say astronauts are "weightless" when they are in the orbit. But a better way to describe their condition is to say they are in free fall. Since everything in a spaceship falls together around the earth, nothing inside supports anything else. It's true that the astronauts hover and float within their spacecraft as if they were weightless, but gravity still pulls on their bodies, so they do have weight. The term weightlessness is a misnomer, but it gets the ideas across. While in free fall, things seem to have no weight relative to each other.

Provided there's no air resistance, everything near the earth's surface falls with acceleration g. We can use this fact and the formula $F_{net} = ma$ to find the weight of an object. If something is falling freely (in vacuum), its weight is the only force acting, so its weight is the net force. The acceleration **a** is simply g, and substituting in the formula, we find weight = mg (When anything is at rest, the acceleration is zero, of course, because the force from the ground balances the weight.) We measure weight in pounds or newtons, the usual units of force.

As an example, we'll find the weight of 1 kg mass on earth in both newtons and pounds: weight = mg = (1kg) (9.8m/s^2) + 9.8N = 2.2lb.

(*Adapted from* **Physics, an introduction** by Jay Bolemon, 1989)

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading text.*

1. What is the weight of a body?

………………………………………………………………………………………
…………………………………………………………………………………

2. What is the difference between the weight and the mass of the same body?

   ………………………………………………………………………………………
   …………………………………………………………………………………

3. What makes the difference to your body on Earth and on the Moon? And what is the difference?

   ………………………………………………………………………………………
   …………………………………………………………………………………

4. Is weight a scalar or vector quantity? Why?

   ………………………………………………………………………………………
   …………………………………………………………………………………

5. In which situation can you be considered to be weightless? What really happens in this situation?

   ………………………………………………………………………………………
   …………………………………………………………………………………

Exercise 2: *Fill in the blanks with the words you have read from the reading text. These statements will make up the summary of the reading text.*

1. We describe ___ with words like *up, down,* and *weight.*
2. The weight of a body is the ___ of earth's gravity on it.
3. Mass is to measure ___ and weight is to measure force.
4. The Earth's ____ ____is 6 times greater than that of the Moon.
5. ____ is the quantity of matter of a body.
6. Common people normally do not _____ ______ ______between mass and weight.
7. The feeling of weightlessness results from the fact that there's no _________ _________ opposing the gravitational pull.
8. Without air resistance. Everything near the Earth's surface falls with ____
9. Astronauts are weightless when in__________
10. When a body's in free fall, its weight is the ____

Exercise 3: New version - *Fill in the blank in the following text about weight.*

The weight W of a body is a (1)………….. that pulls the body towards a nearby astronomical body; in everyday circumstances that (2)………….. body is the Earth. The force is primarily (3)………….. to an attraction – called a gravitational attraction – between the two bodies. Since (4) …………… is a force, its SI unit is the Newton. It is not mass, and its (5)……………. at any given location depends on the value of g there. A bowling ball might (6)…………. 71 N on the Earth, but only 12 N on the Moon, where the (7)……………….. acceleration is different. The ball's mass, 7.2 kg, is the same in either place, because (8)…………….... is an intrinsic property of the ball alone. (If you want to lose weight, climb a mountain. Not only will the exercise reduce your mass, but the increased elevation means you are further from the center of the Earth, and that means the value of g is less. So your weight will be less). We can weigh a body by (9) ……………it on one of the pans of an equal-arm balance and then adding reference bodies (whose masses are known) on the other pan until we strike a balance. The masses on the pans then match, and we know the mass m of the (10)…………. . If we know the value of g for the location of the balance, we can find the weight of the body with the following formula: W = mg.

GRAMMAR IN USE

I) If-clauses

An if- clause is commonly called a conditional clause in complex sentences. You have learnt all types of conditional sentences, but in a brief summary, we should recall all such types:

There are four types of conditional sentences:

Type 0:

1. If your friend is on your back and you jump, your friend's weight disappears from your back while the two of you are in midair
2. If we heat iron, it expands.

Type 1:

1. If you step down and drink two cups of coffee and then step back on the scale, you'll weigh about 1 pound more.
2. If we heat water up to 100^0 C, it will evaporate.

Type 2:

1. If the astronaut shoved the rock in a horizontal direction, it would take just as much of a push to accelerate it at, say, 5 feet/second^2 as it would take on earth
2. If we used a larger amount of matter in our experiment, we would conclude that mass really does not remain the same.

Type 3:

1. If you had worked carefully, you would have found that all the changes in mass that you observed were within the experimental error of your equipment.

In science writing, the last type is much less frequently used than the first three ones. The reason for this lies in the function of each type that we recall as follows:

Type 0: **If … + present … + present**

This type is used to express one thing that always follows automatically from the other (or we can understand it in the way that this pattern is used to express a truth.)

Note: We can use *when* instead of *if*

For example: *When/if* we heat iron, it expands.

Type 1: **If … + present … + will (modal base)**

This type is used to express an open condition. It leaves an open question of whether the action will happen or not.

Type 2: **If … + past … + would (modal past form)**

This type is used to express an imagined condition or a presumption for the action that happens to follow.

Type 3: **If … + past perfect … + would + perfect**

This type is used to express something unreal or an imaginary past action, meaning it did not really happen.

II) Special patterns of comparison

You have learnt all the basic patterns of comparison of adjectives and adverbs. The following will present only two common special patterns that are used quite a lot in science writing:

Pattern 1: **the … + comparative … the … + comparativ**e

This pattern is used to express a parallel increase or to say that a change in one thing goes with a change in another.

Example:

1. *The greater* the mass is, *the larger* the attraction gets.
2. *The more careful* you are when conducting the experiment, *the better* the results.
3. *The more thoroughly* you examine the phenomenon, *the narrower* the limitations of your conclusion (will be).

Pattern 2: **comparative and comparative**

This pattern is used to express gradual and continuous decrease or increase.

Example:

1. As you warm a piece of candle wax in your hand, it becomes *softer and softer*.
2. As the Earth recedes into the distance, the potential increases *more and more slowly.*

PRACTICE

Exercise 1: *Write conditional sentences by combining one clause from A with a suitable one from B.*

A

1. a straight stick is inserted obliquely into water
2. we examine the works of a clock
3. one side of a block is rougher than the other sides
4. the conductor is touched while the charged body is still near it
5. someone claimed that he/she had done an experiment in which as much as one-millionth of the mass disappeared or was created
6. a body is suspended on a scale
7. we were on the Moon
8. two different loads stretch a spring identically at a pole
9. we dissolve some sugar in water
10. no matter is added to a body and not a single particle is separated from it

B

a. **we will find that separate trains of wheels drive the hour hand and the minute hand.**

b. **it is impossible to change its mass, regardless of what external actions we resort to.**

c. **it will appear to be bent at the surface of the water**

d. **the charge which has the same sign as the inducing charge disappears.**

e. **we will be able to find the force of its attraction by the Earth.**

f. **this identity is completely preserved even at the equator.**

g. **friction is increased when the block rests on that surface.**

h. **our weight would be different.**

i. **we should treat the result with great suspicion.**

j. **the mass of the solution will be precisely equal to the sum of the masses of the sugar and the water.**

Exercise 2: ***Decide whether two of the sentences in each pair are exactly the same in meaning or not. Write (S) for the same and (D) for the different.***

1. **a. The frictional force is greater when the contact force is greater.**

   b. The greater the contact force, the greater the frictional force.

2. **a. When the mass of the attracting body is larger, the force of gravity changes more rapidly at a given distance.**

   b. The larger the mass, the larger its tidal force at any given distance.

3. **a. If you climb a mountain, your potential energy increases as you go up.**

   b. The higher you are in the air, the greater your potential energy gets.

4. **a. As the rocket goes up, the Earth's pull on it gets gradually less.**

   b. The higher the rocket is up, the Earth's pull on it gets smaller and smaller.

5. **a. As we move further away from the Earth's surface, the equipotential lines become further and further apart.**

   b. The further we move away from the Earth, the further apart the equipotential lines get.

6. **a. The atoms of a solid vibrate more and more as the temperature rises.**

   b. The higher the temperature, the stronger the atoms of a solid vibrate.

7. **a. Since the force is the same at all points in a uniform field, it follows that the energy of the charge increases steadily as we push it from one plate to the other.**

   b. In a uniform field, as the force is unchanged at any point, the energy of a charge gets higher and higher when we push it from one plate to the other.

8. **a. The potential energy of the test charge increases more and more rapidly the closer you get to the repelling charge.**

   b. The closer you get to the repelling charge, the more rapidly the potential energy of the test charge increase.

9. **a. The strength of a magnetic field depends on how concentrated the flux is.**

   b. The stronger the strength of a magnetic field, the more concentrated the flux is.

10. **a. Through a conductor length L in a magnetic field, a current I will feel a force F; the stronger the field, the greater the force.**

    b. In a magnetic field, a current I through a conductor length L feels a force F which is proportional to the strength of the field.

PROBLEM SOLVING

Describing process in chronological order

When we describe a process or procedure, say, an experiment, we often use the present passive tense to give a general description (But when we report, we use the past passive tense.)

Sequence, or order, is important in this type of description. That's why the sequence markers e.g. first, then…finally are often used. These help not only to link the sentences but to describe actions in a chronological order as well.

***The following are the commonly-used markers*:**

First(ly), … second(ly),… third(ly), ….etc. …then/next/after that/afterward…finally/lastly

One, … two, … three, … etc. …. The next (following) step is/ then/ next/after that/afterward … finally/ lastly

***And some others*:**

while (whilst) …, … at the same time, … … in the mean time, before – ing, … after – ing

Sometimes, in order to avoid repeating a subject, *pronouns* ***and*** *relative clauses* ***are used.***

Read the following examples:

1. ***First*, a hole is made in the cap of a large plastic water can and the valve from an old bicycle tyre is glued to it. *Then*, the cap is put back on the can and the can is weighed on a pair of balances. *After that*, extra air is pumped into the can and the can is weighed again. It will be found that the can weighs more after the extra air is pumped into it than it did before.**
2. ***First*, two pieces of platinum foil are connected to a battery with one piece to the positive terminal and the other to the negative. They are *then* placed in blue copper sulphate solution contained in a beaker. *Next*, a test tube is filled with the solution and fixed over the anode. *Finally*, the current is switched on. The current passes from the anode to the cathode through the solution. It will be seen that the blue solution of copper sulphate gradually becomes paler as the current passes through it. *At the same time*, gas is given off from the anode and is collected in the test tube.**

Combine each set of the following statements into a paragraph, using suitable sequence markers, pronouns and relative clauses as well.

1. Electrolysis using copper electrodes**.**

Two copper plates are weighed.

They are connected to a battery.

They are placed in a vessel containing copper sulphate solution.

The current is switched on.

The current passes from one place to the other through the copper sulphate solution.

After half an hour the current is switched off.

The plates are removed from the copper sulphate solution.

They are dried.

They are weighed again.

2. Oil refining

Crude petroleum is placed in a metal vessel, or still.

Steam is passed over the petroleum.

This provides enough heat to change the lightest oils into vapors.

These vapors are carried to a number of pipes surrounded with water, or condensers.

The vapors are cooled and become liquid in the condensers.

The still is heated.

Heavier oils are changed into vapors.

The vapors are led to condensers.

The vapors are liquefied.

3. The making of alloys

The two metals which are the ingredients of the alloys are melted.

The main gradient is melted.

The other ingredient is melted.

The other ingredient is added to it.

The other ingredient dissolves.

The mixture is poured into metal or sand moulds.

It is allowed to solidify.

4. Welding

The ends of two pieces of metal are carefully cleaned.

They are heated.

The ends become white hot.

A flux is applied to the heated ends.

The flux melts.

The ends are pressed or hammered together.

The joint is smoothed off.

5. The preparation of oxygen

Potassium chlorate crystals are mixed with black manganese (IV) oxide powder.

The mixture is placed in a test tube.

The test tube is fitted with a delivery tube.

The delivery tube leads to a trough of water.

A glass jar containing a column of water is placed upside down in the trough.

The test tube is heated.

The potassium chlorate decomposes.

Oxygen is released.

It passes through the delivery tube.

It is collected in the glass jar.

(*Adapted from* English in Physical Sciences**, Student's edition by J.P.B.Allen, H.G.Widdowson, Oxpford University Press, 1997).**

TRANSLATION

Task one: *English-Vietnamese translation*

1. **Suppose a piece of gold balances a piece of wood, and the piece of wood balances a piece of brass. Then we say that the masses of all three are equal. If something else balances the piece of brass, it also balances the wood and the gold and therefore has the same mass. The equal- arm balance gives us a way of comparing masses of objects of any kind, regardless of their shape, form, color, or what substance they are made of.**
2. **Issac Newton found that any two particles with masses m_1 and m_2 pull on each other, directly towards each other, with forces that are equal and opposite. He found that the force between two particles varies as the product of their masses, divided by the square of their distance, or $F_{gravity}$ varies as m_1m_2/d^2 where d is the distance between them. The farther apart the particles are, the smaller the attraction they have for each other. As d becomes larger, m_1m_2/d^2 becomes smaller – at an ever greater rate. Nevertheless, the distance must become infinitely large before $F_{gravity}$ vanishes completely. Here's a force that acts over a distance as great as you can imagine, straight through anything that is in its way.**
3. **Weight is the force with which a body is attracted by the Earth. This force can be measured with a spring balance. The more the body weighs, the more the spring on which it is suspended will be stretched. With the aid of a weight taken as the unit it is possible to calibrate the spring – make marks which will indicate how much the spring has been stretched by a weight of one, two, three, etc., kilograms. If, after this, a body is suspended on such a scale, we shall be able to find the force (gravity) of its attraction by the Earth, by observing the stretching of the spring. For measuring weights, one uses not only stretching but also contracting springs. Using springs of various thickness, one can make scales for measuring very large and also very small weights. Not only coarse commercial scales are constructed on the basis of this principle but also precise instruments used for physical measurements.**

4. **In measuring weight by comparing it with the weight of a standard, we find a new property of bodies, which is called mass. The physical meaning of this new concept – mass- is related in the most intimate way to the identity in comparing weights which we have just noted. Unlike weight, mass is an invariant property of a body depending on nothing, except the given body. A comparison of weights, i.e. measurement of mass, is most conveniently carried out with the aid of ordinary balance scales. We say that the masses of two bodies are equal if the balance scale on whose pans these bodies are placed is in perfect equilibrium. If a load is in equilibrium on a balance scale at the equator, and then the load and the weights are transported to a pole, the load and the weights change their weight identically. Weighing at the pole will therefore yield the same result: the scale will remain balanced. The mass of a body remains the same no matter where it is.**
5. **If you have worked carefully, you have found that all the changes in mass that you observed were within the experimental error of your equipment. Therefore, your results agree with the conclusion that there were no changes in mass that you could measure. From these experiments alone, you can not predict with the certainty that there will be no change in mass under other circumstances. For example, if we use a larger amount of matter in our experiments and use a balance of higher accuracy, we might measure a change greater than the range of experimental error. Then we would conclude that mass really does not remain the same. Furthermore, although we checked five rather different kinds of change, there is an endless variety of other reactions we could have tried, some even more violent than the reaction of copper and sulfur.**

(*Adapted from* different sources)

Task two: *Vietnamese - English translation*

1. **Khối lượng của một vật là đại lượng đặc trưng cho mức quán tính của vật. Khối lượng là một đại lượng vô hướng, dương và có giá trị không thay đổi đối với mỗi vật.**
2. **Với cách hiểu mới về khối lượng, ta có thể dùng khái niệm này để so sánh các vật bất kỳ, dù làm bằng một chất hay làm bằng các chất khác nhau. Vật nào có khối lượng lớn hơn thì có mức quán tính lớn hơn hoặc ngược lại. Khi nhiều vật được ghép lại thành một hệ vật thì khối lượng của hệ vật bằng tổng khối lượng của các vật đó. Như vậy khối lượng có tính chất cộng. Nhờ có tính chất này mà khối lượng dùng để chỉ lượng chất chứa trong vật khi so sánh các vật cùng chất.**
3. **Vì vật có khối lượng nên khi chịu tác dụng của lực, vận tốc của vật không thể tức thời tăng thêm mà cần có thời gian, vật có khối lượng càng lớn thì thời gian cần thiết càng lớn.**

4. **Định luật III Niutơn cho ta một phương pháp đo khối lượng của một vật: Muốn đo khối lượng của một vật, trước hết phải chọn một vật có khối lượng bằng đơn vị gọi là khối lượng chuẩn. Sau đó ta cho vật cần đo khối lượng m tương tác với khối lượng chuẩn m_o. Khối lượng chuẩn thu được gia tốc a_o, còn vật m thu được gia tốc a. Theo trên ta có: $a/a_o = m_o/m$. Đơn vị khối lượng là 1 kilôgam. Kilôgam là khối lượng của một vật chuẩn hình trụ làm bằng một hợp kim đặc biệt, được cất giữ ở viện đo lường quốc tế ở Pari, thủ đô nước Pháp.**
5. **Trong thời đại du hành vũ trụ hiện nay, ta thường nghe nói đến hiện tượng tăng , giảm, hoặc không trọng lượng. Đó là hiện tượng khi treo một vật vào một lực kế để đo trọng lượng thì thấy lực kế chỉ một lực lớn hơn hoặc nhỏ hơn trọng lực tác dụng lên vật, thậm chí bằng không. Hiện tượng tăng trọng lượng xảy ra trong thang máy lúc bắt đầu chuyển động lên, hoặc trong con tàu vũ trụ lúc bắt đầu được phóng lên. Hiện tượng giảm trọng lượng xảy ra trong thang máy lúc bắt đầu hạ xuống. Còn hiện tượng không có trọng lượng xảy ra trong thang máy rơi tự do hoặc trong con tàu vũ trụ đang chuyển động tròn đều quanh trái đất.**

(*Adapted from* different sources)

KEY TERMS

Air resistance (n)**: Wind drag giving rise to forces and wear on buildings and other structures.**

Alloy (n)**: a metal that is made by mixing two or more types of metal together**

Balance**: 1**(n)**. a situation in which all the different things involved are equal and correct in size, strength…** ***Trạng thái cân bằng***

2 (v). if you balance one thing with another or if several things balance each other, each of the things has the same weight, strength,… ***Cân bằng/ ở thế cân bằng***

Calibrate (v)**: If you calibrate an instrument or tool, you adjust it or mark it sothat you can use it to measure something accurately.** ***Điều chỉnh***

Concept (n)**: an idea or abstract principle.** ***Khái niệm***

Current (n)**: the rate or flow of any conserved, indestructible quantity across a surface per unit time.** ***Dòng***

Electrode (n)**: a small piece of metal that takes an electric current to or from a source of power or a piece of equipment.** ***Điện cực***

Electrolysis (n)**: the process of passing an electric current through a substance in order to produce chemical changes in the substance.** ***Quá trình điện phân***

Electrolyte (n): **a substance, usually a liquid, which electricity can pass through.** ***Chất điện phân***

Equilibrium (n)**: a balance between several different forces, groups, or aspects of a situation.** ***Trạng thái cân bằng***

Horizontal (adj)**: something that is horizontal is flat and level with the ground, rather than at an angle to it (opp: vertical).** ***Theo phương nằm ngang***

Intrinsic property (n)**: a property of a substance that is not seriously affected by impurities or imperfection in the crystal structure.** ***Đặc tính cố hữu/ thuộc về bản chất***

Mass (n)**: a quantitative measure of a body's resistance to being accelerated; equal to the inverse of the ratio of the body's acceleration to the acceleration of a standard mass under otherwise identical conditions.** ***Khối lượng/ lượng chất có trong vật***

Massive (n)**: being large in size, quantity or extent.** ***Lớn/ rộng/ nhiều***

Orbit (n): **1. any closed path followed by a particle or body, such as the orbit of a celestial body under the influence of gravity, the elliptical path followed by electrons in the Bohr theory, or the paths followed by particles in a circular particle accelerator.** ***Quỹ đạo***

2. any path followed by a particle, such as helical paths of particles in a magnetic field, or the parabolic path of a comet. ***đường đi của hạt***

Quantity (n): **the amount of something that there is or you can measure or count.** ***Lượng***

Scale**: a piece of equipment for weighing things.** ***Cái cân***

Tidal force (n)**: the stretching or pulling force that acts on an extended body that is the gravity field of massive object.** ***Lực thuỷ triều***

Vacuum (n)**:**

1. **theoretically, a space in which there is no matter.** ***Theo lý thuyết thì là một vùng chân không.***
2. **practically, a space in which the pressure is far bellow normal atmospheric pressure so that the remaining gases do not affect the processes being carried out in the space.** ***Theo thực tế thì đây là vùng có áp suất quá thấp so với bình thường nên mọi chất khí dù có mặt cũng không có ảnh hưởng đến các quá trình được thực hiện trong môi trường đó.***
3. **the lowest possible energy state of a system, conceived of as a polarizable gas of virtual particles, fluctuating randomly.** ***Mức năng lượng thấp nhất đến mức có thể đạt được của một hệ được hiểu như là một chất khí có khả năng phân cực của các hạt ảo dao động một cách hỗn độn.***

Weigh (v)**: if you weigh something, you measure how heavy it is.** ***Cân trọng lượng***

Weight(n):

1. **the gravitational force with which the earth attracts a body.** ***Trọng lượng/ trọng lực***
2. **by extension, the gravitational force with which a star, planet, or satellite attracts a nearby body.** ***Mở rộng hơn thì đây là lực hấp dẫn mà nhờ nó một thiên thể có thể hút một vật ở gần***

FREE-READING PASSAGE

It is advisable that you read the following passage to learn more about how the conditions are used in an authentic writing. You can do some translation practice on this passage and pick up some new vocabulary items.

Elasticity and friction

1. Elasticity**. Press on a spring, and it compresses and pushes back on your hands. Pull on it and it stretches, pulling back on you. We say it is elastic. An elastic solid is one that can recover its original size and shape after the deforming force is removed. When you squeeze a solid, the atoms and molecules crowd together and the contact force between them grows and pushes back. If you stretch the solid, those small units ease apart, but the intermolecular bonds pulls them back towards each other. The combination of these two separate actions gives the solid elasticity. In effect, this causes the atoms to behave as if they are connected by small invisible springs.**

   No solid is perfectly rigid; all show some degree of springiness, or elasticity. You can bend in the side of an aluminum soft drink can, and it can pop out when you let go. (If you squeeze too hard, however, you'll break some bonds, making a permanent dent) Even your fingertip returns have elasticity. Press a pencil point against one. Take away the pencil, and the fingertip returns to its normal shape.

   Place your hand on a countertop and press down. Even though you can't see it happen, the surface's molecules under your hand squeeze a little closer together as they push back, supporting your hand. Below them, countless others share the weight, shifting a tiny bit and passing the load along to the floor below. When you lift your hand, all the molecules return to their former positions. However, slight their shifting, that's elasticity.

2. Friction**. Slide a dictionary across a desk top. If you push gently, the dictionary won't budge. All solid surfaces, even the smoothest, have microscopic bumps and dips and notches that catch when the surfaces are pressed together. When you push the dictionary gently, these irregularities push against each other. As you push harder, the growing force from your hand will finally break their holds and the dictionary will slide along. Then there is usually less resistance (or**

friction) because the surfaces are skimming over each other. And fewer of the "ups and downs" catch and grab.

The force of friction between the table and the book while the book is stationary is called static friction. Note that the force of static friction grows in respond to your push and matches in ounce up to some maximum force. When the frictional grip of the two faces on one another has been exceeded, the surface slips. The frictional force that remains between them as the dictionary move is called kinetic friction. Fictional force, like all forces, occurs in pairs. When desk resists the dictionary's motion, the desk gets an equal but opposite tug from that sliding dictionary. The direction of a frictional force is easy to find. The frictional forces on objects always oppose the relative motion or the "pending" motion. Frictional forces between solids also depend on how hard the two surfaces press together. That is, the frictional force is greater when the contact force is greater. Put another dictionary on top of the first one and push on that bottom dictionary again. You'll find it is much harder to set into motion: the maximum value of the static friction is greater than before.

Liquids and gases, as we've said, resist the passage of a solid object. That's friction too. Air drags on anything that moves through it; air molecules collide with the oncoming surface, and the contact forces retard its motion. Just swish your hand back and forth rapidly and you can feel the air with your hand. If you swish your hand through water, there's much more resistance.

Our bodies are well adapted to using friction in every day activities. The fingerprint ridges on the elastic skin of our fingers and palms increase friction when we grasp things. One reason a dish can slip from wet hands so easily is because water has filled in the ridges, making a smoother surface. The soles of our feet have similar patterns that aid in gripping. You use friction when you turn a doorknob, tie your shoelace, or scratch an itch.

Close your eyes and imagine waking up and going into your kitchen for breakfast. Now fantasize that as you walk in, all frictional forces ease to exist! You'd really have some problems. To stop your motion over the frictionless floor, you'd have to grab a cabinet knob or something else that is bolted down. The table and stove would have to be perfectly horizontal, or the frictionless plates and pans would slide downhill and fall off. Even then you'd have to set them down with zero speed or they'd drift away, courtesy of the first law. As you stirred a recipe of muffin batter, the reaction force would stir you in return. Your feet would follow a miniature path over the floor like the larger one your hand and spoon made in the bowl. But it probably wouldn't take you long to adjust; Newton's laws would still govern the performance. Astronauts get along without "weight," so surely you could find a way to function without friction.

(*Adapted from* Physics, an Introduction **by Jay Bolemon, 1989)**

Solar home

In this solar home in Corrales, New Mexico, a flat plate collector (lower right) provides energy to heat water pumped by the windmill. The water is stored in large drums on the side of the home.

Unit Ten

ENERGY

READING PASSAGE

Friction, Internal energy, and Heat

Toss your keys along the floor, they'll skitter along for a bit as friction does negative work on them, reducing their kinetic. Quickly, the keys come to rest, and the kinetic energy you gave them is gone. But in this case they can't turn around (as they did when you picked them up), gather speed from the same frictional force that acted to slow them, and jump back into your hand with the same kinetic energy. Once the motion stops, the friction stops, and **it** can not restore the kinetic energy of the keys as gravity is able to do. Frictional forces don't store energy in the form of potential energy. But all the kinetic energy that you gave the keys when you tossed them doesn't just disappear.

The keys skid across the surface of the floor, scraping and catching. The affected surface molecules of the keys and the floor are pushed through some tiny distance, giving **them** extra kinetic energy. Molecules throughout any solid object bounce around in all directions even though they are held in place by their bonds with the molecules around them. When molecules of the keys and the floor strike each other, however, they bounce around even faster. The affected molecules slam into the nearest neighbors (in all directions) and **these**, too, move a bit faster. All the organized kinetic energy the keys had just before they hit the floor disappears, and most of it scatters aimlessly among the molecules. That chaotic energy now is part of the energy stored in the matter. We call that energy the internal energy of the keys and the floor. The internal energy in matter can be thought of as the sum of the kinetic and potential energies of all of its molecules including, as we see, energy called chemical, gravitational, and nuclear, and energy associated with the presence of mass itself.

When the molecules of matter move faster, the matter becomes warmer, that is, **its** temperature increases. But all the keys' original kinetic energy doesn't just go to raise the temperature of the keys and the floor. A portion of **that energy** goes into work that deforms, or scratches, the keys and the floor, and some of the energy even goes into making sound. But the important point here is that whenever frictional forces do work, some of the work goes into increasing the internal energy of matter, and this internal energy spreads out, making it much less effective at producing work than, say, the organized kinetic energy of a moving object.

For example, in a car's engine some of the potential energy stored in the gasoline or diesel fuel turns into random kinetic energy of the molecules. **The heated gases** push pistons downward, but all of that released energy can not be converted to work on the pistons. The energy the pistons get from those hot gases is only about 25 percent of the energy released from the chemical bonds. The rest? Some goes into raising the temperature of the cylinder walls and the piston, and that part spreads outward, doing no useful work. **Some** leaves with the still-hot gases that escape through the exhaust system of the car, once again doing no useful work.

The efficiency of a machine (or animal or any other energy processor) is defined as work done/energy used. The efficiency of a car's engine is 0.25 if 25 percent of the energy released by the fuel goes into work on the car. Because of frictional forces and the loss of energy through the exhaust gases and to the cylinder walls, an automobile's efficiency could never be equal to 1 (or 100 percent). The same is true for us, where a large percentage of energy released in metabolism goes to keep our internal energy high – it goes to keep us warm.

Almost every time anything moves through some distance, friction from some source does work and transforms some kinetic energy into internal energy. As the internal energy spreads, or is even transferred to another body, we say there is a flow of heat or heat transfer. Heat refers to the part of an object's internal energy that is moving because of difference in temperature. (Often the energy that can move this way is called heat energy, or thermal energy, but strictly speaking heat is not stored energy. Heat is energy that is moving from one place to another place, increasing or decreasing an object's internal or stored energy.). But the connections between work done by friction and internal energy and heat were not fully understood until the 1840s. Once that connection was made, **it** quickly led to an important insight into nature. That is the law of conservation of energy: In every interaction of any kind, the total energy afterward is always the same as the total energy to begin with.

(*Adapted from* **Physics, an introduction** by Jay Bolemon, 1989)

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading text.*

1. What's the property of molecules in a solid object?

   ………………………………………………………………………………………
   ……………………………………………………………………………

2. What's internal energy of a matter?

   ………………………………………………………………………………………
   ……………………………………………………………………………

3. What happens when frictional forces do work?

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   ……………………………………………………………………………

4. In your own words, define the efficiency of a machine?

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…………………………………………………………………………………

5. What is heat?

……………………………………………………………………………………………
…………………………………………………………………………………

Exercise 2: *Contextual reference* (Dealing with words in **bold** type*)*

1. "**it**" in line 6 refers to
   a. the motion
   b. thee friction
2. **"Them**" in line 12 refers to
   a. the affected surface molecules of the keys
   b. the affected surface molecules of the keys and the floor
3. "**These"** in line 16 refers to
   a. the affected molecules
   b. the nearest neighboring molecules
4. "**Its"** in line 24 refers to
   a. of the molecule
   b. of the matter
5. "**that energy"** in line 26 refers to
   a. the key's original kinetic energy
   b. the floor's kinetic energy
6. "**The heated gases"** in line 33 refers to
   a. potential energy in gasoline and fuel
   b. random kinetic energy of the molecules
7. "**some"** in line 38 refers to
   a. some of the energy released from the chemical bonds
   b. the energy that spreads out
8. **"it"** in line 56 refers to
   a. nothing
   b. the connection between work done by friction and internal energy and heat

Exercise 3: *Fill in the blanks with words/phrases from the reading text*

1. Friction stops when motion stops but can not restore the ……………………. of the keys tossed along the floor as gravity can.
2. Frictional forces don’t store energy in the form of……………….....…………….
3. All molecules in a …………bounce around in all directions.
4. ………….. ……………of matter equals to the sum of the kinetic energy and potential energy of all of its molecules plus some other forms of energies.
5. A raise in ……………of a matter results from the faster movement of its molecules.
6. Some of …………….…………..done frictional forces helps increase the internal energy of matter.
7. Much of the energy released from the ……………………………of gasoline or diesel fuel in a car’s engine does no useful work.
8. ……………..………………of a car’s engine is defined by the percent of the energy released by the fuel that goes into work on the car.

GRAMMAR IN USE

Present participle with some special functions

A present participle phrase is the one of which the central element is a present participle formed as an –ing form of verb

Example: The phosphor gas rose up into the air, *making specks of light*.

You have learnt the use of present participle in replacing relative clause and clause of reason with active meaning. The following will present some others commonly applied in science writing.

1. ***Present participle phrase (also known as an –ing clause) is used to give an explanation***

Example:

The molten iron, having been in contact with the coke in the lower part of the furnace, contains several percent of dissolved carbon.

In the above example, the participle phrase is used to give an explanation for the action mentioned in the main clause.

2. ***Present participle phrase is used to mention something as a part of the action mentioned in the main clause: that can be either an addition or a result or consequence of that action.***

Example:

a. Toss your keys along the floor, they'll skitter along for a bit as friction does negative work on them, *reducing their kinetic*. (consequence)

b. The keys skid across the surface of the floor, *scraping and catching*. (addition)

c. The affected surface molecules of the keys and the floor are pushed through some tiny distance, *giving* ***them*** *extra kinetic energy*. (result)

Note: If the subject of the participle phrase is the same as the subject of the main clause, it is omitted, as in the above examples. However, if the two objects are different, both of them must be mentioned.

Example:

Wheels of different diameters are engaged to each other, ***the smaller ones*** *making more revolutions.*

3. Present participle is used to replace an adverbial clause of time with active verb phrase (or shorten an adverbial clause of time with active verb phrase to a present participle phrase of time)

First, we should recall of what an adverbial clause of time is like:

In form, an adverbial clause of time is the one which starts with a time conjunction.

In grammar, it is a subordinate (dependent) clause.

In meaning, it sets a time reference for the action mentioned in the main (independent) clause.

Example:

a. *Once the motion stops*, the friction stops, and it can not restore the kinetic energy of the keys as gravity is able to do.

b. All the kinetic energy that you gave the keys *when you tossed them* doesn't just disappear.

c. When molecules of the keys and the floor strike each other, they bounce around even faster.

d. *When the molecules of matter move faster*, the matter becomes warmer.

e. The important point here is that *whenever frictional forces do work*, some of the work goes into increasing the internal energy of matter,...

f. *Almost every time anything moves through some distance*, friction from some source does work and transforms some kinetic energy into internal energy.

An –ing clause can replace an adverbial clause of time in this way:

We retain the conjunction of time, in general, and reduce the verb in the clause to its –ing form. Normally, this can be done with the sentence in which the subject in the time clause is the same as that in the main clause. However, in many cases, especially in science writing, these are different. Thus, we have to retain the subject regardless of the difference.

Therefore, the above sentences can be rewritten in this way:

a. *Once the motion stopping*, the friction stops, and it can not restore the kinetic energy.

b. All the kinetic energy that you gave them *when tossing them* doesn't just appear.

c. *When striking each other*, the molecules of the keys and the floor bounce around even faster.

d. *When the molecules of matter moving faster*, the matter becomes warmer.

e. The important point here is that *whenever frictional force doing work*, some of the work goes into increasing the internal energy of that matter.

f. *Almost every time anything moving through some distance*, friction from some source does work and transforms some kinetic energy into internal energy.

Note: that you may have an impression that the clause is not at all shortened (reduced) in length (or in number of words). However, the word 'shorten' or 'reduce' just implies the reduction in grammatical aspect, i.e. we reduce a clause into a phrase. That's why the use of the word 'replace' is quite reasonable for the cases.

To emphasize the completion of an action with respect to another, we use the perfect participle:

having done

Example:

Having carefully prepared, he successfully detected the questionable element in the compound.

In such a case, we have more than one way to express the relationship between two actions (one is conducted before the other).

You can write the sentence in these ways:

a. After he had carefully prepared, he successfully detected the questionable element in the compound.

b. After preparing carefully, he successfully detected the questionable element in the compound.

c. After having carefully prepared, he successfully detected the questionable element in the compound.

d. Preparing carefully, he successfully detected the questionable element in the compound.

In which:

Sentence (a) is the most neutral in style and the most usual of these patterns in everyday speech. (b) is also usual, although a little more formal. (c) is less usual because *after* and *having* both repeat the idea of one action following the other. (d) and the original one are rather literary. (d) also means that the two actions were very close in time.

PRACTICE

Exercise 1: *Combine each of the following pairs of sentences using an –ing clause, state in each case the function of the -ing clause*

1. Only the magnitude of this variable force changes, not its direction. Moreover, its magnitude changes with the position of the particle.

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   ………………………………………………………………………………

2. In the limit, we let the strip width approach zero. The number of strips then becomes infinitely large.

   ……………………………………………………………………………………
   ………………………………………………………………………………

3. We stretch the spring by pulling the block to the right. In reaction, the spring pulls on the block toward the left, in the direction that will restore the relaxed state.

   ……………………………………………………………………………………
   ………………………………………………………………………………

4. The length of the spring is one of several factors that determine the spring constant k. Thus, the length is in those equations implicitly.

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   ………………………………………………………………………………

5. In the British system, the unit of power is the foot-pound per second. Often the horse power is used.

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   ………………………………………………………………………………

6. At low speeds, the two formulas merge. They yield the same result.

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   ………………………………………………………………………………

7. We apply Newton's laws of mechanics only in inertia reference frames. These frames move at constant velocity.

   ……………………………………………………………………………………
   ………………………………………………………………………………

8. For some physical quantities, observers in different inertia reference frames will measure the exact same values. In Newtonian mechanics, these invariant quantities (as they are called) are force, mass, acceleration and time.

   ……………………………………………………………………………………
   ……………………………………………………………………………

9. Some quantities (such as mass, force, acceleration, and time in Newtonian) are variant. That is, they have the same numerical values when measured in different inertia reference frames.

   ……………………………………………………………………………………
   ……………………………………………………………………………

10. Thermal energy is said to be an internal energy of an object. It involves random motions of the atoms and molecules within an object.

    ……………………………………………………………………………………
    ……………………………………………………………………………

11. The work W_f done on the block by f_k is not entire amount of dissipated energy, but only the part that is transferred from the block to the floor. The rest of the dissipated energy remains within the block as thermal energy.

    ……………………………………………………………………………………
    ……………………………………………………………………………

12. Although the mechanical energy of the block is not conserved, the sum of the mechanical energy of the block and the thermal energy of the block and the floor is conserved. That sum is called the total energy E_{tot} of the block-floor system, and our new conservation principle is called the law of conservation of energy.

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    ……………………………………………………………………………

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    ……………………………………………………………………………

13. Power is the rate at which work is done by a force. In more general sense, it is the rate at which energy is transferred by a force from one form to another.

    ……………………………………………………………………………………
    ……………………………………………………………………………

14. In 1905, Einstein showed that as a consequence of his theory of special relativity, mass can be considered to be another form of energy. Thus the law of conservation of energy is really the law of conservation of mass-energy.

    ……………………………………………………………………………………
    ……………………………………………………………………………

15. A force is conservative if its work on a particle moving between two points does not depend on the path taken by the particle. The gravitational force (weight) and the spring force are conservative forces; the kinetic frictional force is non-conservative force.

    …………………………………………………………………………………………
    ……………………………………………………………………………………

    …………………………………………………………………………………………
    ……………………………………………………………………………………

Exercise 2: *Reduce the adverbial clause of time in each of the following sentences*

1. Note that when we change the variable from x to v we are required to express the limits on the integral in terms of the new variable.

   …………………………………………………………………………………………
   ……………………………………………………………………………………

2. When the tomato returns to the launch point, it again has speed v_0 and kinetic energy $\frac{1}{2}mv_0^2$.

   …………………………………………………………………………………………
   ……………………………………………………………………………………

3. As the particle moves from point y_1 to point y_f, its weight mg does work on it.

   …………………………………………………………………………………………
   ……………………………………………………………………………………

4. When the atom reaches an excited state, it does not stay there but quickly de-excites by decreasing its energy, either in a collision or by emitting light.

   …………………………………………………………………………………………
   ……………………………………………………………………………………

5. While we illustrate the law of conservation of mechanical energy, we persistently repeat: "in the absence of friction; if there were no friction…"

   …………………………………………………………………………………………
   ……………………………………………………………………………………

6. When heat comes from a hot water bottle, the water in the bottle loses internal energy equal to the energy the heat carries away.

   …………………………………………………………………………………………
   ……………………………………………………………………………………

7. When Joule did experiments to warm water with paddle wheels, he wanted to see precisely how much thermal energy came from a given amount of work.

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……………………………………………………………………………………

8. Once the glass of tea reaches the temperature of its surrounding, it is at thermal equilibrium.

   …………………………………………………………………………………………
   ……………………………………………………………………………………

9. When water evaporates, it absorbs a lot of energy without a change in temperature.

   …………………………………………………………………………………………
   ……………………………………………………………………………………

10. When a warm solid surface touches a cold solid surface, many of the molecules touch, and the faster vibrating molecules will pass vibrational energy along to those vibrating slower.

    …………………………………………………………………………………………
    ……………………………………………………………………………………

PROBLEM – SOLVING

Paragraph building

Task one

From the prompts given, build up sentences with the addition of the supplementary material above each set. Delete the words /phrases in Italic

1. AS/ACCELERATES/ MIDPOINT /,/ DECREASES/,/AND/INCREASES

it *speeds up* towards *the center* of the oscillation

its potential energy *reduces*

its kinetic energy *goes up*

....
....

2. AT THE MOMENT/, /IT

when you release the mass

the mass has potential energy

....
....

3. REMAINS CONSTANT

the total amount of energy *does not change*

....
....

4. IN ORDER TO/ ,/IT/

to make a mass oscillate

you have to displace *the mass*

....
....

5. /AND THEREBY/

you do work

transfer energy to the mass

....
....

6. BY INTRODUCING FRICTION/, / HAS/, /AND/ DECREASES

damping *gets* the effect of removing energy from the system

the amplitude and maximum speed of the oscillation *reduces*

....
....

7. THEN/, / SLOWS DOWN /, / AGAIN/ AND/, / DECREASES

as it *decelerates*

its potential energy increases

its kinetic energy *falls*

....
....

8. IN ANY OSCILLATION/,/ THERE IS

this regular interchange *exists* between potential and kinetic energy

....
....

Task two:

The above eight statements make up a paragraph but are put in a wrong order. Write the number in such an order that your arrangement makes up a paragraph.

1. 2. 3. 4.

5. 6. 7. 8.

There are two common ways of building a paragraph: **inductively** and **deductively** (These ways of writing in English can be understood exactly in the same ways of writing in Vietnamese, which you were taught in your secondary school**)** However, no matter how it is built up, there must be three parts in each complete paragraph:

Part one: Introduction.

Part two: Body

Part three: Conclusion

In which, the focus of part two is the same in both ways of writing, but the other two are not. In an inductive paragraph, the controlling idea of the paragraph lies right at the very beginning of the paragraph in the introductory part of the paragraph. It is contrary to the way we build up a deductive paragraph, in which the controlling idea lies at the very end of the paragraph in the conclusion part. That is, you can develop your paragraph either from the generalization to the specification or vice versa. These two ways of writing are interchangeable; the way you build your paragraph depends on the convenience of the condition which you are in.

Task three:

Clarify whether the paragraph you built in task two is inductive or deductive, then you rebuild it in the other way and write your paragraph here:

……………………………………………………………………………………………
……………………………………………………………………………………………
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TRANSLATION

Task one: *English-Vietnamese translation*

1. When you throw back the covers on a cold winter morning and roll out of bed, you feel more than just the contact force as your feet hit the floor. The floor feels cool or even cold to your warm feet. Heat flows from your feet into the floor as soon as the

skin makes contact. The molecules of your skin are moving faster than the floor's molecules, vibrating with more energy. When they touch the surface molecules of the floor, the cooler molecules there are buffeted by the jittering and very quickly begin to vibrate faster themselves, taking energy from your foot. Neighboring molecules beneath them are set into faster motion, and heat flows into the floor. When heat passes between molecules because of their contact, we say the energy is transferred by conduction, or by heat conduction.

2. The electricity (or electrical energy) we use daily is generated from other sources of energy in commercial power plants. Potential energy of some variety produces heat energy, which is used to operate turbines to run the electrical generators. (This energy-producing chain is very much like a food chain in its inefficiency: 60 to 70 percent of available energy disappears as waste heat.)The potential energy stored in fossil fuels (oil, coal, and natural gas) is used to generate most of the electricity in the United States. Nuclear power plants and hydroelectric plants (where potential energy of elevated water drives turbines) account for less than 15 percent of the electrical power in the United States.
3. Energy and energy changes are used to describe the exercise of joggers, the production and output of thunderstorms, the destructive power of earthquakes, the changes in population of prey and predators, the output and input in chemical reactions, and the generation of light and heat from stars. It is the conservation of energy that makes the concept of energy so valuable to describe changes in nature. If only part of the energy can actually be measured in a situation, the rest can be deduced from the application of this law. Energy has been called the "common denominator" of the natural science because its conservation law makes it so useful in understanding any physical process.
4. Infrared radiation is part of the electromagnetic spectrum. It consists of electromagnetic waves whose wavelengths are longer than those of visible light. For every cold object, the wavelengths may be very long, reaching into the microwave part of the spectrum. Astronomers have found evidence of such microwave radiation pervading the Universe. This is called the microwave background, and is the remnant of radiation from the 'big bang', the giant explosion that is believed to have occurred at the beginning of time in the Universe. The wavelength distribution of radiation corresponds to a temperature of just 2.7 K above absolute zero.
5. The law of conservation of mass may be considered valid for chemical reactions (the changes in mass, equivalent to the produced or absorbed energy, are not measurable), but (as was later determined) it is not valid for nuclear reactions, where a much larger quantity of matter is converted into energy. In 1905 Albert Einstein showed, in his special theory of relativity, that mass and energy are equivalent. Consequently, the separate laws of conservation of mass and of energy found a more general and exact formulation as the law of conservation of the total of mass and energy.

(*Adapted from* different souces)

Task two: *Vietnamese - English translation*

1. Mỗi một động cơ có một công suất N nhất định (N = F.v). Công thức này cho thấy muốn tăng lực mà động cơ tác dụng lên vật thì phải giảm vận tốc của vật. Động cơ của ôtô, xe máy… có một bộ phận gọi là hộp số (hộp vận tốc) có các bánh xe răng với số răng khác nhau, truyền lực từ động cơ đến trục của bánh xe phát động. Khi ôtô lên dốc, cần tác dụng một lực lớn lên trục thì người lái xe đổi các bánh răng trong hộp số sao cho một vòng của động cơ làm quay một số vòng của trục nhỏ hơn, tức là trục có vận tốc nhỏ hơn, nhưng lực tác dụng lại lớn hơn.

2. Năng lượng là đại lượng vật lý đặc trưng cho khả năng thực hiện công của một vật hoặc hệ vật. Năng lượng gắn liền với vật chất, nghĩa là vật nào, dạng vật chất nào cũng có năng lượng. Năng lượng có nhiều dạng khác nhau, khoa học ngày càng phát triển thì càng phát hiện được những dạng mới. Thí dụ: đến thế kỷ 20 con người mới phát hiện ra năng lượng hạt nhân. Trong cơ học, chúng ta chủ yếu nghiên cứu dạng năng lượng gắn với chuyển động cơ học, gọi là cơ năng, nhưng cũng đề cập sơ lược đến các dạng năng lượng khác.

3. Hai loại thế năng phổ biến ứng với các lực hấp dẫn và lực đàn hồi là thế năng hấp dẫn và thế năng đàn hồi. Vật nặng có thế năng vì nó chịu tác dụng của trọng lực tức là bị trái đất hút; trọng lực là lực tương tác giữa vật và Trái Đất, không có tương tác ấy thì vật cũng không có thế năng nên đúng ra chúng ta phải nói thế năng hấp dẫn của hệ “vật và Trái Đất”. Nói thế năng của vật nặng chỉ là cách nói vắn tắt. Nếu vật đàn hồi bị biến dạng thì tương tác giữa các phần của vật cũng có thể làm cho vật ấy có thế năng. Thí dụ: nếu một lò xo bị nén hoặc dãn thì lực đàn hồi xuất hiện do tương tác giữa các phần của lò xo, và lò xo có thế năng gọi là thế năng đàn hồi.

4. Định luật bảo toàn cơ năng tổng quát: Trong hệ kín không có lực ma sát, thì có sự biến đổi qua lại giữa động năng và thế năng, nhưng tổng của chúng, tức là cơ năng, được bảo toàn. Định luật bảo toàn cơ năng chỉ đúng cho hệ kín và không có ma sát. Nếu hệ gồm có Trái Đất và vật nặng, và nếu một người lấy tay nâng vật lên cao thì lực của tay là ngoại lực đối với hệ, hiển nhiên cơ năng của hệ không bảo toàn mà tăng. Cũng vậy chỉ có thể nói đến bảo toàn cơ năng của hệ “lò xo và vật” sau khi tay thả vật ra, còn khi tay kéo vật cho lò xo giãn ra thì hiển nhiên là thế năng của hệ tăng.

5. Định luật bảo toàn và chuyển hoá năng lượng (gọi tắt là định luật bảo toàn năng lượng) là một trong vài định luật quan trọng nhất của thiên nhiên, áp dụng cho mọi đối tượng, mọi dạng năng lượng. Người ta tin tưởng rằng dù có phát hiện ra đối tượng vật chất mới thì định luật vẫn đúng, và thực tế lòng tin tưởng này đã dẫn đến việc phát hiện ra các hạt sơ cấp mới như hạt nơtrino chẳng hạn. Một hệ quả của định luật này là không thể có động cơ vĩnh cửu. Đó là một thứ máy tưởng tượng, khi đã kích thích cho chạy thì cứ thực hiện công mãi mà không cần được cung cấp năng lượng. Thực ra, động cơ chỉ là thiết bị biến đổi năng lượng từ dạng này sang dạng khác, không thể tự nó sinh ra năng lượng.

(*Adapted from* different souces)

KEY TERMS

Conservation of energy (n): In every interaction of any kind, the total energy afterward is equal to the total energy before, even when energy changes forms during the interaction. *Sự bảo toàn năng lượng*

Conduction (n): the transfer of heat by molecular vibrations, molecule to molecule; most effective in solids. Even more effective in metals, where free electrons help carry the energy. *Sự truyền, dẫn nhiệt*

Convection (n): the transfer of heat by a current of moving fluid such as air or water. *Sự đối lưu*

Efficiency (n): the ratio of work a system does to the energy it uses. *Hiệu suất*

Heat: energy moving by conduction. *Nhiệt lượng*

Internal energy (n): the energy stored within a matter in the forms of kinetic and potential energies of its molecules or atoms, including the mass itself through $E = mc^2$. *nội năng*

Isolated system (n): a system which is isolated so that it can not exchange matter or energy with its surroundings and can therefore attain a state of thermodynamic equilibrium. *Hệ cô lập*

Kinetic energy (n): the energy of motion of a body. A measure of a moving body's ability to do work, related to its mass and speed through the relation $\frac{1}{2}mv_0^2$. *Động năng*

Potential energy due to gravity (n): the measure of the potential of gravity to do work on an object. Near earth's surface, gravity's potential energy is equal to *mgd*, where d is the distance that the object may fall. *Thế năng có được do trọng trường*

Potential energy (n): energy a body has because a force that acts on a body has the potential to perform work on that body. *Thế năng*

Power (n): the rate of doing work or using energy. Power is the ratio of work done (or energy used) to the amount of time required to do that work (or to use that energy). *Công suất*

Radiation (n): the transfer of heat by radiation. *Truyền nhiệt bằng phát xạ*

Thermal equilibrium (n): property of a system all parts of which have attained a uniform temperature which is the same as that of the system's surroundings. *Trạng thái cân bằng nhiệt*

Work (n): a measure of how productive an applied force is. When a force component pushes or pulls an object through a distance (or resist its motion through a distance), it has done work on the object. In the most general sense, work is how energy is transferred from one body to another body. *Công*

FREE-READING PASSAGE

*It is advisable that you read the following passage for more about energy; you can do some translation practice on this passage and pick up some new vocabulary items***.**

Solar Energy, radiant energy produced in the sun as a result of nuclear fusion reaction. It is transmitted to the earth through space in quanta of energy called photons, which interact with the earth's atmosphere and surface. The strength of solar radiation at the outer edge of the earth's atmosphere when the earth is taken to be at its average distance from the sun is called the solar constant, the mean value of which is 1.37×10^6 ergs per sec per cm^2, or about 2 calories per min per cm^2. The intensity is not constant, however; it appears to vary by about 0.2 percent in 30 years. The intensity of energy actually available at the earth's surface is less than the solar constant because of absorption and scattering of radiant energy as photons interact with the atmosphere.

The strength of the solar energy available at any point on the earth depends, in a complicated but predictable way, on the day of the year, the time of day, and the latitude of the collection point. Furthermore, the amount of solar energy that can be collected depends on the orientation of the collecting object.

Natural transformation of solar energy. .Natural collection of solar energy occurs in the earth's atmosphere, oceans, and plant life. Interactions between the sun's energy, the oceans, and the atmosphere, for example, produce the winds, which have been used for centuries to turn windmills. Modern applications of wind energy use strong, light, weather-resistant aerodynamically designed wind machines that, when attached to generators, produce electricity for local, specialized use or as part of a community or regional network of electric power distribution.

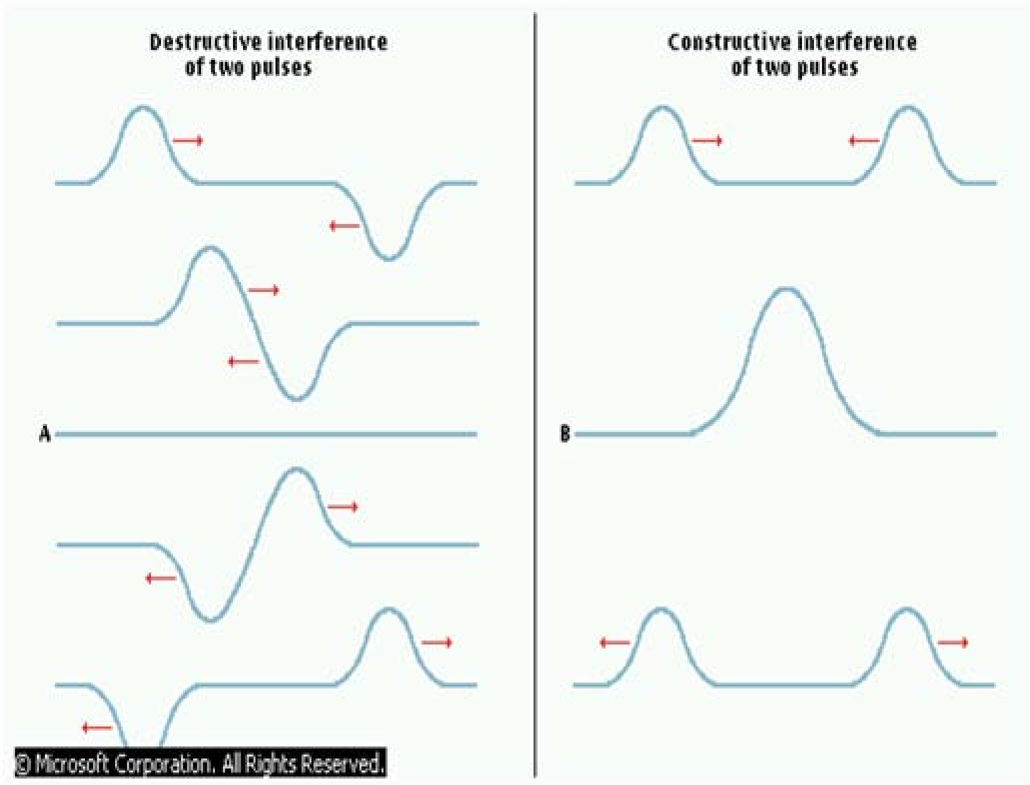
Approximately 30 percent of the solar energy reaching the outer edge of the atmosphere is consumed in the hydrologic cycle, which produces rainfall and the potential energy of water in mountain streams and rivers. The power produced by these flowing waters as they pass through modern turbines is called hydroelectric power.

Through the process of photosynthesis, solar energy contributes to the growth of plant life (biomass) that can be used as fuel, including wood and the fossil fuels that are derived from geologically ancient plant life. Fuels such as alcohol or methane can also be extracted from biomass.

The oceans also represent a form of natural collection of solar energy. As a result of the absorption of solar energy in the ocean and ocean currents, temperature gradients occur in the ocean. In some locations, these vertical variations approach 20° C (36° F) over a distance of a few hundred meters. When large masses exist at different temperatures, thermodynamic principles predict that a power-generating cycle can be created to remove energy from the high-temperature mass and transfer a lesser amount of energy to a low-temperature mass. The difference in these two heat energies manifests itself as mechanical energy (for example, output from a turbine), which can be linked with a generator to produce electricity. Such systems, called ocean thermal energy conversion (OTEC) systems, require enormous heat exchangers and other hardware in the ocean to produce electricity in the megawatt range.

Direct collection of solar energy. The direct collection of solar energy involves artificial devices, called solar collectors that are designed to collect the energy, sometimes through prior focusing of the sun's rays. The energy, once collected, is used in a thermal process or a photoelectric, or photovoltaic, process. In thermal processes, solar energy is used to heat a gas or liquid, which is then stored or distributed. In the photovoltaic process, solar energy is converted directly to electrical energy without intermediate mechanical devices. Solar collectors are of two fundamental types: flat plate collectors and concentrating collectors.

(*From* **http://encarta.com**)



Wave interference

When two pulses traveling on a string meet each other, the amplitudes of the pulses are added together to produce the shape of the resulting pulse. If the pulses are identical but travel on opposite sides of the string, then the sum of the amplitudes is zero and the string will appear flat for one instant (A). This is called destructive interference. When the two identical pulses travel on the same side of the string, then the sum of the amplitudes is double the amplitude of a single pulse when the pulses are together (B). This is called constructive interference.

Unit Eleven

QUANTUM PHYSICS

READING PASSAGE

Making macroscopic models

Science tries to explain a very complicated world. We are surrounded by very many objects, moving around, reacting together, breaking up, joining together, growing and shrinking. And there are many invisible things, too - radio waves, sound, ionizing radiation. If we are to make any sense of all this, we need to simplify it. We use models, in everyday life and in science, as a method of simplifying and making sense of everything we observe.

A model is a way of explaining something difficult in terms of something more familiar. For example, there are many models used to describe how the brain works. It's like a telephone exchange - nerves carry messages in and out from various parts of the body. It is like a computer. It is like a library. The brain has something in common with all these things, and yet it is different from them all. These are models, which have some use; but inevitably a model also has its limitations.

You have probably come across various models used to explain electricity. We can not see electric current in a wire, so we find different ways of explaining what is going on. Current is like water flowing in a pipe. A circuit is like a central heating system. It is like a train carrying coal from mine to power station. And so on. All of these models conjure up some useful impressions of what electricity is, but none is perfect.

We can make a better model of electric current in a wire using the idea of electrons. Tiny charged particles are moving under the influence of an electric field. We can say how many there are, how fast they are moving and we can describe the factors that affect their movement. This is a better model, but it is harder to understand because it is further from our everyday experience. We need to know about electric charge, atoms, and so on. Most people are happier with more concrete models; as your understanding of science develops, you accept more and more abstract models.

Ultimately, you may have to accept a model that is purely mathematical - some equations that give the right answer. Particles and waves are the two powerful and useful models. They can explain a great many different observations. But which should we use in a particular situation? And what if both models seem to work when we are trying to explain something?

This is just the problem that physicists struggled with for over a century, in connection with light. Does light travel as a wave, or as particle?

For a long time, Newton's view prevailed - light travels as particles. He could use this model to explain both reflection and refraction. His model suggested that light travels faster in glass than in air. We now know that this is not the case, and this caused difficulties for the particle model. Young showed both diffraction and interference of light, and this convinced most people that light travels as waves.

One of the experiments that convinced nineteenth- century physicists that light is a wave was Young's double-slit experiment. A beam of light is shone on a pair of parallel slits. Light spreads outwards (diffracts) from each slit into the space beyond; where light from the two slits overlaps, an interference pattern is formed. We interpret these results using a wave model of light. At any point on the screen, light waves are arriving from each slit. Constructive and destructive interference result in this interference pattern. The particle model of light can not explain this pattern. If two particles of light arrived together, we would expect double brightness. We can not imagine two particles arriving together and canceling each other out.

(*From* **Basic Physics 1 and 2** by David Sang, Cambridge University Press)

READING COMPREHENSION

Exercise 1: *Answer the following questions*

1. What should we do to understand all objects around us?

   ....
   ....…………………………………………………………………………….......

2. How can a model simplify a natural phenomenon?

   ....………
   ………..…………………………………………………………………….....

3. How many types of models are in use?

   ....……
   ……………………………………………………………………………......

4. How many examples of models in use are mentioned?

   ....……
   ……………………………………………………………………………......

5. What are the most distinctive examples of models?

   ....……
   ……………………………………………………………………………......

Exercise 2: *Find the words/ phrases in the reading text with similar meaning to the following words/phrases*.

1. complex	....
2. developing	....
3. to understand	....
4. by the use of	....
5. happening	....
6. specific (2 words)	....
7. patterns	....

8. study hard ....
9. persuade ....
10. to lead to ……………………………

Exercise 3: *Decide whether each of the following statements is true or false. Write (T) for the true statements, (F) for the false ones and (N) for the ones with no information to justify.*

1. ……….Any phenomenon can be explained by two models.
2. ……….Any model is absolutely right in explaining a corresponding natural phenomenon.
3. ……….Concrete models are associated with everyday life while the abstracts ones are associated with scientific understanding of things.
4. ……….It's easy to explain electricity with models.
5. ……….Both waves and particles can explain how the light travels.
6. ……….Mathematical equations always give right answers to any predictions.
7. ……….Light behaved as a particle model.
8. ……….Young rejected Newton's explanation about light using particle model.
9. ……….Young was successful in describing light to behave as a wave.
10. ……….When two particles meet, they strengthen each other.

GRAMMAR IN USE

The infinitive

1. Infinitive forms

	Bare infinitive	**To-infinitive**
Simple	conduct	to conduct
Perfect	have conducted	to have conducted
Continuous	be conducting	to be conducting
Perfect+ continuous	have been conducting	to have been conducting

Note: There is no difference in meaning between a bare-infinitive and a to-infinitive. What we use depends on the grammatical pattern.

2. Implications of the infinitive

a. A simple infinitive refers to something happening the same time as the one in the main clause.

Example: *It's not easy to explain a phenomenon even with either model.*

(The easiness and the explanation are both in the present as the truth)

b. A perfect infinitive refers to something happening before the time of the one in the main clause

Example: *It seems to have been proved that light behaves as a particle.*

(The seeming is in present, but the proof is in the past)

c. A continuous infinitive refers to something happening over time

Example: *It's very strange for him to be succeeding in this experimental test.*

(This means He's succeeding now)

3. Functions of the infinitive

a. To –infinitive can function as a subject

To- infinitive on its own or with object and adverbial, as a clause, can function as a subject.

Example:

1. To jump with a scale would be awkward (and dangerous).
2. To conduct such a dangerous experiment requires great precautions.

b. To-infinitive can function as a complement

b.1. ***As a complement after verb be***

Example:

1. But a better way to describe their condition is to say they are in free fall
2. His desire is to get success in his lifetime research.
3. All I ask of you, the reader, is to keep an open, yet discerning mind.

b.2. ***As a complement after some adjectives***

Example:

1. It is not **easy** to keep a car's speed steady
2. Even then, pointing to the one that's **harder** to accelerate, you might from habit still say "That one is heavier"

- Here are some common adjectives in the pattern of the example one.

  'Good/bad': marvelous, terrific, wonderful, perfect, great, good, nice, pleasant, lovely, terrible, awful, dreadful, horrible.

  Adjectives in –ing: interesting, exciting, depressing, confusing, embarrassing, amusing

  Difficulty, danger and expense: easy, difficult, hard, convenient, possible, impossible, safe, dangerous, cheap, expensive.

  Necessity: necessary, vital, essential, important, advisable, better/best

  Frequency: usual, normal, common, rare

  Comment: strange, odd, incredible, natural, understandable

  Personal qualities: good, nice, kind, helpful, mean, generous, intelligent, sensible, right, silly, stupid, foolish, careless, wrong, polite, rude

- Among those above adjectives, only those meaning ‘good’ or ‘bad’ and those of difficulty, danger, and expense can be used in the pattern of the example two.
- With many adjectives, you can use the pattern:

It’s + adjective+ for somebody + to-infinitive

Example:

1. It’s important **for** you to complete all the observations before writing a report.
2. It’s very expensive **for** a poor country to conduct a nuclear test.

The following adjectives are used in this pattern:

anxious	eager	marvelous	silly
awful	easy	necessary	stupid
better/best	essential	nice	terrible
cheap	expensive	ready	willing
convenient	important	reluctant	wonderful
dangerous	keen	safe	wrong
difficult			

- We can use *too* and *enough* with a quantifier, adjective or adverb in the above patterns:

Example:

1. It is true that the flame of your alcohol burner is *hot enough* to produce the spectra of sodium, lithium, calcium, copper, and a few other elements, but that is *not hot enough* to produce the other spectra of elements, such as oxygen and chlorine.
2. This bit of evidence was (much) enough to challenge Robert Bunsen, the German chemist, to search for a new element in the water. (there are two to-infinitive in this case, the former one is the complement, the latter one is the direct object for the first one, *see* **c** *bellow)*
3. It’s *too dangerous* **for** him to conduct such an experiment.

b.3. ***As a complement after some nouns***

Example:

1. His *determination* to take a course in physics is very strong.
2. It is *one thing* to recognize motion but *another* to describe it.
3. Having *no real reason* to seek a better explanation than this for their observations, the team of medieval physicists unanimously concurred, and a new theory was born.
4. Next, they found a smaller piece of glass and discovered that the suction cup had *the gripping power* to suspend it.

Some nouns in this pattern are

c. **A to-infinitive can function as a direct object**

c.1. When a to-infinitive clause function as a direct object, it can have or have not a subject:

Example:

1. If we are curious about her speed at one certain time or at a point along the way, we want to know her instantaneous speed.
2. The team of medieval physicists stepped out of the time machine and began to examine the strange, new device fastened to the window.
3. This new revelation prompted *another physicist* to remark, "The device must also attract the glass!" (In this case the subject of the to-infinitive is another physicist)
4. I merely wish to emphasize mankind's present level of ignorance of the mechanics of our universe.
5. The spectroscope thus enables us to distinguish one element from another. (the subject of the to-infinitive clause is implied in **us**)

Here are the common verbs that take to-infinitive as direct object

afford (have enough time/money)	choose	have	omit
agree	claim	help	ought
aim	dare	hesitate	plan
arrange	decide	hope	prepare
ask	demand	learn	promise
attempt	expect	long	refuse
beg	get(=succeed)	manage	seek
can't wait	guarantee	neglect	swear
train	hasten	offer	threaten
	undertake	used (to)	wish

c.2. You can see that all the above verbs are intransitive verbs. There are some verbs which are not intransitive but still followed by to-infinitive. These verbs include: seem, appear, happen, tend, come, grow, turn out and prove.

Example:

1. This lack of movement might seem to be strangest of all, for we humans are used to motion.
2. The difference in pressure cause, what appears to be, an attraction.
3. While in free fall, things seem to have no weight relative to each other.

In these cases, the to-infinitive say something about the truth of the statement, or the manner or time of the action. In some cases, empty **it** can be used as the subject-**It** *seems that he has got success in his research*.

d. **To-infinitive can follow question word/phrase to form an objective clause (refer to Grammar in Use-UNIT SIX)**

Example:

1. Please make sure when to start the observations.
2. We should know how high the temperature to be kept for the substance to react completely in the reaction.

Here are the verbs that can take the question word to follow

advise someone	discover	know	tell someone
ask someone	discuss	learn	think
choose	explain	remember	understand
consider	find out	show someone	wonder
decide	forget	teach someone	work out

e. **A to-infinitive clause can express purpose and result**

Example:

Purpose:

1. To describe motion accurately, we use rates.
2. It takes accurate measurements of the positions of spectral lines to identify an element.
3. We can use this fact and the formula F_{net} = ma to find the weight of an object
4. To measure your weight you can use a bathroom scale

Result: *(this way of expressing is unusual)*

1. He made so many observations only to find that he was unsuccessful.

f. **A to-infinitive can replace a relative clause:**

f.1. ***A to-infinitive can follow a ordinal number to replace a relative clause***

Example:

1. Galileo Galilei (1564-1642) was the first to understand how earth's gravity affects things near the surface of our planet.
2. Lomonosov was the first to experimentally prove the constancy of the mass of matter participating in chemical transformations.

f.2***. A to-infinitive is placed after a noun/pronoun to replace a relative clause***

Example:

1. Even mosses and lichens that spend their lives fastened to rocks depend on the movements of gases and liquids to bring them the chemicals essential to life and to carry others away. (*meaning* which bring them… and carry…)

Note: This way of expression is not really common.

g. **Patterns for bare infinitive**:

g.1***. Bare infinitive goes after modal verbs and some special phrases***

Example:

1. If a body is at rest, it will remain at rest.
2. The glass must attract the device. The device must also attract the glass.

g.2. ***Pattern: verb+ object+ bare infinitive***

The common verbs in this pattern are *make*, *l*et, and *have* (meaning *cause*) and those of perception.

Example:

1. You know that things will fall if you let them go off your hands.
2. In a solar eclipse, with your unaided eyes, you can not see the Moon cover the Sun.

PRACTICE

Exercise 1: *Choose the correct infinitive form of the verbs given in parentheses. Give your explanation*

1. For the interference pattern (appear)……………….. on viewing screen C, the light waves reaching any point P on the screen must have a phase differences that does not vary in time.
2. If you look closely at your fingernail in bright sunlight, you can see a faint interference pattern called speckle that causes the nail (appear)…………….. covered with specks. You see this effect because light waves scattering from very close points on the nail are coherent enough (interfere)……………… with one another at your eye.
3. (get)…………….. coherent light, we have to send the sunlight through a single slit; because that single slit is small, the light that passes through it is coherent.
4. The equations – d sin ố = mở, for m= 0, 1, 2… and d sin ố = (m+1/2) ở, for m =0, 1,2… tell us (locate) …………….. the maxima and minima of the double-slit interference pattern on screen C as a function of the angle ố presented in the figure. Here we wish (derive) …………….. an expression for the intensity I of the fringes as a function of ố.
5. (combine) …………….. the field components E_1 and E_2 on a phasor diagram, we add them vectorially.

6. If you sight through a pinhole in an otherwise opaque sheet so as to make the light entering your eye approximately a plane wave, you might be able (distinguish) …………….. individual maxima and minima in the pattern.
7. To locate the fringes, we shall use a procedure somewhat similar to the one we used (locate) …………….. the fringes in a two-slit interference pattern.
8. The fact that lens images are diffraction patterns is important when we wish (resolve) …………….. two distant point objects whose angular separation is small. When we wish to use a lens (resolve) …………….. objects of small angular separation, it is desirable (make…………….. the diffraction pattern as small as possible.
9. A grating' capability (resolve) …………….. separate lines of different wavelengths depends on the width of the lines.
10. Interference coatings can also be used (enhance) …………….. – rather than reduce- the ability of a surface to reflect light.
11. To understand interference, we must (go)…………….. beyond the restrictions of geometrical optics and employ the full power of wave optics. In fact, as you will see, the existence of interference phenomena is perhaps our most convincing evidence that light is a wave- because interference can not (explain) …………….. other than with waves.
12. The first person (advance) …………….. a convincing wave theory for light was Dutch physicist Christian Huygens, in 1678. His wave theory is based on a geometrical construction that allows us (tell) …………….. where a given wave- front will be at anytime in the future if we know its present position.
13. If we actually try to form a ray by sending light through a narrow slit or through a series of a narrow slits, diffraction will always defeat our effort because it always causes the light (spread) ……………...
14. It's quite a surprise (find) that there are situations where electrons appear (behave) …………….. like waves. This is just what is observed when a beam of energetic electron is used instead of a beam of light in a double-slit experiment.
15. Another even more surprising result is found when we make the electron beam sufficiently weak that there is never more than one electron in the beam at a time from the electron gun. We still get a pattern of interference fringes. Each single electron seems (pass) …………….. as a wave through both slits, and then recombined on the other side to give a single flash at the screen.
16. Physicists found it hard (explain) …………….. why weak ultraviolet light could have an immediate effect on the electrons in the metal, but very bright light of lower frequency had no effect.
17. Metals (such as zinc) …………….. have electrons that are not very tightly held within the metal. These are the conduction electrons, and they are free (move) …………….. about within the metal. When photons of light strike the metal, some electrons break free. They only need a small amount of energy -about 10^{-19} J- (escape) …………….. from the metal.

18. Now we can see the photon of light (work) …………….. because it pictures light as concentrated particles of energy, each one able to release an electron from the metal.
19. White light consists of photons of many different energies. For a photon (absorb)…………….., it must have exactly the right energy to lift an electron from one energy level to another.
20. First we should remind ourselves that waves and particles are macroscopic phenomena. We are using these models (describe) …………….. microscopic phenomena, and we should not be surprised that they do not work perfectly. But it is still difficult (explain) …………….. why one model works well in one situation, and the other in another situation. We should (not try, imagine) …………….. …………….. "waves of matter" or "particulate waves"; these do not give a true representation of what we observe. However, we can (make) things more acceptable by giving rules, which tell us when (use) …………….. the particle model and when (use) …………….. the wave model. Then, at least, we can solve problems, which is what we really require of physics.

PROBLEM SOLVING

Paragraph building

Task one

From the prompts given, build up sentences with the addition of the supplementary material above each set. Delete the words /phrases in Italic

1. ARE SAID/TO BE/,/WHILE/AND PIECES OF IRON OR GLASS,/WHICH/THEMSELVES/, /ARE SAID/TO BE

   we say that such bodies *are* luminous

   bodies such as bricks do not produce light

   we say that these bodies are non-luminous

   ………………………………………………………………………………………… ………………………………………………………………………………………… ……………………………………………………………………...............

2. THREADED/THAT/THEY

   thread a length of cotton through the holes

   this will demonstrate *this*

   the holes are in straight line

   ………………………………………………………………………………………… ………………………………………………………………………………………… ……………………………………………………………………………

3. THAT/, /A/,/WHICH/MEANS OF/ THE FOLLOWING

   these observation suggest *this*

   light travels in straight line

this fact can be verified by *an* experiment

…………………………………………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………………

4. SUCH AS CLEAR GLASS AND WATER/WHICH/SOTHAT/CAN/BE/SEEN

   some substances allow light to pass through them

   we can see objects on the other side clearly

   we say that these *substances* are transparent

   …………………………………………………………………………………………
   …………………………………………………………………………………………
   …………………………………………………………………………

5. AND/SMALL/THE MIDDLE OF/OF THEM

   take three pieces of cardboard

   make a hole in each *piece*

   …………………………………………………………………………………………
   ………………………………………………………………………………

6. MOST/WHICH/, / FOR/, / GLOWING/AN ELECTRIC/, / OR

   some bodies emit light

   some bodies also emit heat

   one example *is* the sun

   another example is the filament of *a light* bulb

   another example is a fire

   …………………………………………………………………………………………
   ………………………………………………………………………………

7. FROM A PORKET TORCH, A SEARCH LIGHT OR CAR HEADLAMPS/, AND/ UNLESS/DO SO/ THE HELP Of/OR SOME OTHER REFLECTING DEVICE

   a beam of light appears to have straight edges

   a beam of light will not bend round corners

   a beam of light is made to *bend* with mirrors

   …………………………………………………………………………………………
   …………………………………………………………………………………………
   …………………………………………………………………………

8. ALL/LIGHT/AND/THAT

   these bodies emit energy

   they can be seen by the light

   they give out *light*

…………………………………………………………………………………………
………………………………………………………………………………

9. WHICH/WITHOUT/BEING/ARE SAID/TO BE/, WHILE/WHICH/THE PASSAGE OF/ARE SAID/TO BE

some substances allow light to pass through them

objects on the other side *are not* clearly seen

we say that these *substances are* translucent

some substances do not permit light *to pass*

we say these substances *are* opaque

…………………………………………………………………………………………
…………………………………………………………………………………………
………………………………………………………………………

10. IF/IS MOVED/SOTHAT/NO LONGER/ ,/

move one of the pieces of cardboard slightly

the holes are *not* in a straight line

the light will be cut off

…………………………………………………………………………………………
…………………………………………………………………………………………
…………………………………………………………………….........

11. , /LIKE/, /, AND/THERE IS/ THE TWO

light *is a form* of *energy*

heat is a form of energy

a close connection *exists* between *light and heat*

…………………………………………………………………………………………
………………………………………………………………………………

12. LIGHT/BUT/WHEN/FROM LUMINOUS BODIES/AND/FROM THEIR SURFACES

non-luminous bodies do not emit energy

they can be seen

light falls on them

light is reflected

…………………………………………………………………………………………
…………………………………………………………………………………………
………………………………………………………………………

13. PIECES OF/SO THAT/ FROM/ A CANDLE FLAME/CAN BE SEEN/THREE/AT THE SAME TIME

arrange the pieces of cardboard

we can see the light through all *the* holes

……………………………………………………………………………………
………………………………………………………………………………

Task two

Rewrite the thirteen sentences in a logical order to make two paragraphs. The first paragraph should contain a number of ***definitions****, and the second paragraph should deal with* ***the fact that light travels in straight lines****. Before you write the paragraphs, add the following material:*

Write '***this is shown by the fact that***' at the beginning of sentence 6.

Paragraph 1:

Paragraph 2:

TRANSLATION

Task one: *English-Vietnamese translation*

1. **Quantum holography**, in which a pair of laser pulses reveals detailed information about an atom's state, has been used for the first time to control the shape of an atom wave, advancing prospects for tailoring an atom's exact properties. Classical holography, which makes 3D pictures, involves the use of an "object" and a "reference" laser beam. How these beams combine in a piece of film provides information on their relationship (specifically, their relative "phases"), allowing the eyes to build up a 3D scene. In quantum holography, an ultra-short laser pulse (playing the role of an object beam) first puts an atom into a combination of wavelike states, forming a "wavepacket." Shortly thereafter, a subsequent pulse (acting as the reference beam) creates a second wavepacket within the atom. These two wavepackets interfere. Ionizing the atoms and then measuring them at a detector can provide information about the phase relationships between the wavepackets, ultimately yielding details on the individual wavelike states. University of Michigan researchers (Tom Weinacht, 734-764-2344) have now demonstrated a feedback approach, in which they shine a pair of pulses on a gas of cesium atoms, measure the effect, and modify subsequent pairs of pulses until they get the cesium wavepacket they want. Such "wavepacket engineering" may enable scientists to prepare atoms and molecules which undergo precisely desired chemical reactions. (Weinacht et al., Nature, 21 January 1999).
2. **Quantum computers perform their first simulation**. Until now, quantum computers have done simple arithmetic and searched small databases. But one of the first applications envisioned for them, proposed in 1982 by Richard Feynman, was that they could simulate quantum-mechanical processes better and more efficiently than classical computers. Demonstrating Feynman's idea for the first time, researchers (David Cory, MIT, 617-253-3806, dcory@mit.edu) have used a quantum computer to solve a senior-year undergraduate physics problem. Namely, they simulated a "truncated harmonic oscillator", the series of energy levels--assumed to be finite for simplicity--experienced by a quantum particle such as an electron which is bound to another object such as a proton. To simulate this system, they used an NMR quantum computer, a device in which an external magnetic field aligns a group of atomic nuclei in a liquid, solid, or gas, so that the tiny magnet associated with each atom's

nucleus is either along the field (a state known as "spin-down", which can represent a 0 in binary code) or opposed to it ("spin-up", which can represent a 1). Like previous designs, the NMR computer consisted of molecules in the liquid state; in this case the researchers manipulated the spins of two atomic nuclei within each molecule. The manipulation results in the possible energy states for this two-spin system exactly simulating the possible energy states for the quantum particle. Future steps could include modeling the somewhat more sophisticated real-world system of an electron in a hydrogen atom. (Somaroo et al., *Physical Review Letters*, 28 June 1999.)

3. **The struggle to understand wave mechanics**. Neil Bohr became convinced that Born's interpretation of the waves was correct, and his institute at Copenhagen, Denmark, soon emerged as the center of interpretation of the new wave mechanics. He and his colleagues came to the belief (called the postulate of wave mechanics) that the amplitude as calculated by Schrodinger's equation contains all the information we can obtain about the mechanical behavior of a subatomic particle, its position, momentum, energy, and so on. That is, the ỉ wave describes the physical state of the particle as fully as possible. At this point, Einstein, Schrodinger, Planck and de Broglie all objected. They could not believe it was not possible to predict precisely where to find an electron in an atom, that probabilities for finding the positions of such small particles are all anyone could know. They thought there must be another interpretation of the theory of wave mechanics, or perhaps more to be learnt. Schrodinger, especially, was crushed. He had developed an equation that replaces Bohr's jumping electron with a progression of standing waves only to have others discover that his waves were only patterns of probability- that the electron was a pointlike particle that must still "jump" when its probability cloud pattern changed, emitting or absorbing a photon in the process. He said to Bohr, "Had I known that we were not going to get rid of the damned quantum jumping, I never would have involved myself in this business." As for the probabilities that the wave formula predicted, Einstein loudly (for him) protested, "God does not play dice …".But Born's interpretation of the wave cloud is consistent with the results of many experiments. We should experimentally show how the theory of wave mechanics makes predictions about the behavior of particles.

(*From* **Physics-An Introduction** by *Jay Bolemon*; 1989)

Task two: *Vietnamese - English translation*

1. **Giải thích các định luật quang điện bằng thuyết lượng tử.** Nhà bác học Einstein, người Đức, là người đầu tiên vận dụng thuyết lượng tử để giải thích các định luật quang điện. Ông coi chùm sáng như một chùm hạt và gọi mỗi hạt là một phôtôn. Mỗi phôtôn ứng với một lượng tử ánh sáng. Theo ông, trong hiện tượng quang điện có sự hấp thụ hoàn toàn phôtôn chiếu tới. Mỗi phôtôn bị hấp thụ sẽ truyền toàn bộ năng lượng của nó cho một electron. Đối với các electron nằm ngay trên bề mặt kim loại thì phần năng lượng này sẽ được dùng vào hai việc:

   - Cung cấp cho electron đó một công A để nó thắng được các lực liên kết trong tinh thể và thoát ra ngoài. Công này gọi là công thoát.
   - Cung cấp cho electron đó một năng lượng ban đầu mà các electron nằm ở lớp ngoài thu được khi bị bứt ra thì động năng ban đầu này là cực đại:

hf = **A** + $\frac{mv_0^2 \max}{2}$ Đây là công thức Anhxtanh (Einstein) về hiện tượng quang điện.

Đối với các electron nằm ở các lớp sâu bên trong kim loại thì trước khi đến bề mặt kim loại, chúng đã va chạm với các iôn của kim loại và mất một phần năng lượng. Do đó động năng ban đầu nhỏ hơn động năng ban đầu cực đại nói trên.

2. **Lưỡng tính sóng-hạt của ánh sáng.** Ánh sáng nhìn thấy cũng như các tia hồng ngoại, tia tử ngoại, tia Rơnghen, đều là các sóng điện từ có bước sóng khác nhau. Người ta nói chúng có cùng bản chất điện từ. Ta lại thấy ánh sáng có tính chất hạt (tính chất lượng tử). Vậy, ánh sáng vừa có tính chất sóng vừa có tính chất hạt. Người ta nói: *ánh sáng có lưỡng tính sóng hạt*.

   Những sóng điện từ có bước sóng càng ngắn thì phôtôn ứng với chúng có năng lượng càng lớn. Thực nghiệm cho thấy tính chất hạt của chúng thể hiện càng đậm nét thì tính chất sóng càng ít thể hiện. Ta có thể coi những tác dụng sau đây là những biểu hiện của tính chất hạt: khả năng đâm xuyên, tác dụng quang điện, tác dụng iôn hoá, tác dụng phát quang.

   Ngược lại những sóng điện từ có bước sóng càng dài thì phôtôn ứng với chúng có năng lượng càng nhỏ. Thực nghiệm cho thấy: tính chất hạt của chúng càng khó thể hiện thì tính chất sóng của chúng càng dễ bộc lộ. Ta dễ dàng quan sát thấy hiện tượng giao thoa, hiện tượng tán sắc của các sóng đó.

   Sự tồn tại đồng thời của hai tính chất trái ngược nhau (sóng và hạt) trong cùng một sự vật (ánh sáng) là một minh hoạ rất rõ cho luận điểm triết học về sự thống nhất biện chứng của các mặt đối lập.

(*From* **Vat li 12**, **published** by Educational Publishing House, Hanoi, 2000)

KEY TERMS

Arithmetic (n): the part of mathematics that deals with addition, substraction, multiplication, and division of number. *Số học*

Detector (n): an instrument used to find or measure things. *Máy dò, bộ dò*

Dialectical unity (n): the unity basing on the philosophical system of asserting truth by resolving the differences that exist between factors in a particular situation. *Sự thống nhất biện chứng*

Eradiation effect (n): the effect to eradiate of some substances. *Hiệu ứng phát xạ*

Infrared ray(n): a ray of infrared radiation. *Tia hồng ngoại*

Harmonic oscillation (n): 1. any physical system that is bound to a position of stable equilibrium by a restoring force or torque proportional to the linear or angular displacement from this position. *Dao động điều hoà*

2. Anything which has equations of motion that are the same as the system in the mechanics definition. Also known as **linear oscillator;** *bộ dao động tuyến tính*

Simple oscillator (n): 1. Any physical system that is bound to a position of stable equilibrium by a restoring force or torque proportional to the linear or angular displacement from this position. *Bộ tạo dao động đơn giản*

2. Anything which has equations of motion that are the same as the system in the mechanics denifition. Also known as **Linear oscillator; harmonic oscillator.** *Như trên*

Laser (n): an active electron device that converts input power into a very narrow, intense beam of coherent visible or infrared light; the input power excites the atoms of an optical resonator to a higher energy level, and the resonator forces the excited atoms to radiate in phase. Derived from light amplification by stimulated emission of radiation. *laze*

Opposing sides/factors (n): those factors that are opposite to each other. *Những mặt đối lập*

Penetration power: the ability that a particle can pass through s potential barrier, that is, through a finite region in which the particle's potential energy is greater than its total energy. *Sức xuyên, khả năng xuyên*

Phase (n): a particular stage in a process; or a sate of a matter. *Một bước tiến hành trong một quá trình nào đó/ một pha của chất*

Photo-electricity (n): the electrical phenomena taking place under the influence of electromagnetic radiation. *Hiện tượng điện quang*

Quantum holography (n): A technique for recording and later reconstructing, the amplitude and phase distribution of a wave disturbance, widely used as a method of three-dimensional optical image formation, the technique is accomplished by recording on a photographic plate the pattern of interference between coherent light reflected from the object of interest, and light that comes directly from the same source or is reflected from a mirror. *Phép toàn ảnh lượng tử*

Quantum mechanics (n): the modern theory of matter, of electromagnetic radiation, and of interaction between matter and radiation, it differs from classical physics, which it generalizes and supersedes, mainly in the realm of atomic and subatomic phenomena. Also known as **quantum theory.** *Cơ học lượng tử, thuyết lượng tử*

Simulation (n): an attempt to solve a problem by representing it mathematically, often using a computer. *Sự mô phỏng*

Spin (n): 1. rotation of a body around its axis. *Sự quay, xoay, vê tròn*

2. the intrinsic angular momentum of an elementary particle or nucleus which exists even when the particle is at rest, as distinguished from orbital angular momentum. *Spin*

Wave packet (n): In wave phenomena, a superposition of waves of differing lengths, so phased that the resultant amplitude is negligibly small except in a limited portion of space whose dimensions are the dimensions of the packet. Also known as **packet.** *Bó sóng*

Wave mechanics (n): the version of non-relativistic quantum mechanics in which a system is characterized by a wave function which is a function of the coordinates of all the particles of the system and time, and obeys a differential equation, the Schrửdinger equation; physical quantities are represented by differential operators which may act on the wave function, and expectation values of measurement are equal to integrals involving the corresponding operator and the wave function. Also known as **Schrodinger's wave mechanics (n):** *Cơ học sóng*

wave-particle duality(n): the principle that both matter and electromagnetic radiation exhibit phenomena in which they behave as particles, the two aspect being associated by de

Broglie relations. Also known as **duality principle; wave-corpuscle duality.** *Lưỡng tính sóng- hạt*

FREE-READING PASSAGE

It is advisable that you read the following passage to learn more aboutquantum physics. You can do some translation practice on this passage and pick up some new vocabulary items.

Quantum Theory, in physics, description of the particles that make up matter and how they interact with each other and with energy. Quantum theory explains in principle how to calculate what will happen in any experiment involving physical or biological systems, and how to understand how our world works. The name “quantum theory” comes from the fact that the theory describes the matter and energy in the universe in terms of single indivisible units called *quanta* (singular *quantum*). Quantum theory is different from classical physics. Classical physics is an approximation of the set of rules and equations in quantum theory. Classical physics accurately describes the behavior of matter and energy in the everyday universe. For example, classical physics explains the motion of a car accelerating or of a ball flying through the air. Quantum theory, on the other hand, can accurately describe the behavior of the universe on a much smaller scale, that of atoms and smaller particles. The rules of classical physics do not explain the behavior of matter and energy on this small scale. Quantum theory is more general than classical physics, and in principle, it could be used to predict the behavior of any physical, chemical, or biological system. However, explaining the behavior of the everyday world with quantum theory is too complicated to be practical.

Quantum theory not only specifies new rules for describing the universe but also introduces new ways of thinking about matter and energy. The tiny particles that quantum theory describes do not have defined locations, speeds, and paths like objects described by classical physics. Instead, quantum theory describes positions and other properties of particles in terms of the chances that the property will have a certain value. For example, it allows scientists to calculate how likely it is that a particle will be in a certain position at a certain time.

Quantum description of particles allows scientists to understand how particles combine to form atoms. Quantum description of atoms helps scientists understand the chemical and physical properties of molecules, atoms, and subatomic particles. Quantum theory enabled scientists to understand the conditions of the early universe, how the Sun shines, and how atoms and molecules determine the characteristics of the material that they make up. Without quantum theory, scientists could not have developed nuclear energy or the electric circuits that provide the basis for computers.

Quantum theory describes all of the fundamental forces-except gravitation-that physicists have found in nature. The forces that quantum theory describes are the electrical, the magnetic, the weak, and the strong. Physicists often refer to these forces as interactions, because the forces control the way particles interact with each other. Interactions also affect spontaneous changes in isolated particles.

Waves and Particles. One of the striking differences between quantum theory and classical physics is that quantum theory describes energy and matter both as waves and as particles. The type of energy physicists study most often with quantum theory is light.

Classical physics considers light to be only a wave, and it treats matter strictly as particles. Quantum theory acknowledges that both light and matter can behave like waves and like particles.

It is important to understand how scientists describe the properties of waves in order to understand how waves fit into quantum theory. A familiar type of wave occurs when a rope is tied to a solid object and someone moves the free end up and down. Waves travel along the rope. The highest points on the rope are called the crests of the waves. The lowest points are called troughs. One full wave consists of a crest and trough. The distance from crest to crest or from trough to trough—or from any point on one wave to the identical point on the next wave—is called the wavelength. The frequency of the waves is the number of waves per second that pass by a given point along the rope.

If waves traveling down the rope hit the stationary end and bounce back, like water waves bouncing against a wall, two waves on the rope may meet each other, hitting the same place on the rope at the same time. These two waves will interfere, or combine. If the two waves exactly line up—that is, if the crests and troughs of the waves line up—the waves interfere constructively. This means that the trough of the combined wave is deeper and the crest is higher than those of the waves before they combined. If the two waves are offset by exactly half of a wavelength, the trough of one wave lines up with the crest of the other. This alignment creates destructive interference—the two waves cancel each other out and a momentary flat spot appears on the rope.

Matter as Waves and Particles. In 1923 French physicist Louis de Broglie suggested that all particles—not just photons—have both wave and particle properties. He calculated that every particle has a wavelength (represented by ở, the Greek letter *lambda*) equal to Planck's constant (h) divided by the momentum (p) of the particle:ở = h/p. Electrons, atoms, and all other particles have de Broglie wavelengths. The momentum of an object depends on its speed and mass, so the faster and heavier an object is, the larger its momentum (p) will be. Because Planck's constant (h) is an extremely tiny number, the de Broglie wavelength (h/p) of any visible object is exceedingly small. In fact, the de Broglie wavelength of anything much larger than an atom is smaller than the size of one of its atoms. For example, the de Broglie wavelength of a baseball moving at 150 km/h (90 mph) is 1.1×10^{-34} m (3.6×10^{-34} ft). The diameter of a hydrogen atom (the simplest and smallest atom) is about 5×10^{-11} m (about 2×10^{-10} ft), more than 100 billion trillion times larger than the de Broglie wavelength of the baseball. The de Broglie wavelengths of everyday objects are so tiny that the wave nature of these objects does not affect their visible behavior, so their wave-particle duality is undetectable to us.

De Broglie wavelengths become important when the mass, and therefore momentum, of particles is very small. Particles the size of atoms and electrons have demonstrable wavelike properties. One of the most dramatic and interesting demonstrations of the wave behavior of electrons comes from the double-slit experiment. This experiment consists of a barrier set between a source of electrons and an electron detector. The barrier contains two slits, each about the width of the de Broglie wavelength of an electron. On this small scale, the wave nature of electrons becomes evident, as described in the following paragraphs.

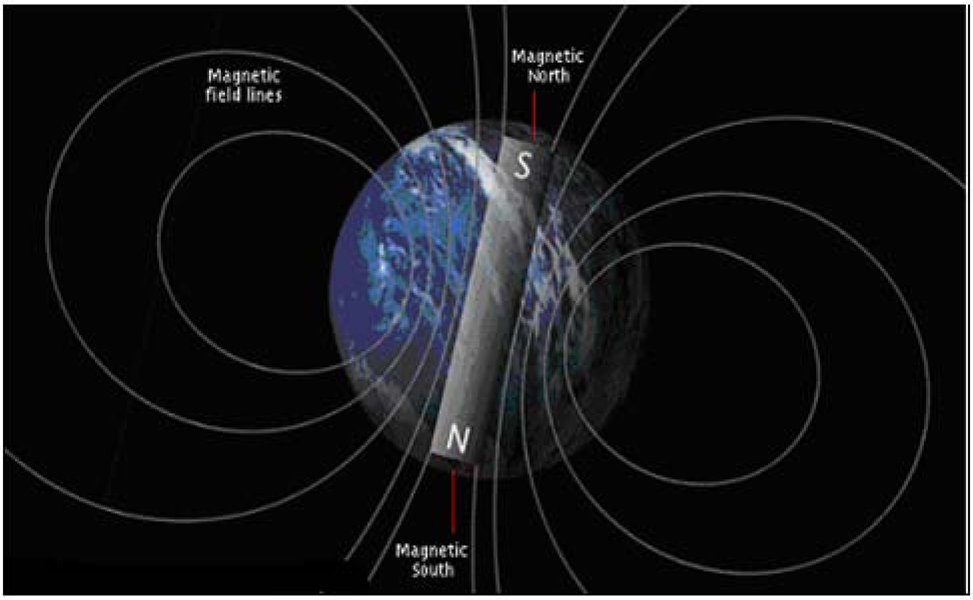
Scientists can determine whether the electrons are behaving like waves or like particles by comparing the results of double-slit experiments with those of similar experiments performed with visible waves and particles. To establish how visible waves behave in a double-slit apparatus, physicists can replace the electron source with a device that creates waves in a tank of water. The slits in the barrier are about as wide as the wavelength of the water waves. In this experiment, the waves spread out spherically from the source until they hit the barrier. The waves pass through the slits and spread out again, producing two new wave fronts with centers as far apart as the slits are. These two new sets of waves interfere with each other as they travel toward the detector at the far end of the tank.

The waves interfere constructively in some places (adding together) and destructively in others (canceling each other out). The most intense waves—that is, those formed by the most constructive interference—hit the detector at the spot opposite the midpoint between the two slits. These strong waves form a peak of intensity on the detector. On either side of this peak, the waves destructively interfere and cancel each other out, creating a low point in intensity. Further out from these low points, the waves are weaker, but they constructively interfere again and create two more peaks of intensity, smaller than the large peak in the middle. The intensity then drops again as the waves destructively interfere. The intensity of the waves forms a symmetrical pattern on the detector, with a large peak directly across from the midpoint between the slits and alternating low points and smaller and smaller peaks on either side.

To see how particles behave in the double-slit experiment, physicists replace the water with marbles. The barrier slits are about the width of a marble, as the point of this experiment is to allow particles (in this case, marbles) to pass through the barrier. The marbles are put in motion and pass through the barrier, striking the detector at the far end of the apparatus. The results show that the marbles do not interfere with each other or with themselves like waves do. Instead, the marbles strike the detector most frequently in the two points directly opposite each slit.

When physicists perform the double-slit experiment with electrons, the detection pattern matches that produced by the waves, not the marbles. These results show that electrons do have wave properties. However, if scientists run the experiment using a barrier whose slits are much wider than the de Broglie wavelength of the electrons, the pattern resembles the one produced by the marbles. This shows that tiny particles such as electrons behave as waves in some circumstances and as particles in others.

(*From* **http://encarta.com**)



The earth's magnetic field

A powerful magnetic field surrounds the earth, as if the planet has an enormous bar magnet embedded within its interior. The S and N on the magnet indicate the orientation of the earth's magnetic field. Because the opposite ends of magnets attract, the northern end of magnets on the earth are attracted to the southern end of the earth's magnetic field, which is called magnetic north. Scientists believe that convection currents of charged, molten metal circulating in the earth's core are the source of the planet's magnetic field.

Unit Twelve

MAGNETISM

READING PASSAGE

Earth's magnetic field

Scientists still do not know exactly what causes the earth's magnetic field. In the 16th century, it was believed that a mountain of *magnetite* (a magnetic mineral) was located at the North Pole and that this mountain caused the earth's magnetic field. English physician William Gilbert was the first to propose, in 1600, that the earth itself was a massive magnet. Current theories hold that the earth's magnetic field is created by currents within the liquid outer core of the earth, which is composed mostly of iron. This liquid core contains ions, or electrically charged atoms and molecules. The motion of these charged particles within the earth is thought to create the earth's magnetic field.

Scientists sometimes find it easier to model the earth's magnetic field as if it were a perfectly symmetrical magnetic field coming from one large bar magnet. The poles of this hypothetical magnetic field, based on averaging the direction and strength of earth's magnetic field, are called the geomagnetic poles. The north geomagnetic pole is located near Thule, Greenland, 1250 km (780 miles) from the geographical North Pole. The south geomagnetic pole is located near Vostok, Antarctica, 1250 km (780 miles) from the geographic South Pole.

Paleomagnetism is the study of the earth's magnetic field in ancient times. Scientists can study the earth's ancient magnetic fields by measuring the magnetic orientation of certain rocks. When molten rock crystallizes, crystals of magnetic minerals align with the earth's magnetic field. The rock thus records the direction of the earth's magnetic field at the time of its crystallization. By measuring the magnetic orientation and determining the age of such rocks, scientists can measure the orientation of the earth's magnetic field at different times in the earth's history. Geologists can use systematic paleomagnetic measurements on rocks of different ages to map out the apparent movement of the earth's magnetic field as a function of time. This map defines what is known as a pole path. Differences in the pole paths of the continents indicate the relative drift of these continents.

Paleomagnetic measurements played a key role in the development of the theory of plate tectonics by providing evidence that the oceans grow from their centers outward. Strips of alternating magnetization found in the ocean floor on either side of the mid-ocean ridges were explained by assuming that oceanic crust continually splits and moves away from the mid-oceanic ridges. Additional crust is continually generated in the gap by the eruption of lava, and the solidifying lava records the orientation of the earth's magnetic field at the time of solidification. The continual creation of new crust produces a record of the direction of the earth's magnetic field over time. Repeated reversal of the earth's magnetic field produces strips of alternating magnetization in the ocean floor on either side of the mid-oceanic ridge.

(*From* **http://encarta.com**)

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading text*

1. What was considered to cause the earth's magnetic field?

   …………………………………………………………………………………………
   ……………………………………………………………………………………
2. What is the latest assumption about the cause of the earth's magnetic field?

   …………………………………………………………………………………………
   ……………………………………………………………………………………
3. What does the writer mean by "this hypothetical magnetic field" in line 13?

   …………………………………………………………………………………………
   ……………………………………………………………………………………
4. How can scientists measure the orientation of the earth's magnetic field in the earth's history?

   …………………………………………………………………………………………
   ……………………………………………………………………………………
5. Why did the paleomagnetic measurements use to be important?

   …………………………………………………………………………………………
   ……………………………………………………………………………………

Exercise 2: *Choose the best alternative*

1. Scientists now
   a. have had enough evidence about the cause of the earth's magnetic field
   b. is still working hard in finding the cause of the earth's magnetic field.
   c. have not understood all about the cause of the earth's magnetic field
2. William Gilbert
   a. was the first to find the cause of the earth's magnetic field.
   b. was the first to make the assumption about the cause of the earth's magnetic field.
   c. was the first to think that the earth itself was an enormous magnet.
3. The term geomagnetic poles refer to:
   a. the earth's poles in its magnetic field
   b. the magnetic poles of the earth.
   c. the magnetic as well as the geographical poles of the earth.

4. Scientists in ancient time study the earth's magnetic field by measuring the magnetic orientation and determining the age of
   a. the rocks of that time
   b. some kinds of rocks of the time
   c. a special kind of rock of that time
5. Geologists use the result of paleomanetic measurements in order to
   a. find out the pole paths of the earth's magnetic field.
   b. to study about the world's continents.
   c. to map out the magnetic field of the earth's as a function of time

Exercise 3: *Match each word in column A with its definition in column B*

A	B
1. mid-ocean ridge	a. the act of something coming out very suddenly and violently
2. strips	b. the process of turning into crystals
3. eruption	c. a particular function
4. role	d. having two halves which are exactly the same, except that one haft is the mirror image of the other.
5. orientation	e. long narrow pieces of something
6. crystallization	f. the area in the middle of the ocean
7. symmetrical	g. the direction an object faces or the direction of the line along which the body exists
8. magnetization	h. the process in which a liquid or semi-liquid turns into a solid
9. solidification	i. the process of giving a substance the power to draw iron and other metals towards it.

GRAMMAR IN USE

The gerund

1. Gerund forms

A gerund is formed exactly like a present participle form of a verb (i.e. simply by adding –ing to the end of the verb) as follows:

	Active	Passive
Simple	conducting	being conducted
Perfect	having conducted	having been conducted

2. Implications of the gerund

a. ***A simple gerund refers to something happening at the same time as the action in the main clause***

Example: *Conducting such an experiment is very dangerous.*

(In this case the action of conducting is at the same time with the being dangerous)

b. ***A perfect gerund refers to something happening earlier than the action in the main clause***

Example: *He made the report without having made enough observations.*

(the action of not making observation happens before the action of making report)

It's unnecessary to use a perfect if it is clear from the context that the time of the gerund is earlier than the time of the action in the main clause:

The above example can be rewritten in this way: He made the report without making enough observation. *(Everyone knows that to make a report, before that enough observations must be made for the sake of scientific accuracy*).

c. ***To form a negative we simply add the negative word 'not' before the gerund***

Example: *He's afraid of not being able to complete his thesis.*

3. Gerund clause

A gerund on its own or can be combined with other elements (with subject; object; or adverbial) to form a clause:

Examples:

i. conducting such an experiment

ii. not being able to complete his thesis

iii. having made enough observations

4. Functions of the gerund

A gerund can be treated as a noun/noun phrase, so it has a wide range of uses as a noun/noun phrase

a. ***A gerund can be treated as a noun on its own or can be used to modify another noun***

Example:

1. Neighboring molecules beneath them are set into faster motion, and heat flows into the floor.
2. This is called the microwave background, and is the remnant of radiation from the 'big bang', the giant explosion that is believed to have occurred at the beginning of time in the Universe.
3. Perhaps nothing is so ingrained in our senses as the perpetual pulling of the earth on our surroundings.
4. The physical meaning of this new concept – mass- is related in the most intimate way to the identity in comparing weights which we have just noted.
5. It's just that nothing would stop that fall, there would be no supporting force opposing the gravitational pull, so he would feel weightless.

b. ***As a subject of a sentence***

Example:

1. Sitting and observing a substance to decay is a hard work.
2. Finding the cause of the earth's field has taken much time of the scientists throughout the story.

When functioning as the subject of a sentence, a gerund can be replaced by a to-infinitive, but there is a difference between them. While a gerund refers to something in general, a to-infinitive refers to something in a particular situation.

c. ***As a complement after be***

Example: What he has to do now is quickly finishing his research.

d. ***As a prepositional complement***

d.1. As a complement after a preposition following a noun

Example:

1. The question of finding the cause of the earth's magnetic field has drawn a great attention from physicists.
2. We can not see electric current in a wire, so we find different ways of explaining what is going on.

The following nouns with their prepositions can be followed by a gerund

advantage of
aim of/in
amazement at
anger about/at
annoyance about/at
anxiety about
apology for
awareness of
belief in
boredom with
danger of/in
difficulty (in)
effect of
excitement about/at
expense of/in
fear of
insistence on
interest in
job of
matter of
objection to
pleasure in/of
point of/in
possibility of
problem in/of
worry about
prospect of
purpose of/in
question about/of
reason for
satisfaction with
success in
surprise at
task of
work of

d.2. As a complement after a preposition following an adjective

Example:

1. This internal energy spreads out, making it much less effective at producing work than, say, the organized kinetic energy of a moving object.
2. Energy has been called the "common denominator" of the natural science because its conservation law makes it so useful in understanding any physical process.

The following are the adjectives with their prepositions that can take a gerund

afraid of
amazed at
angry about/ at
annoyed about/at
anxious abut
ashamed of
aware of
bad at
bored with
capable of
content with
dependent on
different from/to
excited about
famous for
fed up with
fond of
good at
grateful for
guilty of
happy about/with
interested in
keen on
nervous of
pleased about/with
ready for
responsible for
satisfied with
sorry about/for
successful in
surprised at
worried about
wrong with

Other prepositions that are followed by a gerund

after
against
as a result
as well as
because of
besides
by
by means of
despite
for
in
in addition to
in favor of
in spite of
instead of
on account of
since
through
what about
with

before how about on without

Example:

1. Absorption spectra of gases may be obtained by passing white light through a sample of gas before the light enters the prism.
2. By measuring the magnetic orientation and determining the age of such rocks, scientists can measure the orientation of the earth's magnetic field at different times in the earth's history.
3. Using springs of various thickness, one can make scales for measuring very large and also very small weights.

e. ***As a complement after adjectives expressing degrees of difficulty***

Example:

1. It's difficult detecting an element without using a spectroscope.
2. It's impossible keeping a car in steady speed.

Note: Refer to the **Grammar in use** part in **UNIT ELEVEN** for these adjectives. However, It' is more common to use a to-infinitive instead of a gerund.

f. ***As a direct object after some verbs***

These verbs include some one - word verbs and some prepositional verbs

Example:

1. We can live quite happily without thinking about why this is so. Once we start thinking about the force of gravity, which makes things fall, we may come up with some odd ideas.
2. He's thinking **of** taking a course of physics.
3. Some energy goes into raising the temperature of the cylinder walls and the piston, and that part spreads outward, doing no useful work

The following verbs take gerund as a direct object

admit	delay	imagine	postpone
advise	deny	involve	practice
allow	detest	justify	put off
anticipate	dislike	keep (on)	quit
appreciate	enjoy	leave off	recommend
avoid	escape	mention	resist
can't help	excuse	mind	resume
confess	face	miss	risk
consider	finish	permit	save
	give up		suggest
			tolerate

The following prepositional verbs can take a gerund

admit to	benefit from	get on with	rely on
(dis)agree with	care for	insist on	resort to
aim at	confess to	object to	succeed in
apologize for	count on	pay for	think of
(dis)approve of	depend on	put up with	vote for
believe in	feel like		

Note: Of all the adjectives, nouns, and verbs listed, many may not be used frequently in a document of purely scientific matter (with technical sense only). However, if you have a chance to get access to wider range of reading materials (especially those about our universe and human beings, which are viewed in many aspects of physics), you can find them with more frequent use.

PRACTICE

Exercise 1: *Complete the sentences with the correct form of the verbs given: to-infinitive or gerund or present participle. State each case of a gerundthat is used.*

1. You can use your knowledge of how charged particles and electric currents are affected by fields (interpret) ……………… diagrams of (move) ……………… particles.
2. You can use such an arrangement (observe) ……………… the effect of (change) ……………… the strength and direction of the field, and the effect of (reverse)………………the field. Note that you can seriously damage a television set by (bring) ……………… a magnet close to the screen.

3. You can make a field in two ways: (use) ……………… a permanent magnet, or (use) ……………… an electric current. There is really no fundamental difference between these two ways of (create) ……………… magnetic fields. You should be familiar with the magnetic field patterns of bar magnets. These can be shown up (use) ……………… iron bar fillings or (plot) ……………… compass. We represent magnetic fields, like gravitational and electric fields, by (draw) ……………… lines of force.
4. In a solenoid, (reverse) ……………… the current reverses the direction of the field.
5. Here are some useful rules for (remember) ……………… the direction of the magnetic field produced by a current:
   - The right - hand grip rule gives direction of field lines in an electromagnet. Imagine (grip) ……………… the coil, so that your fingers go around it (follow) ……………… the direction of the current. Your thumb now points in the direction of the field lines inside the coil, i.e. points towards the electromagnet's north pole.
   - The corkscrew rule is a way of (remember) ……………… the direction of the field lines around a current - carrying wire. Imagine (push) ……………… a corkscrew into a cork, and (turn) ……………… it. The direction in which you push is the direction of the current, and the field lines go round the direction in which you are turning the corkscrew.
6. The magnet creates a fairly uniform magnetic field. The rod has a current (flow) ……………… through it. As soon as the current is switched on, the rod start (roll) ………………, (show) ……………… that a force is acting on it. We use Fleming's left-hand rule (predict) ……………… the direction of the force. There are three things here, all of which are mutually at right-angles to each other – the magnetic field, the current in the rod and the force on the rod. These can be represented by (hold) ……………… the thumb and first two fingers of your left hand so that they are mutually at right-angles. Your fingers then represent: thuMb-Motion; First finger-Field; seCond finger-Current. You should practice (use) ……………… your left hand (check) ……………… that the rule correctly predicts these directions.
7. Scientists have put considerable effort into (research) ……………… for particles that have just one magnetic pole (magnetic monopoles).
8. We can generate electricity by (spin) ……………… a coil in a magnetic field. This is equivalent to (use) ……………… an electric motor backwards.
9. Another use of electromagnetic induction is in transformers. An (alternate) ……………… current in the primary coil produces a (vary) ……………… magnetic field in the core. The secondary coil is also wound round this core, so the flux (link) ……………… the secondary coil is constantly changing. Hence a (vary) ……………… e.m.f. is induced across the secondary.

10. Ampere's (find) ……………… revealed that when a charged particle crosses magnetic lines, it gets pushed to one side.
11. The tendency of a compass needle (dip) ……………… is a nuisance for compass users. (eliminate) ……………… this motion in a compass made for use in North America, the needle is suspended off center, or even counterweighted on the southern end, so that it moves only in the horizontal plane of the compass.
12. Electromagnets are the (work) ……………… parts of some of the instruments used (measure) ……………… currents and voltages.
13. In 1681, an English ship (sail) ……………… to Boston was struck by lighting. After the storm had passed, the sailors noticed that the ship's compass no longer pointed north. Somehow, the lighting had reserved the magnetic poles. Nevertheless, (use)……………… the wrong end of the compass for orientation, they came safely into Boston Harbor.
14. A person moves by (push) ……………… off from the Earth; a boat sails because the rowers push against the water with their oars; Thus, (push)………. off from a support seems (be) ……………… a necessary condition for motion; even an airplane moves by (push) ……………… the air with its propeller. But is it really? Might there not be some intricate means of moving without (push) ……………… off from anything.
15. If you rub a strip of plastic so that it becomes charged, and then hold it close to your hair, you feel your hair (pull)……………… upwards.

PROBLEM-SOLVING

Paragraph building

Task one

From the prompts given, build up sentences with the addition of the supplementary material above each set. Delete the words /phrases in Italic

1. MAGNETIZED/ SO THAT/ UPRIGHT/ WITH/ PROTRUDING/, AND/ HORIZONTALLY

   Place a knitting needle in a cork

   it will float in a trough of water

   its north pole *will* just *protrude* out of the cork

   support a bar magnet above the water

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………

2. THAT/ ;/ (1791-1867)/ TO/ OF/ WHAT/ SURROUNDING

   it is important to realize *this*

   lines of force have no objective existence

they were suggested by Michael Faraday
they give a mental picture
something is happening in the space
the space surrounds a magnet

……………………………………………………………………………………………
……………………………………………………………………………………………
………………………………………………………………………………

3. FLOATING/ WITH ITS /AND/ IT
put the needle *near the magnet*
the north pole *of the needle will be* near the north pole of the magnet
release the *needle*

……………………………………………………………………………………………
……………………………………………………………………………………………
………………………………………………………………………………

4. THE EXISTENCE OF/ BY A SIMPLE EXPERIMENT
lines of force *exist*
this may be demonstrated

……………………………………………………………………………………………
……………………………………………………………………………………………
………………………………………………………………………………

5. TO THE SOUTH POLE OF THE MAGNET
the needle will travel along a curved path

……………………………………………………………………………………………
……………………………………………………………………………………………
………………………………………………………………………………

6. TO/ DIFFERENT/ , AND/ SO
a diagram can be drawn
the diagram will represent the paths
the paths are traced out by the needle
the lines *are* drawn
the lines indicate lines of magnetic force

……………………………………………………………………………………………
……………………………………………………………………………………………
………………………………………………………………………………

7. THAT IS/ TEND TO/ WHICH
the force acts along definite lines
magnetic poles will be driven along certain lines

these lines are called lines of force

………………………………………………………………………………………
…………………………………………………………………………

8. AS/ AN INDEPENDENT/ WHEN/ IT/ FREE TO MOVE

   we can define a line of magnetic force

   a line of magnetic force is the path *of a needle*

   the path is traced out by a north pole

   the north pole is under the influence of a magnet

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ……………………………………………………………………

9. THE/ ROUND A MAGNET/

   this area is a magnetic field

   ………………………………………………………………………………………
   …………………………………………………………………………

10. IF/ WITH/ , / ALWAYS/ , BUT

    the experiment is repeated

    the needle *will be* in different starting positions

    the starting positions will be near the north pole of the magnet

    the needle will travel to the south pole

    the needle will travel along different paths

    ………………………………………………………………………………………
    ………………………………………………………………………………………
    ……………………………………………………………………

Task two

*Rewrite ten sentences in a logical order to make a paragraph. Before you write the paragraph, add the following material: '**within this field**' at the beginning of sentence 7*

Your paragraph:

1.	2.	3.	4.	5.
6.	7.	8.	9.	10.

TRANSLATION

Task one: *English-Vietnamese translation*

1. **Detection of Earth's magnetic field using neutrinos** has been accomplished at the Super-Kamiokande detector located underneath Mt. Ikenoyama in Japan. Here is the sequence of events: a cosmic ray proton strikes an oxygen or nitrogen atom in Earth's upper atmosphere, creating a neutrino which passes freely into the Earth where it may

find its way into Super-Kamiokande, a device consisting chiefly of 50,000 tons of pure water. In the water the neutrino (when it bothers to interact at all) will typically convert into a muon or electron, plus light, which is recorded in surrounding photo detectors. In this process, the neutrino and its daughter muon or electron track pretty closely the trajectory of the original cosmic ray proton. But the incoming cosmic ray flux, which would otherwise be isotropic, is shaped by the Earth's magnetic field. This acts as a sort of prevailing wind which sets up an east-west anisotropy in cosmic rays. This anisotropy, measured as long ago as the 1930s, should be matched by a corresponding anisotropy in neutrinos, which is precisely what the Super-Kamiokande team now finds. This measurement, while it says nothing new about Earth's magnetic field, does reassure the researchers that their detection of neutrino oscillation (one of the top physics stories of 1998) stands on a firm understanding of the complex chain of events whereby a cosmic ray in outer space leads to a burst of light in a cavern beneath Japan.

2. **Mar's magnetism**. The Mars Global Surveyor spacecraft has discovered patterns of magnetized surface rock—broad stripes of magnetic material pointing in one direction alternating with magnetic material pointing in the opposite direction, somewhat like the patterns seen at mid-ocean rift zones on Earth. On our planet the alternating stripes testify to the changing nature of Earth's magnetic field and to the recurring upwelling of magma resulting from the movement of tectonic plates above a seething molten planetary core. The conclusion: Mars too might have experienced tectonic activity.
3. **Magnetism and you**. Anywhere there is an electric current, there is a magnetic field: in a bolt of lighting, in the circuits of a hand calculator, and even in the extremely weak ion currents that travel along the nerve cells in your body. The magnetic fields of the currents along these nerves are very weak, about one- billionth as strong as the earth's magnetic field, which turns compass needles. Whenever you reach out to touch something, nerves carry an impulse to the muscles you need to use and cause contraction. This electrical impulse creates a temporary magnetic field. Two major sources of magnetic fields in the body are the heart (whose powerful contractions are triggered by large synchronous electrical impulses) and the brain. Strangely enough, if you drink a glass of cold water, the magnetic field around your middle increases slightly. Apparently there is an ion flow stimulated by cold liquid in your abdomen.
4. Because the mineral asbestos has magnetite in it, asbestos miners often have magnetic fields some 10,000 times larger than normal around their chest. The asbestos dust is harmful to the miners, but not because of its magnetism. The magnetite in the dust is insoluble in the body – it is inert. Therefore, asbestos in human lungs can be detected by its magnetic field before the concentrations are large enough to show up on X rays. The lungs of foundry workers, too, sometimes have large magnetic fields due to inhaled iron particles, as do those of arc welders. To detect such particle, the patient is painlessly magnetized in a medium-strength magnetic field (shades of Mesmer),

and any magnetic particles in this field align. The external magnet is turned off, and special detectors quickly measure the magnetic field of the aligned particles. The same technique is used to detect iron levels in the liver. With these devices, a medical physicist could tell if you'd just eaten canned beans by the trace amounts of iron in your stomach from the can.

5. **Using electromagnets to measure currents and voltages.** Electromagnets are working parts of some of the instruments used to measure currents and voltages. The idea is simple. An electromagnet is mounted on a pivot directly between the two poles of a permanent magnet. If a current passes through the electromagnet's coil (meaning that the voltage difference exists across the ends of the coil), it becomes a magnet, and its north pole is attracted to the permanent magnet's south pole and repelled by its north pole. That causes the electromagnet to turn on the pivot, where a spring resists its motion. The stronger the electromagnet's field, the farther it twists against the spring. A needle that rotates with the pivot indicates the current (or voltage) on a dial.
6. The electromagnet that rotates in the field of the permanent magnet is called a galvanometer. A single galvanometer can measure currents or voltage over different ranges. The user merely flips a knob that adds or subtracts various resistors in parallels or series to the electromagnet's circuit. When a galvanometer measures currents, it is called an ammeter, and when it measures voltage, a voltmeter. By the way, the name galvanometer is a tribute to Lugi Galvani, who, while discussing frogs abut 1791, accidentally discovered that if two dissimilar metals touched a frog's leg muscle, the muscle twitched. Galvani thought he was activating animal electricity and he proceeded to investigate, like Mesmer with magnetism, the use of animal electricity to cure disease. But, as we've seen, Volta created an electric cell without animal parts in 1800, and this proved the downfall of Galvani's idea.

(*Adapted from* different sources)

Task two: *Vietnamese - English translation*

1. **Điều khiển vệ tinh bằng từ trường trỏi đất.** Sợi dõy nối giữa hai vệ tinh cú tỏc dụng như một nam chõm điện.

   Xuất phỏt từ một hiện tượng tự nhiờn là trường điện từ của trỏi đất luụn tỏc động một lực nhất định vào vật cú từ tớnh, cỏc nhà khoa học Phỏp và Mỹ đó nghĩ ra một phương phỏp kỳ lạ: điều khiển vệ tinh nhờ một sợi dõy điện dài 20km nối giữa hai chiếc...

   Khi một vật cú từ tớnh chịu tỏc dụng của một từ trường đủ lớn, nú sẽ chuyển động. Chẳng hạn chiếc la bàn vốn là một thanh nam chõm cú cú thể phỏt ra một từ trường quanh nú, khi gặp tỏc động của từ trường trỏi đất, chiếc kim sẽ quay tớt và chỉ dừng lại khi cỏc lực đú cõn bằng (kim chỉ hướng bắc).

Cỏc nhà khoa học sử dụng hai vệ tinh, một hơi lệch xuống dưới, một hơi lệch lờn trờn quỹ đạo. Vệ tinh thứ nhất luụn cú xu hướng rơi xuống, trong khi vệ tinh thứ hai luụn sẵn sàng tỏch ra khỏi quỹ đạo trỏi đất. Hai vệ tinh được nối với nhau bằng một sợi cỏp điện dài 20 km.Và chỳng bị hỳt về hai hướng nờn sợi cỏp luụn được kộo căng và nằm theo phương thẳng đứng so với mặt đất. Khi hai vệ tinh di chuyển, điểm giữa của sợi dõy sẽ quay theo quỹ đạo Trỏi Đất.

Dũng điện do một trong hai vệ tinh sản xuất ra từ năng lượng mặt trời chạy qua sợi cỏp khiến nú biến thành một nam chõm. Từ trường của sợi dõy điện tương tỏc với từ trường trỏi đất tạo ra một lực mà cường độ và hướng của nú tựy thuộc vào gúc giữa sợi cỏp và cỏc đường sức từ của trỏi đất. Chớnh lực tỏc động này sẽ điều chỉnh hai vệ tinh luụn đi đỳng theo quỹ đạo.

(*Theo* **VnExpress,** Số Chủ nhật ngày 15/7/2001)

2. **Giả thuyết của Ampere về dũng điện phõn tử.** Để giải thớch từ tớnh của nam chõm, Ampere là người đầu tiờn nờu lờn giả thuyết về cỏc dũng điện kớn tồn tại trong lũng nam chõm gọi là dũng điện phõn tử. Theo Ampere thỡ từ trường của nam chõm chớnh là từ trường của cỏc dũng điện phõn tử trong lũng nam chõm đú. Ngày nay ta hiểu dũng điện phõn tử là do cỏc electron chuyển động bờn trong nguyờn tử tạo thành. Cú thể dựng khỏi niệm dũng điện phõn tử để giải thớch sự nhiễm từ của cỏc chất thuận từ và nghịch từ. Cũn đối với cỏc chất sắt từ thỡ khụng thể giải thớch bằng dũng điện phõn tử mà bằng một lý thuyết khỏc, tuy nhiờn cỏi chớnh của giả thuyết Ampere là dũng điện sinh ra từ trường thỡ vẫn giữ nguyờn giỏ trị.

3. **Cỏc chất sắt từ.** Trong tự nhiờn cú một số ớt chất (sắt, kền, coban…) cú tớnh nhiễm từ rất mạnh. Độ từ thẩm của cỏc chất đú lớn đến hàng nghỡn, thậm chớ cú trường hợp lớn đến hàng gần một triệu đơn vị. Tớnh nhiễm từ mạnh của chất sắt giải thớch vỡ sao nam chõm và sắt bao giờ cũng hỳt nhau. Một miếng sắt đặt gần một nam chõm sẽ bị nhiễm từ rất mạnh và cũng sẽ trở thành một nam chõm. Đầu miếng sắt gần cực bắc của nam chõm sẽ trở thành cực nam và ngược lại. Hai cực khỏc tờn bao giờ cũng hỳt nhau.

   Tớnh nhiễm từ mạnh của sắt khụng thể giải thớch bằng cỏc dũng điện phõn tử mà bằng cỏc miền nhiễm từ tự nhiờn. Khi khụng cú từ trường ngoài cỏc miền nhiễm từ tự nhiờn này được xếp sao cho từ trường của cỏc miền nhiễm từ tự nhiờn khử lẫn nhau. Khi đặt vào từ trường ngoài thỡ sẽ xảy ra sự phõn bố lại cỏc miền nhiễm từ tự nhiờn dẫn đến kết quả là sắt bị nhiễm từ mạnh.

   Cỏc chất sắt từ cú hai nhúm. Nhúm thứ nhất gồm những chất chẳng hạn sắt non, khi từ trường ngoài bị khử thỡ từ tớnh của chỳng mất rất nhanh. Những chất trong nhúm này được dựng đẻ chế tạo nam chõm điện. Nam chõm điện gồm một lừi sắt đặt bờn trong ống dõy. Cho dũng điện qua ống dõy, lừi sắt trở thành nam chõm. Ngắt dũng điện từ tớnh của lừi sắt mất rất nhanh.

Nhúm thứ hai gồm những chất, chẳng hạn như thộp, sau khi từ trường ngoài bị khử, từ tớnh của chỳng vẫn cũn giữ được khỏ lõu. Tớnh chất này được sử dụng trong việc chế tạo cỏc nam chõm vĩnh cửu hay gọi tắt là cỏc nam chõm.

(*From* **Vat li 11,** published by Educational Publishing House, Hanoi, 2000)

KEY TERMS

Anisotropy (n); the characteristic of a substance for which a physical property, such as index of refraction, varies in value with the direction in or along which the measurement is made. Also known as **aeolotropy; eolotropy.** *tớnh khụng đẳng hướng, tớnh dị hướng*

Asbestos (n): amian

Cosmic rays (n): electrons and the nuclei of atoms, largely hydrogen, that impinge upon the earth from all directions of space with nearly the speed of light. Also known as **cosmic radiation; primary cosmic rays**. *Tia vũ trụ*

Crystal (n/adj): mineral that has formed into a regular symmetrical shape. *Tinh thể/ ở dạng tinh thể*

Crystallize (v): turn into crystals. *Chuyển thành tinh thể/ tinh thể hoỏ*

Diamagnetic (adj): the property of magnetized material in external magnetic field so that the induction vector of the magnetic field appeared is opposite to that of the external magnetic field. *Cú tớnh nghịch từ.* **Diamagnetism (n)**

Electromagnet (n): pertaining to phenomena in which electricity and magnetism are related. *Nam chõm điện*

Ferromagnetism (n): A property, exhibited by certain metals, alloys, and compounds of the transition (ion group) rare- earth and actinide elements, in which the internal magnetic moments spontaneously organize in a common direction; gives rise to a permeably considerably greater than that of vacuum, and to magnetic hysteresis. *Tớnh thuận từ*

Foundry (n): a place where metal and glass is melted and formed into particular shapes. *Xưởng đỳc, lũ dỳc, nghề đỳc*

Inert (adj): not moving at all and appear to be lifeless. *Trơ*

Isotropic (adj): having identical properties in all directions. *Cú tớnh đẳng hướng*

Lava (n): a kind of rock which comes out of a volcano in the form of very hot liquid, and gradually cools and becomes solid. *Nham thạch*

(Ferro)Magnetic domain (n): a region of a ferromagnetic material within which the spontaneous polarization is constant. *Miền sắt từ*

Magnetism (n): phenomena involving magnetic fields and their effects upon materials. *Từ tớnh*

Magnetize (v): give power to an object so that it can draw iron or other metals towards it. *Từ hoỏ*

Paleomagnetism (n): ancient study of magnetism. *Cổ từ học*

Paramagnetic (adj): the property of a substance in an external magnetic field magnetized in the same direction as that of the field as when without external field, the substance has no magnetic order. *Cú tớnh thuận từ.* **Paramagnetism (n)**

Planetary (adj): relating or belonging to planets. *Thuộc về hành tinh*

Rift (n): a split that appears in something solid. *Kẽ nứt, khe rónh, sự tỏch lớp*

Seething (adj): boiling. *ở trạng thỏi sụi*

Tectonic (adj); belonging to construction. *Thuộc kiến tạo, xõy dựng*

Trace amount (n): very small amount of something that is hardly noticeable. *Lượng vết*

Trajectory (n): the curve described by an object moving through space, as of a meteor through the atmosphere, a planet around the sun, a projectile fired from a gun, or rocket in flight. *Quỹ đạo, đường đạn*

FREE-READING PASSAGE

It is advisable that you read the following passage for more about magnetism; you can do some translation practice on this passage and pick up some new vocabulary items.

Electricity and Magnetism

Although the ancient Greeks were aware of the electrostatic properties of amber, and the Chinese as early as 2700 BC made crude magnets from lodestone, experimentation with and the understanding and use of electric and magnetic phenomena did not occur until the end of the 18th century. In 1785 the French physicist Charles Augustine de Coulomb first confirmed experimentally that electrical charges attract or repel one another according to an inverse square law, similar to that of gravitation. A powerful theory to calculate the effect of any number of static electric charges arbitrarily distributed was subsequently developed by the French mathematician Simon Denis Poisson and the German mathematician Carl Friedrich Gauss.

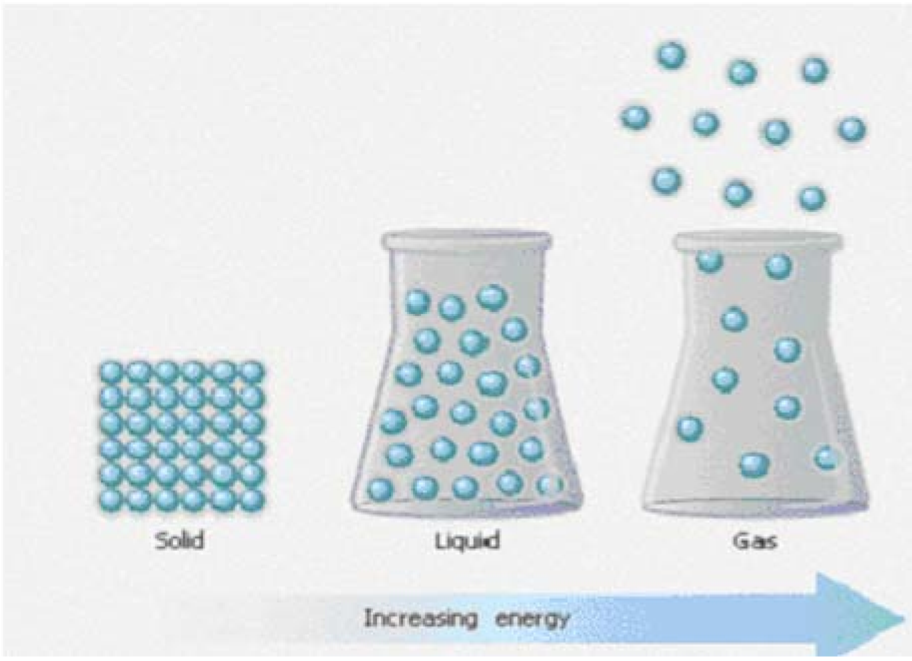
A positively charged particle attracts a negatively charged particle, tending to accelerate one toward the other. If the medium through which the particle moves offers resistance to that motion, this may be reduced to a constant-velocity (rather than accelerated) motion and the medium will be heated up and may also be otherwise affected. The ability to maintain an electromotive force that could continue to drive electrically charged particles had to await the development of the chemical battery by the Italian physicist Alessandro Volta in 1800. The classical theory of a simple electric circuit assumes that the two terminals of a battery are maintained positively and negatively charged as a result of its internal properties. When the terminals are connected by a wire, negatively charged particles will be simultaneously pushed away from the negative terminal and attracted to the positive one, and in the process heat up the wire that offers resistance to the motion. Upon their arrival at the positive terminal, the battery will force the particles toward the negative terminal, overcoming the opposing forces of Coulomb's law. The German physicist George Simon Ohm first discovered the existence of a simple proportionality constant between the current flowing and the electromotive force supplied by a battery, known as the resistance of the circuit. Ohm's law, which states that the resistance is equal to the electromotive force, or voltage, divided by the current, is not a fundamental and universally applicable law of physics, but rather describes the behavior of a limited class of solid materials.

The historical concepts of magnetism, based on the existence of pairs of oppositely charged poles, had started in the 17th century and owe much to the work of Coulomb. The first connection between magnetism and electricity, however, was made through the pioneering experiments of the Danish physicist and chemist Hans Christian Oersted, who in 1819 discovered that a magnetic needle could be deflected by a wire nearby carrying an electric current. Within one week after learning of Oersted's discovery, the French scientist Andre Marie Ampere showed experimentally that two current-carrying wires would affect each other like poles of magnets. In 1831 the British physicist and chemist Michael Faraday discovered that an electric current could be induced (made to flow) in a wire without connection to a battery, either by moving a magnet or by placing another current-carrying wire with an unsteady—that is, rising and falling—current nearby. The intimate connection between electricity and magnetism, now established, can best be stated in terms of electric or magnetic fields, or forces that will act at a particular point on a unit charge or unit current, respectively, placed at that point. Stationary electric charges produce electric fields; currents—that is, moving electric charges—produce magnetic fields. Electric fields are also produced by changing magnetic fields, and vice versa. Electric fields exert forces on charged particles as a function of their charge alone; magnetic fields will exert an additional force only if the charges are in motion.

These qualitative findings were finally put into a precise mathematical form by the British physicist James Clerk Maxwell who, in developing the partial differential equations that bear his name, related the space and time changes of electric and magnetic fields at a point with the charge and current densities at that point. In principle, they permit the calculation of the fields everywhere and any time from knowledge of the charges and currents. An unexpected result arising from the solution of these equations was the prediction of a new kind of electromagnetic field, one that was produced by accelerating charges, that was propagated through space with the speed of light in the form of an electromagnetic wave, and that decreased with the inverse square of the distance from the source. In 1887 the German physicist Heinrich Rudolf Hertz succeeded in actually generating such waves by electrical means, thereby laying the foundations for radio, radar, television, and other forms of telecommunications.

The behavior of electric and magnetic fields in these waves is quite similar to that of a very long taut string, one end of which is rapidly moved up and down in a periodic fashion. Any point along the string will be observed to move up and down, or oscillate, with the same period or with the same frequency as the source. Points along the string at different distances from the source will reach the maximum vertical displacements at different times, or at a different phase. Each point along the string will do what its neighbor did, but a little later, if it is further removed from the vibrating source. The speed with which the disturbance, or the message to oscillate, is transmitted along the string is called the wave velocity. This is a function of the medium, its mass, and the tension in the case of a string. An instantaneous snapshot of the string (after it has been in motion for a while) would show equispaced points having the same displacement and motion, separated by a distance known as the wavelength, which is equal to the wave velocity divided by the frequency. In the case of the electromagnetic field one can think of the electric-field strength as taking the place of the up-and-down motion of each piece of the string, with the magnetic field acting similarly at a direction at right angles to that of the electric field. The electromagnetic-wave velocity away from the source is the speed of light.

(*From* **http://encata.com**)



Order in matter

Matter is composed of atoms or groups of atoms called molecules. The arrangement of particles in a material depends on the physical state of the substance. In a solid, particles form a compact structure that resists flow. Particles in a liquid have more energy than those in a solid. They can flow past one another, but they remain close. Particles in a gas have the most energy. They move rapidly and are separated from one another by relatively large distances.

UNIT THIRTEEN

PHASE OF MATTER

READING PASSAGE

The solid state and the structure of Solids

We all live on terra firma, the 29 percent of our planet's solid crust that lies above sea level. And almost everything we do is tied to solids, living in houses, creating and marketing solid goods, eating solid foods, and so on. But if you are asked to define a solid, it might be difficult. A solid is one of those familiar things that are hard to put into words. A good definition of a solid is that **it** tends to keep its shape when **it** is left alone. But that doesn't mean a solid is necessarily rigid. Rubber bands, books, and the clothes you wear- these flexible materials maintain their shape to some degree. **They** aren't rigid, but **they** are solid.

We've seen that at the atomic level, the atoms or molecules bonded together in a solid stay in place with respect to their neighbors. The strength and rigidity of the solid, then depends to some degree on how strong the bonds are between those atoms or molecules. But more is involved than just bonds. Diamond, the hardest natural substance, and graphite, which is so soft and slippery that **it** its used to lubricate door locks, are both pure forms of carbon atoms, held together with covalent bonds. The difference that makes **one** so hard and the other soft is the structural arrangements of their atoms.

In any solid, the atoms or molecules are in fixed positions. When there is an order, that is a pattern in the placement of the molecules or atoms that repeats throughout the solid, it is called crystalline. Examples of crystalline solids are table salt, diamonds, quartz and ice. If the molecules or atoms in a solid have no particular arrangement, fitting together in a seemingly random way, the solid is called amorphous. Plastics, glass, and the cement in concrete are examples of amorphous solids. However, many solids have mixed structures. Rocks such as sandstone and granite are amorphous composites of small crystals of different chemical compositions.

Whether a solid is crystalline or amorphous depends on how it is formed. For example, suppose melted rock (called magma) cools very fast, as when magma vents from a volcano at earth's surface. The molecules have no time to find a place in a crystalline pattern; besides, there's little incentive for the cooling atoms to get together in an orderly arrangement unless they are under pressure. That magma hardens into an amorphous solid; sometimes it even looks like glass. When magma cools while underground, it cools more slowly and under pressure. The resulting rock has grains of mineral crystals in it, giving it a rough texture. (A mineral is a naturally occurring inorganic compound, and over 2000 are known. Inorganic compound means' "containing no carbon atoms.'" Diamond and graphite, being pure carbon and not compounds, aren't referred to as inorganic). Especially, slow cooling can sometimes results in very large crystals. The same process affects the quality of ice cream. To get the smooth consistency prized in top-quality ice cream, commercial producers control the crystallization process. They must take the new ice cream mixture to -40^0C Fahrenheit as quickly as possible. Ice cream that is frozen too slowly is very grainy in texture because of the large crystals; rapid freezing of the mixture produces only microscopic crystals.

Even if in trace amounts, impurities in a crystalline solid often affect its physical properties such as color or even hardness. Ordinarily a natural diamond (a crystal of carbon atoms) has a faint blue color due to the presence of one boron atom for every million carbon atoms. If a diamond has one atom of nitrogen interspersed among 100,000 carbon atoms, **it** is no longer clear and blue, but yellow instead. Clear, colorless aluminum oxide, Al_2O_3 (the mineral corundum), becomes pink sapphire if a small percentage of chromium atoms are interspersed throughout the corundum crystal. A slightly lager percentage of chromium turns the corundum into the deep red mineral called ruby.

(*Adapted from* **Physics - An introduction** by Jay Bolemon, 1989)

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading text.*

1. What is a solid?

   …………………………………………………………………………………

   …………………………………………………………………………………

2. What decides the strength and rigidity of a solid?

   …………………………………………………………………………………

   …………………………………………………………………………………

3. How many structures can the solids have? What are they?

   …………………………………………………………………………………

   …………………………………………………………………………………

4. What is the difference between a crystalline and an amorphous solid?

   …………………………………………………………………………………

   …………………………………………………………………………………

5. What decides the structure of a solid? Give an example.

   …………………………………………………………………………………

   …………………………………………………………………………………

Exercise 2: *Fill in the blanks with words from the text.*

1. ______ _______ accounts for 29% of our solid crust above the sea level.

2. Solid tends to keep its _______ when left alone.
3. A solid may or may no be _______.
4. At ______ ______, atoms and molecules bonded together in a solid stay in place with respect to their neighbors.
5. Diamond and graphite are both example of pure forms of ______ ______ held together with covalent bonds.
6. The _______ _______ of a solid's atoms decides it rigidity.
7. In a(n) _______ _______ , the placement of the molecules or atoms repeats throughout the solid.
8. In a(n) _______ _______, the molecules or atoms have no particular arrangement.
9. The way in which a solid is formed decides the _________ of the solid.
10. The _______ ________ of a crystalline solid are affected by the impurities present in it.

Exercise 3: *Contextual reference* (Dealing with words in **bold** type one by one)

1. Two '**it**' in line 5
   a. both refer to the solid
   b. the former refers to the solid, the latter refers to the solid's shape
   c. both refer to the solid's shape.
2. Two **'they'** in line 7 and 8
   a. both refer to rubber band, books, and clothes
   b. both refer to flexible materials
   c. the former refers to rubber band, books, and clothes; the latter refers to flexible materials.
3. **'it'** in line 13 refers to
   a. the diamond
   b. the graphite
   c. both of the above.
4. '**one'** in line 15 refers to
   a. the diamond
   b. the graphite
   c. any solid.
5. '**it**' in line 45 refers to

a. the diamond
b. the atom of nitrogen
c. any solid.

GRAMMAR IN USE

A) Noun clause (3)

Refer to **UNIT SIX** for the definition of a noun-clause.

Hereby, noun clauses forming with **whether….. or not** *and* **if,** sometimes known as yes-no interrogative clause are presented.

In two conjunctions, the former one is a correlative subordinator while the latter one is a simple subordinator.

The noun clauses formed from these two subordinators have the following functions in a sentence:

1. Both can function as a direct object

Example:

a. On a straight and smooth road, we can not feel **whether** there is any change in your car's speed.
b. To find out **if** temperature has any effect on the intensity of radiation from radioactive substances, samples of these substances have been heated to very high temperatures, and they have been cooled to very low temperatures in liquid air.

- *Whether* **can take a to-infinitive after it**

Example:

1. He did not know whether to go on with the research (or not).

2. Only the clause with *whether* **can function as a subject**

Example:

c. **Whether** a solid is crystalline or amorphous depends on how it is formed.

Note that only ***whether*** can be followed by ***'or not'*** but the clause with it can not be made negative, except when it is the second part of an alternative question.

Example:

1. When analyzing a change in matter, we should clarify whether it has undergone a physical change or (it has) not.

Note: '***Whether'*** is more commonly used than '***if'.*** That's why you'll encounter a lot of 'whether' to be used rather than 'if'.

You may have seen that a noun clause with ‘whether’ or ‘if’ somehow originates from a yes/no question because it leaves only two choices for the answer. Still, the question is used for a confirmation of the information by ‘yes’ or ‘no’, a ‘whether’- clause leaves a wonder for the information by ‘or not’.

B) Patterns expressing result

It is really important that you know how to state a result of an action, especially when you write a description or/and make a report.

You have learnt how to use a to-infinitive to express result though uncommonly, and you did learn in **UNIT TEN** that a present participle phrase can also be used to express result. Some common conjunctions or conjunctional phrases, which are commonly used to do such a task, will be presented.

A lot of conjunctions/connectives can be used: so; therefore; thus (V-ing); hence (V-ing); accordingly; consequently; now; then; so that.

Besides, there are some conjunctional/connective phrases to be used in this way: with the result that; as a result/consequence; the result/consequence is; for this/that reason; because of this/that

Example:

1. In 1905, Einstein showed that *as a consequence* of his theory of special relativity, mass can be considered to be another form of energy. *Thus* the law of conservation of energy is really the law of conservation of mass-energy.
2. A mass has zero gravitational potential energy when it is ‘at infinity’- that is, at some point so far from the Earth and any other massive objects that it feels no gravitational force. *Then*, to calculate the potential energy of a mass near to the Earth (or anywhere else), we calculate the work done against gravity in bringing the mass from infinity to that point…*Hence*, we can arrive at the following definition: The gravitational potential at a point in a field is equal to the work done against gravity in bringing unit mass from infinity to that point. *So* $\theta = -G\frac{M}{r}$.
3. The frequency of vibration is set *so that* there are two loops along the string; the frequency of the stroboscope is set *so that* it almost touches that of vibration.
4. A ball thrown horizontally in the Earth’s uniform gravitational field continues to move at steady speed horizontally, but at the same time it accelerates downwards. *The result is* the familiar curve is shown.
5. The diagram shows that the electrons will be pushed in the direction from X to Y. *So* a current has been induced to flow in the wire; its direction is from Y to X.

PRACTICE

Exercise 1: *Find a sentence in column B to match with each one in A to make a pair of sentences which are closely related in meaning.*

A

1. The smallest divisions on a metric ruler are 0.1cm (1mm) apart; this is a small distance indeed.
2. If the edge of the measured object falls between two lines of 4.8 and 4.9 cm, to gain more information, you have to estimate the position of the edge.
3. Think of two glasses containing liquids, both liquids are transparent and have no smell.
4. If we want to find out whether two objects are made of the same substances or of different ones, we have to look for properties that are characteristic of a substance.
5. The density of the liquid in a car's radiator tells us whether there is enough antifreeze (in most cases, glycol) in the mixture.
6. To find the concentration of a saturated solution, you could add a tiny amount of solid at a time and see whether it dissolves.
7. To find out whether temperature has any effect on the intensity of radiation from radioactive substances, samples of these substances have been heated to very high temperatures, and they have been cooled to very low temperatures in liquid air.
8. If we ignore air resistance, the total external force $\sum F_{ext}$ acting on the system is the weight Mg of the

B

a. A better method is to begin with a large mass of solid and shake it until you judge that no more will dissolve.

b. But it was found that temperature changes do not affect the radiation from a radioactive substance.

c. Can you say whether they are the same?

d. If you can not tell whether the edge is closer to one line or the other, it is best to report the reading as 4.85 cm or 48.5 mm.

e. In particular, he wondered whether the Earth's gravitational pull was confined to the Earth's surface, or whether it extended into space – as far as the Moon.

f. It does not matter whether the conductor is moved through the field, or the magnet is moved past the conductor, the result is the same – an induced current flows.

g. It's no, because theory shows that in this case the curve depicting the dependence of the displacement on the time is a sinusoid.

h. Nevertheless, when the object you wish to measure has sharp edges, you can see whether the edge fall s on one of the lines.

i. Similarly, the density of the liquid in a car's battery should be recharged.

j. That is, we have to find out the properties that do not depend on the system, regardless of whether the rocket explodes.

9. We think of this cutting of flux by a conductor as the effect that gives rise to an induced current flowing in the conductor.
10. Isaac Newton investigated the question of the Earth's gravity.
11. Because almost everything you do requires moving something about, whether you're turning a page or merely taking a breath, you know all this ahead of time.
12. Suppose we have a newly made substance.
13. If an isolated conductor is placed in an external electric field, all points of the conductor still come to a single potential regardless of whether the conductor has an excess charge.
14. Regardless of whether they have permanent electric dipole moments, molecules acquire dipole moments by induction when placed in an external field.
15. Sometimes we wonder whether it is necessary to turn to a graph to find the magnitude of the displacement of a point making small oscillation about its equilibrium position.

amount of the substance or on the shape of the sample.

k. That is, you have a feeling that is based on experience for how things move.
l. The free conduction electrons distribute themselves on the surface in such a way that the electric field they produce at interior points cancels the external electric field that would otherwise be there.
m. This external field tends to 'stretch' the molecule, separating slightly the centers of negative and positive charge.
n. Thus, the acceleration of the center of mass of the fragments (while they are in flight) remains equal to g, and the center of mass of the fragments follows the same parabolic trajectory that the unexploded rocket would have followed.
o. We wish to find out whether it is truly a new substance, different from all others, or a substance already known but made in a new way.

Exercise 2: *Fill in each blank with one suitable word. Some of the words are those listed in grammar part B.*

1. **Electromagnetic induction**. So far, we have not given an explanation of electromagnetic induction. You have seen that it (1) ……………occur, and you know the factors that affect it. But why does an induced current flow?

   The following will give a(n) (2) …………….. A straight wire XY is being pushed downwards through a horizontal magnetic field B. Now, think about the free electrons (3) ……………. the wire. They are moving downwards, (4) ……………in effect an electric current. Of course, because (5)……………….are negatively charged, the conventional current is flowing upwards.

We (6) ……………. have a current flowing across a magnetic field, and the motor effect will (7) ……………..come into play. Using Fleming's left-hand rule, we can find the direction of the force (8) ……………. the electrons. The diagram shows that the electrons will be pushed in the direction from X to Y. So a current has been induced to flow in the wire; its direction is from Y to X.

Now we can check that Fleming's right- hand rule gives the correct direction for motion, field and current, which it indeed does.

(9) ……………., to summarize, an induced current flows because the electrons are pushed by the motor effect. Electromagnetic induction is simply a (10) ……………. of the motor effect.

2. **Matter and temperature**. If we heat some matter so that its temperature rises, the amount of energy we must (1). ……………..depends on three things: the mass m of the material we are (2) ……………...; the temperature rise $\triangle\vartheta$ we wish to achieve ($\triangle$ is Greek capital delta); and the material itself. Some materials are easier to heat than others – it takes more energy to raise the temperature of 1 kg of water by 1^0C than to raise the temperature of 1 kg of alcohol by the (3) ……………...amount.

   We can represent this in an equation. The amount of energy $\triangle Q$ that must be supplied is given by: $\triangle Q = mc\triangle\vartheta$ (4) ………………..c is the specific heat capacity of the material. Rearranging this equation gives c = $\triangle Q/m\triangle\vartheta$.(5) ………………….,the specific heat capacity of a substance is the amount of energy required to raise the (6) ……………..of 1 kg of the substance by 1^0C (or by 1K). (The word 'specific' here means 'per unit mass', i.e. per kg). (7) ……………..this form of equation, you should be able to see that the units of c are $Jkg^{-1}\,{}^0C^{-1}$ (or Jkg^{-1} K^{-1}). Specific (8) ……………...capacity is related to the gradient of the sloping sections of the time-graph for water, heated at a steady rate. The steeper the gradient, the faster the substance heats up, and (9) ……………. the lower its specific heat capacity must (10) …………….

3. **Metals**. The feature that defines a metal is that, the highest occupied energy level falls somewhere near the middle of an energy band. If we (1) ……………. a potential difference across a sample of such a solid, a current can exist because there are plenty of vacant levels at higher energies into (2) …………….....electrons can be raised. (3) ……………..a metal can conduct electricity because electrons in its highest occupied band can easily move into higher energy levels within (4) …………….. band. We did mention the free-electron model of a metal, in which the conduction electrons are (5) …………….. to move through the volume of the (6) …………….... like the molecules of a gas in a closed container. We used this model to derive an expression for the resistivity of a (7) ……………..., assuming that the electrons follow the laws of Newtonian

mechanics. Here we use that same (8). to explain the behavior of the electrons – called the conduction electrons. However, we (9) …………….the laws of quantum mechanics by assuming the energies of these electrons to be quantized and the Pauli Exclusion Principle to hold. We (10)……………. too that the electric potential energy of a conduction electron has the same constant value all points within the lattice. If we choose this value of the potential energy to be zero, as we are free to do, then the energy E of the conduction electrons is entirely kinetic.

PROBLEM-SOLVING

Writing a summary

In **Units Nine** and T**en**, you were asked to fill in the blanks with words from the reading text.

In **Unit Nine**, exercise 3 in the reading comprehension requires you to complete a new version about weight with the words from the reading passage. As you can see, the two passages are about the same topic. However, the new version is briefer than the reading passage and still contains all the main ideas in the reading passage. We can, thus, consider it as the summary of the reading passage.

In **Unit Ten**, exercise 3 in the reading comprehension requires you to complete each separate sentence with words from the reading passage. It is clearly seen that, in this case, each sentence coveys a main idea of the reading passage. Thus, if you link these sentences with suitable linking markers, you can have the summary of the reading passage.

Refer to the two mentioned units for reference.

Also, in the reading comprehension, the exercises dealing with contextual reference make themselves very important as a support for the writing skill development. A good writing is the one which, firstly, is smooth-reading. That's why the use of pronouns, to avoid the repetition of the key nouns in the writing, is stressed. Hence, you should use the pronouns properly in your writing in order to make it sound fine. Refer to all the exercises of contextual reference for the proof.

Read the following passages and write a summary for each

1. **Buoyancy: Archimedes' Principle**. Here's a trick that you always pull off. Tell two friends you can pick them up, one with each arm, and carry them around for 5 minutes. Once they agree, tell them how you will do it: shoulder-deep in water. Anything immersed in water seems to weigh less, and water pressure is the reason.

If you lower your hand, palm down, into water, pressure from the water on the top of your hand pushes it downward, while pressure from beneath it pushes upward. The water under your hand, however, is father below the surface than the water that's just over your hand. That means the upward pressure on your palm is higher than the downward pressure on the back of your hand. P = density x g x depth. Consequently, your hand gets a net push in the upward direction. We call that net push from the water's pressure the buoyant force, F_b. The buoyant force is why your friends will seem to weigh less in water. Their weights (mg) won't change, of course, but each gets a buoyant force from the water that pushes upward, counteracting (to some extent) their weights. The buoyant force affects you, too. Get it up to your shoulders and you can stand on the very tips of your toes with no trouble at all. On dry land, it hurts to do that- if you can manage it at all.

Simple experiments show exactly how large the buoyant force is. First, fill a container to the brim with water. Carefully place a toy boat on the surface, catching the overflow with another container. In this case you can tell immediately what buoyant force is acting on the boat. Since the floating boat neither rises nor falls, the net force on the boat is zero. The buoyant force, then, is equal and opposite to the boat's weight. Next, weigh the overflow, and you'll find the weight of the water displaced by the floating boat is equal to the boat's own weight. The buoyant force on a floating object is equal to the weight of the displaced water.

Another experiment takes the result further. Suspend a rock from a spring scale with string. When you completely immerse this rock in a container filled with water, its pull on the scale is less than its weight, mg. Notice how much force is missing – that's the buoyant force on the rock. Next, weigh the overflow as before. You'll find the weight of the displaced water (this time equal in volume to the submerged rock's own volume) is once again equal to the buoyant force. Just as for the floating boat, the buoyant force on a submerged object equals the weight of displaced water. This is called Archimedes' Principle.

(*Adapted from* **Physics, an Introduction** by Jay Bolemon, 1989)

2. **The liquid inside you**. About once a second the muscle that is your heart squeezes down, putting pressure on the blood inside and pushing it into the aorta. Like water, blood is nearly compressible, so when your heart muscle pushes, the blood throughout your body's circulatory system moves. It flows through the major channels called arteries and veins and into the tinier vessels called capillaries. (These capillaries don't depend on capillary action: their name stems only from their size.) Four to five quarts of this liquid carry molecular fuel and the oxygen need to 'burn' it to all the cells in your body. The oxygen is transported by the hemoglobin molecules in the red cells, which typically account for about 45% of the blood's volume. The blood also carries away the molecular waste products from the cells and the waste heat that's generated as the cells burn their '"food.'" The molecular waste is filtered from the blood by your liver and kidneys, and the heat escapes when the blood circulates in the many small vessels close to your skin.

When you are standing, the pressure of the blood in your feet is greater than in your brain (pressure = density x g x depth). Lie on the floor for a minute and then stand up quickly. You might feel a little lightheaded until the heart increases the pressure to pump your blood up to your head. You can get the same feeling at the fair if a ride accelerates you upward. Along with everything else in your body, your blood becomes '"heavier'" with an upward acceleration, and it's harder for the heart to pump it up to your head. In fact, if such an acceleration exceeds three times the acceleration of gravity (3 g's) while you are standing, your heart isn't strong enough to pump any blood to your head, and you will have black out. Your cardiovascular system is built for 1g, and your heart works all the time to pump the blood against the force of gravity from your feet up to your scalp. To keep the rising blood from draining back down between heartbeats, small bands of muscles (called shunts, or cuffs) around the ends of the smaller vessels clamp down, ensuring that blood flows in only one direction. When one of these one-way valves fails for some reason, the blood pools, and the result is varicose vein.

(*Adapted from* **Physics, an Introduction** by Jay Bolemon, 1989)

Before you write the summary for each passage, find the main and sub-main ideas of each paragraph by underlining them. For example, a double line (===) for a main idea and a single line (______) for a sub-main idea. Then, from those underlined, you develop into a paragraph. This paragraph will be the required one. Make sure that your paragraphs are well organized (refer to UNIT TEN for the form of a paragraph); making good use of the linkers, pronouns and any types of subordinate clauses.

Now write your paragraphs here:

1. **Buoyancy: Archimedes's Principle**

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2. **The liquid inside you**

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TRANSLATION

Task one: *English-Vietnamese translation*

1. **Matter.** Material substance that constitutes the observable universe and, together with energy, forms the basis of all objective phenomena. The basic building blocks of matter are atoms. All matter shares certain fundamental properties. Every physical entity has gravitation, the property by which it attracts every other entity. Another inherent and permanent property of matter is inertia, which causes a body to resist any change in its condition of rest or its motion. The mass of a body is a measure of its inertia, though it is commonly taken as a measure of the amount of material contained in the body. Matter in bulk may have several states, the most familiar of which are the gaseous, liquid, and solid states. Less clearly definable but also referred to as states of matter are plasma, clusters, and amorphous conditions such as the glassy state. Each such state exhibits properties that distinguish it from the others. Moreover, these general states can be subdivided into groups according to particular types of properties. Solids, for example, may be divided into metallic, ionic, covalent, or molecular based on the kinds of bonds that hold together the constituent atoms. According to Albert Einstein's special theory of relativity, matter (as mass) and energy are equivalent. Accordingly, matter can be converted into energy and energy into matter. The transformation of matter into energy, for instance, results during nuclear fission, which involves the splitting of a nucleus of uranium or another heavy element into two fragments of almost equal mass.

(*From* **Encyclopedia Britannica 2001**)

2. **Phases.** In thermodynamics, chemically and physically uniform or homogeneous quantity of matter that can be separated mechanically from a nonhomogeneous mixture and that may consist of a single substance or of a mixture of substances. The three fundamental phases of matter are solid, liquid, and gas (vapor), but others are considered to exist, including crystalline, colloid, glassy, amorphous, and plasma phases. When a phase in one form is altered to another form, a phase change is said to have occurred. General considerations: A system is a portion of the universe that has been chosen for studying the changes that take place within it in response to varying conditions. A system may be complex, such as a planet, or relatively simple, as the liquid within a glass. Those portions of a system that are physically distinct and mechanically separable from other portions of the system are called phases. Phases within a system exist in a gaseous, liquid, or solid state. Solids are characterized by strong atomic bonding and high viscosity, resulting in a rigid shape. Most solids are crystalline, inasmuch as they have a three-dimensional periodic atomic arrangement; some solids (such as glass) lack this periodic arrangement and are noncrystalline, or amorphous. Gases consist of weakly bonded atoms with no long-range periodicity; gases expand to fill any available space. Liquids have properties intermediate between those of solids and gases. The molecules of a liquid are condensed like those of a solid. Liquids have a definite volume, but their low viscosity enables them to change shape as a function of time. The matter within a system may consist of more than one solid or liquid phase, but a system can contain only a single gas phase, which must be of homogeneous composition because the molecules of gases mix completely in all proportions.

(*From* **Encyclopedia Britannica 2001**)

3. **Complex fluids go through a strange phase**

(By **T .Tlusty and S. A. Safran 2000 Science 290 1328)**

We are familiar with the idea of a liquid existing alongside its gaseous form - like water and water vapor inside a kettle - but not all liquids are so simple. Scientists are unsure how - or even if - different phases exist in certain liquids commonly used in industry and research. Now Tsvi Tlusty and Sam Safran of the Weizmann Institute of Technology in Israel are a step closer to understanding the complex behavior of these fluids.

Some liquids are very useful because their molecules act as tiny dipoles that can be aligned by electric or magnetic fields. Vehicle clutches, ink-jet printers and lubricants are among the applications that make use of these so-called dipolar fluids, which consist of micron-sized spherical particles suspended in a fluid. But to exploit the liquids further, scientists need a better understanding of how they behave. '"Understanding phase separation in these liquids will allow us to predict whether they will remain homogeneous under certain conditions'", Safran told Physics Web. '"This is crucial for the development of new applications for dipolar fluids'".

In these dipolar liquids, the colloidal particles line up head-to-tail to form long chains, rather like polymers. This tends to prevent fluids behaving in a simple manner. But Tlusty and Safran found that the key to understanding the fluid was to treat the chains, rather than the individual molecules, as the basic unit of the liquid. The pair developed a simple model of the actions of a dipolar fluid at different temperatures. In a simple fluid, the liquid and gas phases are easily distinguished by their greatly differing concentrations. But Tlusty and Safran found that different phases in the dipolar fluid are rather unusual in that they also have very distinct topologies. Impurities in the dipolar liquid caused Y-shaped branches and 'loose ends' to form in the chains. The model showed that under certain conditions, the liquid separates into a dense network of chains and a dilute 'gas' of loose ends.

The separation of the fluid into the two phases will affect the overall viscosity of the fluid. '"We need to take into account local fluctuations next'", said Safran. '"This will give us an even greater insight into the complexities of these fluids'".

(*From* **Physics Web,** Edition November 2000)

Task two: *Vietnamese - English translation*

1. **Tinh thể**. Quan sát hạt muối ăn (NaCl) ta thấy chúng đều có dạng khối lập phương hoặc khối hình hộp. Nếu đập vỡ một hạt muối tinh khiết thành những mảnh có độ lớn khác nhau thì tất cả những mảnh này đều có dạng khối lập phương hoặc khối hình hộp.

Tiếp tục đập vụn hạt muối thành những hạt nhỏ li ti và đưa chúng vào kính hiển vi quan sát ta thấy những hạt muối này dù rất nhỏ vẫn có dạng khối lập phương hoặc khối hình hộp, những kết cấu rắn có dạng hình học xác định như thế gọi là các tinh thể.

Tinh thể của mỗi chất có hình dạng đặc trưng xác định. Tinh thể muối ăn có dạng khối lập phương hoặc khối hình hộp. Tinh thể thạch anh (SiO_2) có dạng hình khối lăng trụ sáu mặt, hai đầu là hai hình chóp.

2. **Chất vô định hình**. Chất vô định hình là những chất không có cấu tạo tinh thể. Thuỷ tinh, nhựa thông, hắc ín là các chất vô định hình.

Khác với các chất kết tinh, chất vô định hình không có nhiệt độ nóng chảy xác định. Khi bị làm nóng dần lên thì chất vô định hình mềm đi và dần dần chuyển sang trạng thái lỏng. Quá trình biến đổi là liên tục, không có giới hạn rõ ràng giữa trạng thái rắn và trạng thái lỏng.

Vì không có cấu tạo tinh thể nên chất vô định hình có tính đẳng hướng.

Có một số chất như lưu huỳnh, thạch anh, đường, có thể vừa là chất kết tinh vừa là chất vô định hình. ví dụ khi đổ lưu huỳnh kết tinh nóng chảy (ở 350 ^{0}C) vào nước lạnh thì do bị làm nguội nhanh lưu huỳnh lỏng không đông đặc thành tinh thể mà thành lưu huỳnh dẻo vô định hình.

3. **Tính đàn hồi và tính dẻo**. Khi tác dụng vào vật rắn ta có thể làm cho vật rắn biến dạng. Khi ngoại lực thôi tác dụng vật lấy lại hình dạng và kích thước ban đầu thì biến dạng của vật gọi là biến dạng đàn hồi và vật ấy có tính đàn hồi. Nếu khi ngoại lực thôi tác dụng vật

không lấy lại được hình dạng và kích thước ban đầu thì biến dạng của vật là biến dạng dẻo (hay biến dạng còn dư) và vật ấy có tính dẻo.

Các vật rắn có thể có cả tính đàn hồi và tính dẻo. Chẳng hạn khi kéo nhẹ một lò xo mảnh rồi buông tay ra, lò xo lấy lại hoàn toàn kích thước và hình dạng ban đầu: nó có tính đàn hồi. Nếu căng lò xo quá mức thì khi buông ra lò xo không lấy lại được kích thước và hình dạng ban đầu: nó có tính dẻo.

Giới hạn trong đó vật có tính đàn hồi goị là giới hạn đàn hồi của vật.

4. **Hình dạng của khối chất lỏng**. Các khối chất lỏng (nước trong ống, rượu trong chai, thuỷ ngân trong bầu của nhiệt kế) có thể tích xác định nhưng không có hình dạng riêng.

Ở mặt đất, dưới tác dụng của trọng lực khối chất lỏng có hình dạng của bình chứa. Ở những chỗ chất lỏng tiếp xúc với bình chứa mặt giới hạn của chất lỏng trùng với thành bên trong của bình chứa.

Ở những chỗ chất lỏng không tiếp xúc với bình chứa, mặt giới hạn gọi là mặt thoáng. Trên mặt thoáng có thể là không khí, một chất khí nào đó hoặc chân không. Thông thường mặt thoáng là mặt nằm ngang.

Các khối chất lỏng ở trạng thái không trọng lượng, các khối chất lỏng chịu sự tác dụng của những lực cân bằng nhau (giọt aniline trong dung dịch muối có khối lượng riêng bằng khối lượng riêng của anilin) đều có dạng hình cầu.

5. **Sự sắp xếp phân tử và chuyển động nhiệt**. Mật độ phân tử ở chất lỏng lớn gấp nhiều lần mật độ phân tử trong chất khí nhưng gần bằng mật độ phân tử trong chất rắn.

Trong chất lỏng khoảng cách giữa các phân tử có độ lớn vào khoảng kích thước phân tử, do đó các phân tử chất lỏng chuyển động rất khó khăn. Mỗi phân tử trong chất lỏng luôn luôn dao dộng hỗn độn xung quanh một vị trí cân bằng xácđịnh. Sau một khoảng thời gian nào dó do tương tác với các phân tử ở gần, nó nhảy sang một vị trí xác định khác và lại dao động hỗn độn xung quanh vị trí này một thời gian, rồi lại nhảy sang vị trí xác định mới.

Chuyển động mô tả ở trên là chuyển động nhiệt của các phân tử trong chất lỏng. Khi nhiệt độ của chất lỏng tăng thì chuyển động nhiệt tăng.

6. **Thời gian cư trú**. Thời gian một phân tử giao động xung quanh một vị trí xác định tính từ lúc tới cho đến lúc đi gọi là thời gian cư trú. Nhiệt độ của chất lỏng càng cao thì thời gian cư trú càng ngắn, trật tự sắp xếp các phân tử thay đổi tính chất hỗn độn càng tăng. Chất lỏng ở nhiệt độ cao có cấu trúc gần với chất khí.

Ở nhiệt độ không cao cấu trúc của chất lỏng giống cấu trúc của chất vô định hình. Sự khác nhau chỉ ở chỗ các phân tử trong chất vô định hình chuyển dời vị trí dao động chậm hơn trong chất lỏng. Nói cách khác là thời gian cư trú của phân tử trong chất vô định hình lớn hơn trong chất lỏng. Do đó về mặt cấu trúc người ta có thể xếp chất vô định hình vào loại chất lỏng. Sự chuyển từ trạng thái vô định hình sang trạng thái lỏng được thực hiện một cách liên tục vì không có sự thay đổi đột ngột về cấu trúc.

(*All from* **Vat li 11**, published by Educational Publishing House, Hanoi, 2000)

KEY- TERMS

Amorphous (adj): Pertaining to a solid which is noncrystalline, having neither definite form nor structure. *Có tính vô định hình*

Aorta (n): the aorta in a body is the main artery through which the blood leaves the heart before flows through the rest of the body. *động mạch chủ*

Buoyancy (n): The resultant vertical force exerted on a body by a static fluid in which it is submerged or floating. Also known as buoyant force. *tính nổi, sức nổi*

Colloid (n): a sticky substance. *Chất keo*

Colloidal (adj): being sticky. *Thuộc keo*

Composites (n): something made up of several substances. *Hợp chất, hợp thể, phức*

Corundum (n): corindon (Vietnamese transcription)

Elasticity (n): 1. the property whereby a solid material changes its shape and size under action of opposing forces, but recovers its original configuration when the forces are removed. *Tính đàn hồi*

2. The existence of forces which tend to restore to its original position any part of a medium (solid or fluid) which has been displaced. *đàn tính*

Flexible (adj): being able to be flexed. *Mềm dẻo, linh hoạt, dễ uốn*

Flexibility (n): the quality or state of being able to be flexed or bent repeate**dly.** *Tính mềm dẻo, linh hoạt, dễ uốn*

Hemoglobin (n): a substance that carries oxygen in red blood cells. Also spelt haemoglobin.

Impurity (n): a substance that, when diffuse into semiconductor metal in small amounts, either provides free electrons to the metal or accepts electron from it. *Tạp chất*

Inherent (adj): qualities or characteristics that are inherent in something or someone exist as a necessary and natural part of that person or thing. *Thiết yếu, có tính di truyền*

Isotropy (n): the quality of a property which does not depend on the direction along which it is measured, or of a medium or entity whose properties do not depend on the direction along which they are measured. *Tính đẳng hướng*

Nuclear fission (n): the division of an atomic nucleus into parts of comparable mass; usually restricted to heavier nuclei such as isotopes of uranium, plutonium and thorium. Also known as fission; atomic fission. *Phản ứng phân hạch*

Portion (n): A portion of a physical object is a part of it that has a particular quality or feature**.** *Phần*

Quart (n): Abbreviated qt. *quat*

1. A unit of volume used for measurement of a liquid substances in the United States, equal to 2 pints, or ẳ gallon, or $57^3/_4$ cubic inches or $9.46352946 \times 10^{-4}$ cubic meter
2. A unit of volume used for measurement of solid substances in the United States, equal to 2 dry pints or 1/32 bushel, 107,521/1600 cubic inches, or approximately 1.10122×10^{-3} cubic meter.
3. A unit of volume used for measurement of both liquid and solid substances, although mainly the former, in the United Kingdom, equal to 2 U.K. pints, or ẳ U.K. gallon, or approximately 1.13652×10^{-3} cubic meter

Resident time (n): the time during which an atom oscillates around a finite position. *Thời gian cư trú*

Rigid (n): 1. being unable to be changed or varied, and are therefore sometimes considered to be severe. *Vững*

2. Very stiff and does not bend, stretch, or twist easily. *Cứng*

Terra firma (n): is used to refer to the ground when you are contrasting it with the sea or air, especially because it seems safer. *Vùng đất liền*

Viscosity(n): the resistance that a gaseous or liquid system offers to flow when it is subjected to a shear stress**. Đ***ộ nhớt, tính nhớt*

FREE-READING PASSAGE

It is advisable that you read the following passage for more about matter; you can do some translation practice on this passage and pick up some new vocabulary items.

Matter, Changes in, alteration in the form or composition of matter. In science, matter is defined as anything that occupies space and possesses the attributes of gravity and inertia. Matter occurs in three forms: solid, liquid, or gas. Changes in matter may be of two types: physical or chemical.

Physical change. A change in matter that involves no chemical reaction. When a substance undergoes a physical change, the composition of its molecules remains unchanged, and the substance does not lose its chemical identity. Melting, evaporating, and freezing are three types of physical change. For example, water (H_2O) is a liquid that freezes to form the solid ice, which may again be melted into water. Because molecules of water and ice are composed of the same chemical elements in the same proportions, the change from water to ice is a physical change. Physical changes include any alteration in the shape and size of a substance. For example cutting, grinding, crushing, annealing, dissolving, or emulsifying produce physical changes. Still another physical change is sublimation, the change from a solid to a gas.

Chemical change . When a substance undergoes a chemical change, the composition of its molecules changes. The properties of the original substance are lost, and new substances with new properties are produced. An example of a chemical change is the production of rust (iron oxide) when oxygen in the air reacts with iron. Chemical changes may also result in physical changes. For example, when wood (a solid) is burned, it is combined with oxygen gas to produce gaseous carbon dioxide (CO_2), liquid water, and solid carbon.

Some of the various chemical changes that matter may undergo are classified below. For a more detailed discussion of chemical reactions.

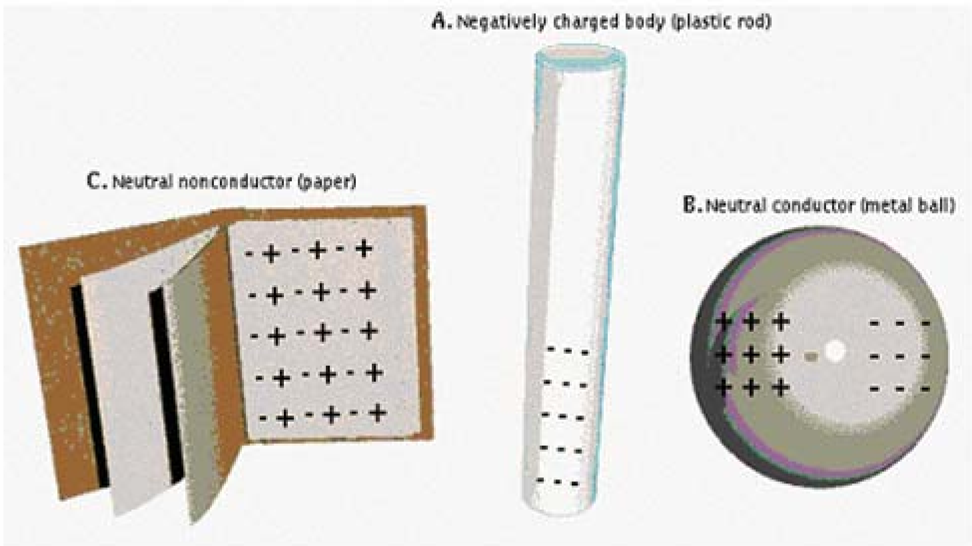
Antimatter, matter composed of elementary particles that are, in a special sense, mirror images of the particles that make up ordinary matter as it is known on earth. Antiparticles have the same mass as their corresponding particles but have opposite electric charges or other properties related to electromagnetism. For example, the antimatter electron, or positron, is positively charged but is identical in all other respects to the electron. The antimatter equivalent of the changeless neutron, on the other hand, differs in having a magnetic moment of opposite sign (magnetic moment is another electromagnetic property). In all of the other parameters involved in the dynamical properties of elementary particles, such as mass, spin, and partial decay, antiparticles are identical with their corresponding particles.

The existence of antiparticles was first proposed by the British physicist Paul Adrien Maurice Dirac, arising from his attempt to apply the techniques of relativistic mechanics to quantum theory. In 1928 he developed the concept of a positively charged electron but its actual existence was established experimentally in 1932. The existence of other antiparticles was presumed but not confirmed until 1955, when antiprotons and antineutrons were observed in particle accelerators. Since then, the full range of antiparticles has been observed or indicated. Antimatter atoms were created for the first time in September 1995 at the European Organization for Nuclear Research (formerly known by the acronym CERN). Positrons were combined with antimatter protons to produce antimatter hydrogen atoms. These atoms of antimatter exist only for forty-billionths of a second, but physicists hope future experiments will determine what differences there are between normal hydrogen and its antimatter counterpart.

A profound problem for particle physics and for cosmology in general is the apparent scarcity of antiparticles in the universe. Their nonexistence, except momentarily, on earth is understandable, because particles and antiparticles are mutually annihilated with a great release of energy when they meet. Distant galaxies could possibly be made of antimatter, but no direct method of confirmation exists. Most of what is known about the far universe arrives in the form of photons, which are identical with their antiparticles and thus reveal little about the nature of their sources. The prevailing opinion, however, is that the universe consists overwhelmingly of '"ordinary'" matter, and explanations for this have been proposed by recent cosmological theory.

In 1997 scientists studying data gathered by the Compton Gamma Ray Observatory (GRO) operated by the National Aeronautics and Space Administration (NASA) found that the earth's home galaxy—the Milky Way—contains large clouds of antimatter particles. Astronomers suggest that these clouds form when high-energy events—such as the collision of neutron stars, exploding stars, or black holes—create radioactive elements that decay into matter and antimatter or heat matter enough to make it split into particles of matter and antimatter. When antimatter particles meet particles of matter, the two annihilate each other and produce a burst of gamma rays. It was these gamma rays that GRO detected.

(*From* **http://encarta.com**)



INDUCED ELECTRIC CHARGE

Three objects demonstrate the way in which electrical charges affect conductors and nonconductors. A negatively charged rod, A, affects the way charges are distributed in a nearby conductor, B, and a nonconductor, C. A positive charge is induced on the sides of B and C that are nearest A; a negative charge is induced on the sides of B and C that are farthest from A. In the conductor, B, the separation of charge involves the entire object because the electrons are free to move. In the nonconductor, C, the separation of charge is limited to the way in which the electrons redistribute themselves within an atom. This effect is most noticeable if the nonconductor is close to the charged object.

Unit Fourteen

ELECTRIC CHARGE

READING PASSAGE

Electric charge and a measure for the quantity of charge

Any household electrical appliance – be it a light bulb, a motor, or a television set – has two contacts which have to be plugged in to get the device to operate.

This common characteristic, that an electrical apparatus must have two wires connecting it to a source of electricity, gave the rise in the eighteenth century to the idea that when an electrical device is working, something is moving through it. That something is called electric charge. When you pull out a plug, turn off a switch, or disconnect a battery, the flow of electric charge stops and with it the operation of the apparatus.

The idea of a flowing electric charge is quite attractive, because it permits us to draw in our minds a mental picture which may eventually lead to a useful model. To develop the intuitive idea of a flowing charge into a model, we must find a way to measure the quantity of electric charge that flows through a bulb, a motor, or any other device. We have to look for an effect produced by moving charge which can be measured quantitatively. You have used such indirect methods many times before, probably without noticing it. For example, you can not see temperature directly. To measure temperature, we use the fact that substances expand when heated, and we can construct various kinds of thermometers using thermal expansion. We shall use a similar method to build a charge meter.

In the experiment on the decomposition of water, the longer the time the electrodes are connected to the battery, the greater the volume of both gases produced. This suggests that more charge must have flowed through the apparatus when it was connected for a longer time. Thus it seems reasonable to use the quantity of either gas produced in the reaction as a measure of the quantity of electric charge that passes through the water. We shall choose the quantity of hydrogen, since we get twice as much of this gas as we do of oxygen, and this makes it easier to detect small quantities of charge. This apparatus, which we shall use as a charge meter, we shall refer to as a 'hydrogen cell'. Notice that since we shall not be measuring the amount of oxygen, we have made no provision to collect it.

A source of electricity, such as a battery or a wall outlet, and one or more electrical devices connected to the source make up what is called an electric circuit. If we want to know how much charge flows through a given part of an electric circuit, we break the circuit at that place and insert the hydrogen cell. The amount of hydrogen collected tells us how much charge passed through the cell.

You will recall that volume is not a reliable measure of the quantity of matter, particularly in the case of a gas, since a gas expands and contracts appreciably as the pressure and the temperature change. Thus, to be accurate, we should measure the quantity of electric charge in terms of the mass, rather than the volume, of hydrogen collected in the test tube. But we can be quite sure that the temperature and pressure of the hydrogen are nearly the same all over the classroom for a short time. Therefore, as long as we are interested only in comparing quantities of charge measured almost at the same time, we can be satisfied with simply comparing the volumes of hydrogen collected in the test tube of different hydrogen cells. We can choose any convenient volume of hydrogen in a test tube as our unit of electric charge. We shall use our unit the charge needed to produce 1.0 cm^3 of hydrogen.

(*From* Uri Haber-Schaim. et al; **Introductory Physical Science**; Prentice Hall, Inc; Englewood Cliffs, New Jersey 07632; 1987).

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading passag*e

1. How do the electrical appliances operate?

   ....
   ....

2. How was the idea of electric charge provoked?

   ....
   ....

3. What do you think is the function of a switch?

   ....
   ....

4. Is electric charge measured directly or indirectly? Explain.

   ....
   ....

5. What name is given for the device to measure charge?

   ....
   ....

6. What is the relationship between the volume of the gases produced and the time taken for the production?

   ....
   ....

7. Why should we take use of the quantity of hydrogen to measure charge?

....
....

8. What is an electric circuit?

....
....

Exercise 2: *Find the words/phrases in the text which have similar meaning or implication to the followings*

1. domestic ....
2. popular ....
3. a piece of equipment ....
4. give birth to ....
5. cell ....
6. performance ....
7. sensible ....
8. proper/appropriate ....
9. truthful ....

Exercise 3: *Finish each of the following sentences by circling the best choice or by phrases from the reading passage.*

1. To find a method of measurement of charge,
   a. We should look for an effect produced by moving charge which can be measured quantitatively.
   b. We should use an indirect method.
   c. Either way of the above expressions is correct
2. The direct proportion between the time the electrodes are connected to an electric source and the volume of oxygen and hydrogen produced in the experiment of decomposition of water results in

   ....
   ....
   ....

3. An electric circuit consists of

   ....

   ....

4. The quantity of charge flowing through a given part of an electric circuit is measured with ....

....

5. Though volume is unreliable measure of the quantity of matter, hydrogen volume is still used to measure quantities of electric charge measured almost at the same time because

   ....……………………………………….....

   ....
   ....

GRAMMAR IN USE

A review of prepositions

As a review on prepositions, the following just gives a summary on what types of prepositions there are, basing on the function of each.

First we should go through briefly about prepositions in general

1. **A preposition usually comes before a noun phrase, sometimes an adverb**

Example: ***in*** our minds ***into*** a model ***through*** a bulb
at once ***up to*** now ***through*** there

2. **Prepositions and their object to form a prepositional phrase functioning as an adverbial**

Example:

1. We all live on terra firma, the 29 percent of our planet's solid crust that lies ***above*** *sea level*.
2. Rubber bands, books, and the clothes you wear- these flexible materials maintain their shape ***to*** *some degree*.
3. We've seen that at the atomic level, the atoms or molecules bonded together in a solid stay in place ***with respect to*** *their neigh*bors.

3. **Some prepositions can also be adverbs, many forming phrasal verbs**

Example:

1. Whether a solid is crystalline or amorphous *depends* ***on*** how it is formed.
2. Especially, slow cooling can sometimes *results* ***in*** very large crystals.

4. **Some prepositions of time can also be conjunctions**

Example:

1. **After** preparing carefully, he successfully detected the questionable element in the compound.

2. He had made lots of observations **before** he made such a report.

5. **Types of prepositions**

5.1. *Prepositions of place:*

In/inside	on/ on top of	under(neath)	above/over	
under/below	up/down	through	off	out of
at next	to/by/beside	close to/near	in front	of
behind	between	opposite	among	round
beyond	against			

Example:

To understand interference, we must go *beyond* the restrictions of geometrical optics and employ the full power of wave optics.

5.2. *Prepositions of direction/movement:*

onto	into	to	away from	from	along	past	towards
across	around		through	off			

Example:

Toss your keys along the floor, they'll skitter *along* for a bit as friction does negative work on them, reducing their kinetic.

5.3. *Prepositions of time:*

at on	in	during	over	since/for
till/until	before/ after	by	from	between

Example:

But we can be quite sure that the temperature and pressure of the hydrogen are nearly the same all over the classroom *for* a short time.

5.4. *Prepositions with other meanings*

about	according to	against as/as for	
for by	instead of	because of	with respect to
on	on behalf of	up to with	of

Example:

We can choose any convenient volume of hydrogen in a test tube *as* our unit of electric charge.

5.5. *Idiomatic phrases with prepositions*

at top speed	from……..point of view		by mistake
in advance	out of order	at risk	on average

Example: The equipment is *out of order* now, you should call for an engineer.

PRACTICE

Exercise 1: *Fill in the blank with suitable prepositions*

1. You will be familiar (1)............the idea that, when you use a power supply or other source (2)............e.m.f., you can not assume that it is providing you (3)............ the exact voltage that its controls suggest. You need to measure the voltage to be sure (4)............its value. There are two reasons (5)............this. First, the supply may not be made (6)............a high degree of precision, batteries become flat, and so on. However, there is a second, more important, reason for measuring the voltage (7)................the supply to be sure of its value. Experiments show that the supply voltage depends (8)............the circuit of which it is part. (9)..............particular, the voltage of a supply decreases if it is required to supply more current.
2. Matter is made up (1).............three types of particles: electrons (which have negative charge), protons (positive) and neutrons (neutral). An uncharged object has equal numbers (2).............protons and electrons, whose charges therefore cancel out.

   When one material is rubbed (3).............another, there is a force of friction (4).............them, and electrons may be rubbed off one material (5).............the other. The material that has gained electrons is now negatively charged, and the other material is positively charged.

   If a positively charged object is brought close (6).............an uncharged one, the electrons (7).............the second object may be attracted; we observed this (8)………..a force of attraction between two objects. (This is electrostatic induction)

   Note that it is usually electrons that are involved (9).............. moving within a material, or (10)............one material to another. This is because electrons, which are (11)............the outside of atoms, are less strongly held within a material than protons; they may be free to move about within a material (like the conduction electrons in a metal), or they may be relatively weakly bound within atoms.

Exercise 2: *Complete each of the following statements with suitable phrases from the list given*

A. between two parallel metal plates

I. on each other

B. between them

C. by showing lines of forces

J. spreads outwards in all directions

D. due to an excess of electrons.

E. in moving from one plate to the other.

F. In order to observe the field

G. once summoned by friction

H. to leak away into the air

K. with the addition of a small amount of energy

M. to that point

N. being pulled upwards

O. to some degree

P. in the process of doing work

1. ...., we need to put something in it that will respond to the field**.**
2. If you rub a strip of plastic so that it becomes charged and then hold it close to your hair, you feel your hair ………............
3. We can draw electric fields in much the same way that we can draw gravitational and magnetic fields...............................
4. A radial field...................., for example from a point charge or from a charged sphere.
5. You can set up a uniform field .... by connecting them to the terminals of high- voltage power supply.
6. Any two charges particles exert a force ....that is proportional to each of their charges and inversely proportional to the square of the distance between them.
7. It is quite tricky to investigate the force between charged particles, because charge tends ....during the course of any experiment.
8. ...., energy is transferred from you to the charge that you are pushing.
9. The potential difference (voltage) between the plates tells us the energy charge per coulomb........................
10. The electric potential at a point is equal to the work done per unit charge in moving a positive charge from infinity.........................
11. Long before the days of plastic pens and rubber balloons, investigators found that charges, …......................., could be transferred from one material to another.
12. To day, we know that any material can become charged ....by bringing it into contact with a different material.
13. The negative charge on a piece of rubbed amber or rubber is..............................
14. A semi-conductor is an electrical insulator that, ..., becomes a conductor.
15. A proton repels another proton and attracts any electron, though nothing tangible bridges the distance...................................

PROBLEM - SOLVING

Writing a report on research

Task one

Read through the following report, and then complete it by filling in each blank with one word from the list given:

at between	chosen	save	start	progress
end research	group	relevant	satisfied	spent
bibliography	literature	topic	step	for
consultation	advised	supervisor	provoked	
advice	studying	discovered	expected	

Report on my research

I arrived at the University (1) …………….. the beginning of October last year to (2) …………… my studies. I am (3) ……………..for a Master's degree in Economics – M.A. (Econ.) – by research. It will take me (4) ………………..one and two years to complete.

At the beginning of last term I discussed my research with my (5) ………………., Dr. M.Jones, in the Department of Economics. He (6) ……………….me to draw up a research outline in the area I had (7) ………………… for my research – 'A case study in foreign aid to developing countries'. After further (8) ………………..with Dr. Jones, my outline was approved and accepted by the Faculty of Economics.

My next (9) ………………was to begin reading appropriate books, journals and reports (10) ………………..the background section of the research. 'A study of the literature'. My supervisor's (11) ………………..was to keep a set of index cards and write details of each (12) ………………I read on a card. Thus I have started making a (13) ………………which will be very useful for future reference. It will also (14) ……………… me a lot of time when I need to provide one at the (15) ……………… of my thesis.

This term I have (16) ……………time reading and have also made a draft of the first section of the (17) ………………, summarizing views on foreign aid to developing countries. I have also started to read (18) ……………… on the country I have chosen for my case study –Utopia. I have (19)……………… that many of the World Bank and UN publications are (20) ………………to my research.

I am quite pleased with the (21) ……………… I have made so far, although the reading is taking me longer than I (22) ………………. My supervisor asked me to present a paper on my research findings up to the present, to a small (23) ……………… of research students in economics. He was (24) ……………… with the paper and said that it was good seminar as it had (25) ……………… a number of questions and a lot of discussion.

Task two

The above writing is a good example of a research report. The following will present its structure. The structure of a dissertation or thesis would be very similar.

Preliminaries:

1. The title
2. Acknowledgements
3. List of contents
4. List of figures/tables

Introduction:

5. The abstract
6. Statement of the Problem

Main body:

7. Review of literature
8. Design of the investigation
9. Measurement techniques used
10. Results

Conclusion:

11. Discussion and conclusion
12. Summary of conclusions

Extras:

13. Bibliography
14. Appendices

Below are the functions of each part, read them carefully and match them each with the appropriate number (1-14)

a. …………The appreciation in a logical order of information and data upon which a decision can be made to accept or reject the hypothesis.

b. …………A compilation of important data and explanatory and illustrative material, placed outside the main body text.

c. …………The sections, in sequence, included in the report.

d. ………… A survey of elective, relevant and appropriate reading, both of primary and secondary source materials. Evidence of original and critical thought applied to books and journals.

e. …………The presentation of principles, relationships, correlations and generalizations shown by the results. The interpretation of the results and their relationship to the research problem and hypotheses. The making of deductions and inferences, and the implications for the research. The making of recommendations.

f. …………An accurate listing in strict alphabetical order of all the sources cited in the text.

g. …………An extremely concise summary of the contents of the report, including the conclusions. It provides an overview of the whole report for the reader.

h. …………Thanking colleagues, supervisors, sponsors, etc. for their assistance.

i. …………Detail descriptions and discussion of testing devices used. Presentation of data supporting validity and reliability. A discussion of the analysis to be applied to the results to test the hypotheses.

j. …………A concise account of the main findings, and the inferences drawn from them.

k. …………A statement and discussion of the hypotheses, and the theoretical structure in which they will be tested and examined, together with the methods used.

l. …………The sequence of charts or diagrams that appear in the text.

m. …………The fewest words possible that adequately describe the paper.

n. …………A brief discussion of the nature of research and the reasons for undertaking it. A clear declaration of proposals and hypotheses.

TRANSLATION

Task one: *English-Vietnamese translation*

1. Two types of charge

We can easily collect reams of data on electrical forces between different substances that have been charged in different ways. We find for example that cat fur prepared by rubbing against rabbit fur will attract glass that has been rubbed on silk. How can we make any sense of all this information? A vast simplification is achieved by noting that there are really only two types of charge. Suppose we pick cat fur rubbed on rabbit fur as a representative of type A, and glass rubbed on silk for type B. We will now find that there is no "type C." Any object electrified by any method is either A-like, attracting things A attracts and repelling those it repels, or B-like, displaying the same attractions and repulsions as B. The two types, A and B, always display opposite interactions. If A displays an attraction with some charged object, then B is guaranteed to undergo repulsion with it, and vice-versa. One Coulomb (C) is defined as the amount of charge such that a force of 9.0×10^9 N occurs between two pointlike objects with charges of 1 C separated by a distance of 1 m.

(*From* **Electricity and Magnetism** by Benjamin Cowell)

2. A model of two types of charged particles

Experiments show that all the methods of rubbing or otherwise charging objects involve two objects, and both of them end up getting charged. If one object acquires a certain amount of one type of charge, then the other ends up with an equal amount of the other type. Various interpretations of this are possible, but the simplest is that the basic building blocks of matter come in two flavors, one with each type of charge. Rubbing objects together results in the transfer of some of these particles from one object to the other. In this model, an object that has not been electrically prepared may actually possess a great deal of *both* types of charge, but the amounts are equal and they are distributed in the same way throughout it. Since type A repels anything that type B attracts, and vice versa, the object will make a total force of zero on any other object. The rest of this chapter fleshes out this model and discusses how these mysterious particles can be understood as being internal parts of atoms.

(*From* **Electricity and Magnetism** by Benjamin Cowell)

3. Electrical Circuits: DC and AC

The potential difference between the battery terminals in a car can start the engine, light the way, clear the rain from the windshield, and bring you music. The potential difference between the wires in the walls of a house can do an even wider range of tasks. What does the work? Energy that comes from the source of the potential difference. In the case of a battery it is energy from the chemical reactions. For a home circuit it is energy from a power plant, which comes from burning coal or oil, or from water falling at a dam, or from nuclear fission.

To operate any electrical device, all you need to do is provide a connected conducting path for electrons between the potential difference that is supplied by the battery or the home circuit. Any such conducting path is called an electrical circuit. An electric switch lets you turn the appliance on or off. If the switch is on, the circuit is complete or closed, and a current flows in the appliance. If the switch is off, the circuit is open, and there is a break in the circuit; with no connected conducting path between the potential difference for electrons to move along, no current flows.

When electric current flows in one direction through a circuit, as it does when a battery supplies the potential difference, it is called direct current, or DC. The current from the electrical outlet in a home, however, is alternating current, or AC. Its voltage is not steady; instead, it oscillates, changing the direction of the electric force first one way, then the other.

The alternating current used by power companies throughout North America is a 60-cycle-per-second current. Responding to the alternating electric field in a wire, electrons sway back and forth in a very short distance some 60 times every second. The electric field is caused by an alternating voltage applied to the wires at the power station. So when an appliance is connected at an outlet, the electrons in the appliance don't really go anywhere; they just surge back and forth under an average potential difference of 110 to 120 volts. This points out an important feature of AC electricity. The electrons in the power station never leave, nor do the electrons in a home circuit. They merely move back and forth a very short distance, quicker than your eye could follow. An alternating current is just a vibration of the sea of electrons superimposed on their faster, random thermal motions.

(*From* **Physics, an introduction** by Jay Bolemon, 1989)

4. High and low resistance

A toaster is connected to the 110-volt potential difference in a wall socket by an electrical cord. Inside the cord are two copper wires, each wrapped in an insulating material to keep them apart and each connected to a metal prong in the plug. These copper wires lead to opposite ends of a strip of high-resistance conducting wire in the toaster. That high resistance means the current flowing through the toaster is small. Exactly the same current flows in the copper wires in the electrical cord too, but because those copper wires have less resistance, much less heating occurs. *Essentially all of the energy the toaster circuit draws goes into heating the toaster wire (or element).*

Suppose the insulation between the conducting wires in the toaster cord becomes damaged, and the two wires at different electric potentials touch while the toaster is on. Suddenly the electrons have an easier path to follow. The new path, through that point of contact, would offer almost no resistance compared to the toaster element. Ohm's law, V=IR, tells us that if R gets very small while V remains constant (110 volts), the current in the wires and across that point grows. As the current goes up, the rate of heating increases and that heat can set the insulation on fire. Such a place of low resistance in a circuit is called a **short circuit**, or just a **short**.

A safely feature is used in home circuits to protect them from overheating in case of a short circuit. These devices also work in case too many appliances are connected to some part of the household circuit, raising the current to high level and overheating the wires in the wall. In older homes a meltable *fuse*, encased in glass, is part of each circuit. If an appliance shorts out, that circuit draws a large current. In a matter of seconds, the fuse melts (at a predetermined current noted on the fuse) and breaks the circuit before the wires can overheat. The dangerous short should be repaired before the melted fuse is replaced.

Another type of device is used in the circuits of all newer homes, a bimetallic strip that curls up when it gets hot from carrying too much current. As it heats and curls, it snaps away from a contact to break the circuit. This kind of device, called a *circuit breaker*, works a little faster than a fuse, so it's safer. And once an overload is corrected and the open bimetallic strip cools, you only need to flip a switch to reset it.

You can demonstrate the action of a fuse or a short circuit with a flashlight cell. From a pad o steel wool, select the thinnest strand you can find. Then attach two copper wires to the cell, one at each terminal. Use the thread of steel wool to complete the circuit. If you touch the copper wires to the steel wire at points about a centimeter apart, the steel gets warm. If you move those copper wires closer together along that thin steel thread, the length of steel between the copper wires gets really hot. A smaller length of the steel wire offers less resistance, so the current increases. If the points of contact of the copper wires come to within a millimeter or so of each other, the steel will glow white hot like the filament of a light bulb and melt, breaking the circuit.

(*From* **Physics, an Introduction** by Jay Bolemon, 1989)

Task two: *Vietnamese - English translation*

1. Dòng điện xoay chiều. Mạch tiêu thụ điện ở các nơi sử dụng thường gồm các bóng đèn, quạt máy, bếp điện, động cơ điện, máy công cụ. Trong mạch đó có cả điện trở, cuộn cảm, tụ điện. Như sau này ta sẽ biết đó là những mạch dao động tắt dần, có tần số dao động riêng của chúng, và khi nối chúng vào ổ cắm điện, dao động riêng của chúng tắt nhanh, hiệu điện thế (u = U_0sinựt) tạo ra trong mạch một dòng điện dao động cưỡng bức có tần số góc bằng ự: i = I_0sin(ựt+ử).

Giữa cường độ dòng điện i và hiệu điện thế u có một độ lệch pha ự phụ thuộc tính chất của mạch điện. Vì điện trường truyền trong các dây dẫn với vận tốc rất lớn, gần bằng vận tốc ánh sáng, nên tại mỗi thời điểm nhất định, điện trường tại mọi điểm trên các mạch điện không phân nhánh ta thường dùng là như nhau, do đó cường độ dòng điện ở mọi điểm trên mạch không phân nhánh là như nhau.

Dòng điện mô tả bằng i = I_0sin(ựt+ử) là một dòng điện biến thiên điều hoà. Nó được gọi là dòng điện xoay chiều. Trong thực tế có những dòng điện đổi chiều nhưng không điều hoà. Khi ta nói dòng điện xoay chiều, ta quy ước rằng ta chỉ nói về dòng điện dao động điều hoà.

2. Nguyên tắc hoạt động của máy phát điện xoay chiều. Máy phát điện xoay chiều kiểu cảm ứng hoạt động nhờ hiện tượng cảm ứng điện từ. Nguyên tắc của máy đó là: khi từ thông qua một khung dây dao động điều hoà, nó làm phát sinh trong khung dây một suất điện động dao động điều hoà, suất điện động đó tạo ra ở mạch ngoài (mạch tiêu thụ) một dòng điện xoay chiều dao động điều hoà.

Suất điện động trong một khung dây là rất nhỏ. Để có một suất điện động đủ lớn dùng được trong công nghiệp và trong đời sống, người ta bố trí trong máy phát điện nhiều cuộn dây dẫn, mỗi cuộn gồm nhiều vòng dây, và nhiều nam châm điện tạo thành nhiều cặp cực bắc-nam khác nhau.

Các cuộn dây trong máy phát điện được mắc nối tiếp nhau, và hai đầu dây được nối với mạch tiêu thụ bằng một cơ cấu riêng gọi là bộ góp.

3. Ích lợi của dòng điện một chiều. Dòng điện xoay chiều được sử dụng rộng rãi trong đời sống và trong kĩ thuật. Tuy nhiên, trong một số trường hợp cụ thể, dòng điện một chiều là không thay thế được. Dòng điện một chiều được sử dụng trong công nghiệp để mạ điện, đúc điện, nạp ác quy, sản xuất hoá chất bằng điện phân, tinh chế kim loại bằng điện phân. Các thiết bị vô tuyến điện tử được cung cấp năng lượng bằng dòng điện một chiều. Những động cơ điện một chiều được dùng để chạy xe điện, xe lửa điện, vì chúng có ưu điểm hơn động cơ điện xoay chiều ở chỗ có mômen khởi động lớn và thay đổi được vận tốc một cách dễ dàng.

Dòng điện một chiều do pin và ac quy cung cấp không có công suất lớn, không đạt được hiệu điện thế cao, và đắt tiền.

Dòng điện một chiều cũng do máy phát điện một chiều cung cấp. Nhưng với công suất bằng nhau thì một máy phát điện một chiều chế tạo tốn kém hơn một máy phát điện xoay chiều và dòng điện một chiều không truyền tải xa được bằng dòng xoay chiều. Phương pháp kinh tế nhất và phổ biến nhất để có dòng điện một chiều là chỉnh lưu dòng điện xoay chiều, biến dòng xoay chiều thành dòng một chiều.

4. Điện từ trường. Phát minh của Macxoen dẫn đến kết luận là không thể có điện trường hoặc từ trường tồn tại riêng biệt, độc lập với nhau. Điện trường biến thiên nào cũng sinh ra từ trường biến thiên, và ngược lại từ trường biến thiên nào cũng sinh ra điện trường biến thiên.

Một nam châm vĩnh cửu đặt trên bàn tạo ra xung quanh nó một từ trường. Nhưng một người quan sát chuyển động với vận tốc bất kỳ và mang theo một khung dây dẫn khép kín sẽ quan sát được dòng điện trong khung dây, tức là quan sát được điện trường cùng tồn tại với từ trường. Cũng như vậy, một người quan sát chuyển động sẽ quan sát được từ trường cùng tồn tại với điện trường của một điện tích đứng yên trên bàn, vì đối với người quan sát này điện tích là chuyển động và có tác dụng như một dòng điện.

Như vậy, điện trường và từ trường là hai mặt thể hiện khác nhau của một loại trường duy nhất gọi là điện từ trường. Trong một số trường hợp đặc biệt, thí dụ, khi người quan sát đứng yên so với điện tích hoặc so với nam châm vĩnh cửu, người đó chỉ quan sát thấy điện trường hoặc từ trường. Ngay cả trong trường hợp đó, điện từ trừơng vẫn là một dạng vật chất tồn tại khách quan trong thực tế, mặc dù con người chỉ quan sát thấy một bộ phận của nó.

(*From* **Vat li 12** by Dao Van Phuc, Duong Trong Bai, Nguyen Thuong Chung, Vu Quang)

KEY TERMS

Alternating current, AD (n): An electric current whose direction oscillates. *Dòng điện xoay chiều*

Ampere (n): The metric unit of measurement for an electric current; 1 coulomb of charge per second. *Am-pe*

Battery (n): A combination of two or more cells joined to produce an electrical potential difference that is equal to the sum of the voltages of the individual cells. *Ac quy*

Chemical cell (or cell) (n): A device that uses chemical reactions to produce a difference in electric potential which can give rise to a current. *Pin hoá học*

Coulomb (n): The metric unit of measure of electric charge. *Cu-lông*

Direct current, DC (n): An electric current that moves in only one direction. *Dòng điện một chiều*

Electric current (n): A flow of charged particles. *Dòng điện*

Electric dipole (n): A positive and an equal negative charge separated by a short distance. *Ngẫu cực điện*

Electric field lines (n): Imaginary lines used to visualize the electric force field in the region around a charged particle of object. *Đường sức điện trường*

Electric force field (n): the electric influence around a charged particle. *Trường lực điện*

Electric potential (n): The potential energy *per unit of charge* of a particle due to the electric field. *Điện thế*

Electrical circuit (n): A connected, conducting path for electrons between points of different electric potential. *Mạch điện*

Electrical conductor (n): A medium in which charges can easily move. *Chất dẫn điện*

Electrical induction (n): The process of separating charge on an object by bringing it near another charged body. *Sự truyền, dẫn điện.*

Electrical insulator (n): A material that won't ordinarily carry an electric current; a nonconductor. *Chất cách điện.*

Electrical potential energy (n): The potential energy a charged particle has due to the presence of an electric field. Its metric units are joules. *Thế năng có được của hạt mang điện do có sự xuất hiện của điện trường*

Electrical resistance (n): The opposition to the flow of charge through matter. *Điện trở*

Electroscope (n): A device used to detect the presence of an electric charge. *điện nghiệm*

Ohm (n): The metric unit of electrical resistance; 1 volt per amp. *ôm*

Polar molecule (n): A molecule that, though neutral overall, has positive and negative areas on its surface. *Phân tử cực*

Polarization (n): The shifting of charge in an object when it is exposed to an electric field. Its atoms or molecules become negatively charged on one side and positively charged on the other side. *Sự phân cực*

Semiconductor (n): An electrical insulating material in pure form that takes on the properties of a conductor when impurity atoms of specific types are introduced in small amounts. *Chất bán dẫn*

Series circuit (n): An electrical circuit that provides more than one path along which current can move. *Mạch nối tiếp*

Short circuit (n): A path of too low resistance in an electric circuit, leading to a great increase in the amount of current in the circuit. *Đoản mạch*

Static charge (n): charge not in motion. *Điện tích tĩnh*

Superconductor (n): An element or compound whose electrical resistance vanishes at its critical temperature, allowing current to pass without any loss of energy. *Chất siêu dẫn*

Volt (n): The unit of electrical potential. *Vôn*

Watt (n): The metric unit of power, equal to 1 joule per second. *woat*

FREE- READING PASSAGE

It is advisable that you read the following passage for more about matter; you can do some translation practice on this passage and pick up some new vocabulary items.

Induction (electricity), in electricity, the creation of an electric current in a conductor moving across a magnetic field (hence the full name, electromagnetic induction). The effect was discovered by the British physicist Michael Faraday and led directly to the development of the rotary electric generator, which converts mechanical motion into electric energy.

Electric generator. When a conductor, such as a wire, moves through the gap between the poles of a magnet, the negatively charged electrons in the wire will experience a force along the length of the wire and will accumulate at one end of it, leaving positively charged atomic nuclei, partially stripped of electrons, at the other end. This creates a potential difference, or voltage, between the ends of the wire. If the ends of the wire are connected by a conductor, a current will flow around the circuit. This is the principle behind the rotary electric power generator, in which a loop of wire is spun through a magnetic field so as to produce a voltage and generate a current in a closed circuit.

Electric transformer. Induction occurs only if the wire moves at right angles to the direction of the magnetic field. This motion is necessary for induction to occur, but it is a relative motion between the wire and the magnetic field. Thus, an expanding or collapsing magnetic field can induce a current in a stationary wire. Such a moving magnetic field can be created by a surge of current through a wire or electromagnet. As the current in the electromagnet rises and falls, its magnetic field grows and collapses (the lines of force move outward, then inward). The moving field can induce a current in a nearby stationary wire. Such induction without mechanical motion is the basis of the electric transformer.

A transformer usually consists of two adjacent coils of wire wound around a single core of magnetic material. It is used to couple two or more a-c circuits by employing the induction between the coils.

Self induction. When the current in a conductor varies, the resulting changing magnetic field cuts across the conductor itself and induces a voltage in it. This self-induced voltage is opposite to the applied voltage and tends to limit or reverse the original current. Electric self-induction is thus analogous to mechanical inertia. An inductance coil, or choke, tends to smooth out a varying current, as a flywheel smooths out the rotation of an engine. The amount of self-induction of a coil, its inductance, is measured by the electrical unit called the henry, named after the American physicist Joseph Henry, who discovered the effect. The inductance is independent of current or voltage; it is determined only by the geometry of the coil and the magnetic properties of its core.

Alternating current. When a conductor is moved back and forth in a magnetic field, the flow of current in the conductor will change direction as often as the physical motion of the conductor changes direction. Several devices generating electricity operate on this principle, producing an oscillating form of current called alternating current. Alternating current has several valuable characteristics, as compared to direct current, and is generally used as a source of electric power, both for industrial installations and in the home. The most important practical characteristic of alternating current is that the voltage or the current may be changed to almost any value desired by means of a simple electromagnetic device called a transformer. When an alternating current passes through a coil of wire, the magnetic field about the coil expands and collapses and then expands in a field of opposite polarity and again collapses. If another conductor or coil of wire is placed in the magnetic field of the first coil, but not in direct electric connection with it, the movement of the magnetic field induces an alternating current in the second coil. If the second coil has a larger number of turns than the first, the voltage induced in the second coil will be larger than the voltage in the first, because the field is acting on a greater number of individual conductors. Conversely, if the number of turns in the second coil is smaller, the secondary, or induced, voltage will be smaller than the primary voltage.

The action of a transformer makes possible the economical transmission of electric power over long distances. If 200,000 watts of power is supplied to a power line, it may be equally well supplied by a potential of 200,000 V and a current of 1 amp or by a potential of 2000 V and a current of 100 amp, because power is equal to the product of voltage and current. The power lost in the line through heating is equal to the square of the current times the resistance. Thus, if the resistance of the line is 10 ohms, the loss on the 200,000 V line will be 10 watts, whereas the loss on the 2000 V line will be 100,000 watts, or half the available power.

The magnetic field about a coil in an AC circuit is constantly changing, and the coil constantly impedes the flow of current in the circuit, because of the quality of the inductance mentioned above. The relationship between the voltage impressed on an ideal coil (that is, a coil having no resistance) and the current flowing in the ideal coil is such that the current is at a zero value when the voltage is at a maximum, and the current is at a maximum when the voltage is at zero. Furthermore, the changing magnetic field induces a potential difference in the coil that is equal in magnitude and opposite in direction to the impressed potential difference. In practice, coils always exhibit resistance and capacitance as well as inductance.

If a capacitor, also called a condenser, is placed in an AC circuit, the current is proportional to the size of the capacitor and to the time rate of the change of the voltage across the capacitor. Therefore, twice as much current will flow through a capacitor that has a capacity or size of 2 farads as in a capacitor of 1 farad capacity. In an ideal capacitor the voltage is exactly out of phase with the current. No current will flow when the voltage is maximum because then the rate of change of voltage equals zero. The current will be maximum when the voltage equals zero because then the rate of change of voltage will be maximum. Current flows through a capacitor even if there is no direct electrical connection between its plates because the voltage on one plate induces an opposite charge on the other plate.

It follows from the above effects that if an alternating voltage is applied to an ideal inductance or capacitance, no power is expended. In all practical cases, however, AC circuits contain resistance as well as inductance and capacitance, and power is actually expended. The amount of power depends on the relative amounts of the three quantities present in the circuits.

(*From* **http://encarta.com**)

TOKAMAK FUSION REACTOR

University's plasma physics laboratory in New Jersey, produced a controlled fusion reaction, during which the temperature in the reactor surpassed thre times that of the core of the sun. In Tokamak reactor, massive magnets sonfine hydrogen plasma under extremely high temperatures and pressures, forcing the hydrogen nuclei to fuse when atomic nuclei are forced together in nuclear fusion, the reaction releases an extraordinary amount of energy.

Unit Fifteen

NUCLEAR PHYSICS

READING PASSAGE

Explaining fission and fusion

In both fission and fusion, unstable nuclei have become more stable. Energy is released. In order to explain **these processes**, we need to be able to say where this energy comes from. One answer lies in the origins of the nuclei we are considering. Take, for example, uranium. The earth's crust contains uranium. In some places, **it** is sufficiently concentrated to make it worth while extracting it for use as the fuel in fission reactors. This uranium has been part of the Earth since it was formed, 4500 million years ago.

The Earth formed a swirling cloud of dust and gas, at the same time that the Sun itself was forming. **These materials** condensed under the force of gravitational attraction. But where did they come from in the first place? **It** is believed that heavy elements (such as uranium) were formed in a supernova. At some time in the distance past, an aging star collapsed and then blew itself apart in an explosion of awesome scale. At the very high temperatures that resulted, there was sufficient energy available for light nuclei to fuse to form the heaviest nuclei, which we now find if we dig in the Earth's crust. It is this energy, from an ancient stellar explosion, that is released when a large nucleus undergoes fission.

We can extend this explanation by asking: How can we calculate the amount of energy released in fission or fusion? To find the solution to **this**, we need to think first about the masses of the particles involved.

We will start by considering a stable nucleus, ${}^{12}_{6}C$. This consists of six protons and six neutrons, fortunately for us, because we have a lot of this form of carbon in our bodies, this is a very stable nuclide. This means that the nucleons are bound tightly together. It takes a lot of energy to pull **them** apart.

Consider the following simple experiment. On the left-hand side of a balance is a ${}^{12}_{6}C$ nucleus. On the right-hand side are six photons and six neutrons, the result of dismantling the nucleus. The surprising thing is that the balance is tipped to the right. The separate nucleons have more mass than the nucleus itself. This means that the law of conservation of mass has been broken. We have violated **a fundamental law of nature**, something that was held to be true for hundreds of years.

Notice that, in dismantling the nucleus, we have had to do work. The nucleons attract one another with nuclear forces and **these** are strong enough to make the nucleus very stable. So we have put energy in to the system to pull the nucleus apart. Where has this energy gone?

At the same time, we have the mystery of the appearing mass. There is more mass when we have pulled the nucleons apart than when they are bound together.

You probably already know that these two problems, disappearing energy and appearing mass, can be solved together. We say that 'energy has turned to mass'. If we let the separate protons and neutrons recombine to make a ${}^{12}_{6}C$ nucleus, the extra mass will disappear and the missing energy will be released. This mass-energy conversion explains where the energy comes from in a nuclear fusion.

A better way to express this is to treat mass and energy as aspects of the same thing. Rather than having separate laws of conservation of mass and energy, we combine these two. The total amount of mass and energy together in a system is constant. There may be conversions from one to the other, but the total amount of mass plus energy remains constant.

(*From* **Basic Physics 1 and 2** by David Sang)

READING COMPREHENSION

Exercise 1: *Answer the following questions by referring to the reading passage*

1. What happens in both processes of fission and fusion?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………

2. What is assumption of the origin of the dust and gas formed by the Earth?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………

3. What must be done first to calculate the amount of energy released in fission and fusion?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………

4. Why does it take a lot of energy to pull the nucleons in a ${}^{12}_{6}C$ apart?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………

5. How has the law of conservation of mass been broken?

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ………………………………………………………………………………

6. What makes the nucleus strongly stable? The significance of this?

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ………………………………………………………………………………

7. What exactly explains where the energy released in a nuclear fusion comes from?

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ………………………………………………………………………………

8. If we combine the two separate laws of conservation of mass and energy, what name do you think would be given to the common law?

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ………………………………………………………………………………

Exercise 2: *Contextual reference* **(**dealing with words in **bold** type one by one**)**

1. '**These processes'** in line 2 refers to
   a. the processes of fusion and fission
   b. the process of releasing energy
   c. both of the above
2. **'it'** in line 4 refers to
   a. earth's crust
   b. uranium
   c. the nuclei
3. '**these materials'** in line 9 refers to
   a. dust and gas
   b. the earth and the sun
   c. none of the above
4. **'it'** in line 10 refers to
   a. the force of gravitational attraction
   b. the first place

c. nothing

5. **'this'** in line 18 refers to

   a. the explanation

   b. the calculation of the amount of energy

   c. fission or fusion

6. '**them**' in line 23 refers to

   a. stable nucleus

   b. protons and neutrons

   c. our bodies

7. '**a fundamental law of nature'** in line 29 refers to

   a. the law that the separate nucleons have more mass than the nucleus itself.

   b. The law of conservation of mass

   c. The law of conservation of energy

8. '**these'** in line 31 refers to

   a. nucleons

   b. nuclear forces

   c. both of the above

Exercise 3: *Decide whether each of the following sentences is true or false. Write (T) for the true ones, (F) for the false ones and (N) for the ones with no information to justify*

1. …………Energy is released in both fusion and fission and we call it extra energy.
2. …………Without uranium, the earth could not have formed.
3. …………Uranium was first discovered 4.500 years ago.
4. …………Uranium has the heaviest nuclei of all elements,
5. …………The calculation of the amount of energy released in fission or fusion requires considering the masses of the particles involved.
6. …………Due to strong nuclear forces among the nucleons in the carbon nucleus, pulling them apart requires much energy.
7. …………The separate nucleons of carbon actually have more mass than the nucleus itself.
8. …………The nucleus is stable thanks to the strong nuclear forces among the nucleons.
9. …………The extra mass is actually the energy that we put in to the system to pull the nucleus apart.

10. …………The total amount of mass plus energy of the same object is constant.

GRAMMAR IN USE

A) Some confusing pairs of conjunctions

In English there are some pairs of conjunctions that are interchangeable in a sentence. This means, we can use either of the two to form the sentence while the meaning of the other is also implied. In Vietnamese, you have to use both of them if you want to build the equivalent sentence. The following two are the common ones.

1. **but** and **(al)though**

Example:

You can write:

Although uranium was formed at the same time as the formation of the earth, it is not the main part of the earth.

(Uranium is not the main part of the earth (al) though formed at the same time as the formation of the earth)

Or: Uranium was formed at the same time as the formation of the earth*, but* it is not the main part of the earth.

You can not write: *Though* uranium was formed at the same time as the formation of the earth, *but* it is not the main part of the earth.

In this case, if you replace *but* with *still* or *yet,* you may have the sentence that sounds like your Vietnamese way of expression.

2. **because and so**

Example:

You can write: Because uranium has the heaviest nuclei, it is used in fission reaction.

Or: Uranium has heaviest nuclei, so it is used in fission reaction.

B) Adverbs with two forms

In English there are a number of adverbs that have two forms, which are quite different in meaning when functioning in many contexts.

Example:

hard and hardly

In this case:

He has work *hard* but *hardly* reached the goal.

with:

Hard: strenuously and industriously (showing the manner of the action)

Hardly: almost never

You have more pairs:

1. *rough*: in the open air, or outside	*roughly*: violently, briefly, or approximately
2. *flat:* level and horizontal	*flatly:* frankly
3. *free*: without	*freely*: liberally
4. *late:* after the usual or normal time	*lately*: recently
5. *wide:* large and broad in size	*widely*:broadly, generally
6. *near:* close to	*nearly*: almost

PRACTICE

Exercise 1: *Combine each of following pairs of sentences to one sentence, using appropriate conjunctions.*

1. The rock formations of Grandfather Mountain in North California are 1 billion years old. The oldest rocks on earth- some 4 billion years old-lie in Green land.

   ……………………………………………………………………………………...……
   ……………………………………………………………………………….…

2. Plants use carbon dioxide from the atmosphere (and emit oxygen) in their life processes. Any living plant has the same ratio of carbon -12 to carbon-14 atoms as the atmosphere does at that time.

   ……………………………………………………………………………………..……
   …………………………………………………………………………..…………
   …………………………………………………………………………....

3. All animals (including humans) depend on plants through the food chain. They have carbon-12 and carbon -14 in this same ratio.

   ……………………………………………………………………………………..……
   ……………………………………………………………………………….…

4. In 1932, two of "papa" Rutherford's "boys" John Cockroft and Earnest Walton, managed to build a device to accelerate protons. It produced only 100.000 volts or so.

   ……………………………………………………………………………………...……
   ……………………………………………………………………………….…

5. The arrangement of electrons to make the bonds releases 4.1 electron volts energy. The splitting (or fission) of one uranium atom's nucleus would release some 2000 million electrons volt of energy.

………………………………………………………………………………………..……
………………………………………………………………………………..…..………
………………………………………………………………………...

6. Uranium-235 nucleus fissions most easily by absorbing a slow neutron. It can also fission (with a lower probability) as a result of a strike by a fast neutron.

   ………………………………………………………………………………………..……
   ……………………………………………………………………………........

7. Liquid metal sodium boils at 895^{0} C. It does not have to be under high pressure as water does.

   ………………………………………………………………………………………...……
   ……………………………………………………………………………....

8. The liquid sodium also becomes very radioactive because its nuclei can capture neutrons. It is much less efficient than water radiation.

   ……………………………………………………………………………………...………
   ……………………………………………………………………………....

9. Fission reactions are controlled today in nuclear power plants. Fusion reactions have yet to be tamed.

   ………………………………………………………………………………………...……
   ……………………………………………………………………………....

10. The binding energy per nucleon is different among the various nuclei. The arrangement of the nucleus by either breaking the nucleus apart or by merging nuclei together always releases or absorbs energy.

    ……………………………………………………………………………………...………
    ………………………………………………………………………………...……………
    ……………………………………………………………………….....

Exercise 2: *Complete the following statements by filling in each gap with one suitable adverb presented in Grammar in use B*

1. Over the last 1,000 years the science of physics has enabled us to probe and understand the world of the very large—the stars and the galaxies that contain them—and, ..., the world of the very small—the fundamental particles that make up matter and the forces that govern their interactions.
2. Scientists are now working ………………. to solve the problem of worldwide energy crisis.
3. Though entering the forum of particle physics ………………., he has made himself ……………… well-known with an astonishing assumption about elementary particles. The forum is always open ………….. for such a figure.

4. Though not refusing…………….. Newton's theory that light behaves as particles; Young draw attention of scientists at his time all to his new theory that light behaves as a wave.
5. Electrons are the …………..- moving particles in an atom.
6. Before going on with the details of the report, he presented the content ……………. with an Overhead Projector, getting his audience all ears to him.
7. He intended to do his experiment ……………… but his supervisor disagreed because he insisted that the experiment must be conducted in room temperature.
8. He .... reached the goal when he decided to quit the research only because of financial deficiency.
9. While lying ……………. on the floor, he suddenly found out the solution to what he is wondering.
10. If the north pole of a magnet is brought ………….. the south pole of another, the poles will attract each other.

PROBLEM - SOLVING

Writing research report (cont.)

In the previous unit, you did have an overview and a sample of what a research report would be conducted. In this unit, you are required to build up your own research report with the following suggested structure and vocabulary aid.

1. Organize the report so that it has three paragraphs
   i. Introduction: outline of studies, the beginning
   ii. Development: description/ explanation; now
   iii. Conclusion: difficulties or success; the future
2. Choose carefully the verb tenses that you will use. Some commonly used verb tenses in reports are:

Present continuous	(e.g. I am studying)
Present perfect	(e.g. I have experimented)
Past simple	(e.g. I started)

Below are examples of sentences with alternatives that may be useful for your report.

A. Introduction

1.

I am studying	X (subject) On an M.Ed.Course		*at the* University of Y. *at* Y University. *in the* Department of Z.
	for a(n)	M.Sc.Ph.D.	in X

2.

I am attending (some)	lectures seminars	in Nuclear Physics	
		relating to which are related to	Nuclear/ Fusion/ fission/test/reactions

3.

I am	doing conducting carrying out	research	*in* nuclear power *into the* problems of nuclear waste.

4.

My	subject course research investigation	is	divided into in	x parts…

5.

I started my	course studies research	*in* the first week of *at* the beginning of	(month) October this term this year
		on 1st October *in* October	

6.

It They	will continue	until for	next September. (the summer of) 200 -. two more years. another two years.

B. Development

7

Since (last) October	I have worked I have been working	on some of the problems
which are	concerned with associated with related to	nuclear waste

8

To start with From x until y	I was studying theoretical aspects of nuclear fision/fusion/rest/reactions
now I am doing some practical experiments.	

9

The aim of my	work studies research	is to	see if x	is possible. exists.
			show the role of x in y. suggest ways in which x might be done.	

10

I have	made	Considerabl e some only a little	progress (so far).
	made	much any	

11

The most	interesting difficult	part of my work (so far) has been…

12 The result of my research (so far) is that evidence exists to show…

13
The most | shows / proves / suggests | that…

14
I have been helped by my | tutor / supervisor | Mr/Ms/Dr./Prof. X

C. Conclusion

15
I have | written / completed | the first / draft chapter / the outline | …of my | dissertation. / thesis.

16
Now that / When | I have finished x / Next term | I shall…

Now, write your essay here:

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

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………………………………………………………………………………………

TRANSLATION

Task one: *English-Vietnamese translation*

1. The Case of the Missing Neutrinos

Although particle physics grew out of nuclear physics and became a preoccupation of many leading physicists, the field of nuclear physics did not lie dormant. Nuclear physics has enabled us to understand the processes that fuel the sun and other stars and that produce the chemical elements, including the elements that make up our bodies. Nuclear physicists have even demonstrated in the laboratory all the nuclear reactions that keep the sun shining.

One of the mysteries that occupy nuclear physicists as we enter the 21st century is the case of the missing solar neutrinos. According to the standard theory that explains nuclear reactions within the sun, these reactions should give off a certain number of neutrinos. In fact neutrinos are so abundant that a billion of them just passed through your head as you read this sentence.

But although neutrinos are numerous, they are difficult to detect because they rarely interact with matter. Some physicists have described neutrinos as “barely a fact” because they have no electric charge, no radius, and negligible mass. Elaborate experiments to try to measure the number of neutrinos that should be emanating from the sun have been set up underground so that other high-energy particles cannot interfere with the experiments. Solar physicists believe they understand the reactions that produce energy and radiation from the sun. This allows them to predict the number of neutrinos. So far, the experiments have detected far fewer neutrinos, but one theory is promising. This theory holds that neutrinos are so difficult to detect because they have the bizarre ability to “oscillate” and change from one type of neutrino to another. For example, a muon neutrino may oscillate to become a tau neutrino. In the 21st century, this theory may be confirmed, which will help assure us that our understanding of how stars shine is correct.

2. Particles and Cosmology

Nuclear physics and particle physics have helped us understand much about the early universe, which is the domain of another subdiscipline of physics known as *cosmology* (the study of the origin and evolution of the universe). Particle physics and cosmology are mutually dependent fields. In the early universe, all the fundamental particles that could exist did exist shortly after the big bang. As the universe cooled, however, many of these particles combined and ceased to exist on their own. The enormous temperatures of the early universe generated a pure democracy of fundamental particles when massive top quarks, which can now be created only in the largest particle accelerator experiments, with a mass of 170 GeV, coexisted with electrons with a mass of 0.0005 GeV.

Physicists have identified many of the fundamental particles that existed at the time of the big bang. It is impossible, however, to duplicate the conditions that existed at the time of the big bang in a particle accelerator. The creation of the universe was a particle accelerator laboratory with a totally unconstrained budget. There may, however, be particles currently unknown to physics. If more such particles exist, there is a chance that the study of the present universe may show direct or indirect evidence of these particles. For example, our study of the present universe revealed the evidence of the big bang itself, when scientists in the 1960s detected the remnant of that explosive event in the microwave background radiation that pervades the cosmos.

One example of the close connection between particle physics and cosmology is an experiment that was performed in 1965 using the particle accelerator at Brookhaven National Laboratory on Long Island, New York. According to prevailing theories, a certain symmetry in the early universe created equal amounts of matter and its opposite, antimatter. We can see something like this at Fermilab when collisions produce equal numbers of protons and their opposite, antiprotons. But when matter and antimatter collide, they annihilate each other in bursts of radiation. So if the early universe produced equal amounts of matter and antimatter, then either all the matter and antimatter should have consumed each other, leaving a universe of nothing but radiation, or the matter and antimatter may have in some way separated. If so, where is the antimatter?

From careful searches for the radiation that results from matter-antimatter annihilations, scientists learned that the density of antimatter in the observable universe was very small. The Brookhaven experiment helped solve the puzzle of the missing antimatter by revealing a violation of a certain symmetry in the decay of *neutral kaons* (a type of meson, which in turn is a subatomic particle that is made up of quarks and antiquarks). As a result of this tiny violation of symmetry, a slight excess of matter survived annihilation by antimatter. This surviving matter now forms the galaxies, stars, and planets.

In the 21st century, particle physicists and cosmologists will work to address another mystery about the universe, known as the dark matter problem. The dark matter problem resulted from the observation that gravitational forces were acting in and around galaxies that could not be accounted for by visible matter—bright, shining stars. Astrophysicists became aware that some huge fraction of the mass of the universe doesn't shine; hence the name, dark matter. Further analysis indicated that much of this dark matter may not be the same stuff that we are familiar with. Searches for exotic new particles are underway at Fermi lab and at CERN. The possibility that tau or muon neutrinos may contribute to dark matter has stimulated efforts to detect whether or not these neutrinos have enough mass to account for the observed gravitational effects.

(*From* **Physics in new millennium; http://encarta.com**)

Task two: *Vietnamese - English translation*

1. Sự phóng xạ

Thời trung cổ các nhà giả kim thuật đã tốn nhiều công sức để cố gắng biến đổi nguyên tố hoá học này thành nguyên tố hoá học khác, nhất là thành vàng. Họ đã không thành công vì không có đủ cơ sở khoa học kỹ thuật. Tuy nhiên hi vọng của họ không phải là không có căn cứ. Thực tế hạt nhân nguyên tử không phải là bất biến mà có thể biến đổi thành hạt nhân khác một cách tự nhiên (sự phóng xạ) hoặc trong các phản ứng hạt nhân (do con người gây ra).

Phóng xạ là hiện tượng một hạt nhân tự động phát ra những bức xạ gọi là tia phóng xạ và biến đổi thành hạt nhân khác. Tia phóng xạ không nhìn thấy được nhưng có những tác dụng lí hoá như làm iôn hoá môi trường, làm đen kính ảnh, gây ra các phản ứng hoá học v.v.. Cho các tia phóng xạ đi qua điện trường ở giữa hai bản của một tụ điện, ta có thể xác định được bản chất của các tia phóng xạ mà các chất phóng xạ khác nhau phóng ra. Có ba loại tia phóng xạ:

a. Tia anpha: Chất phóng xạ đầu tiên do nhà bác học Pháp Beccơren (Becquerel) phát hiện ra là urani (Z=92), bức xạ mà nó phóng ra bị lệch về phía bản âm của tụ điện, gọi là tia anpha, ký hiệu α .

Nghiên cứu kỹ hơn thì thấy rằng các tia ấy gồm các hạt nhân của nguyên tử ${}^{4}_{2}He$ mang hai điện tích dương, gọi là hạt anpha. Hạt anpha phóng ra từ hạt nhân với vận tốc khoảng 10^7 m/s, nó làm iôn hoá môi trường và mất dần đi năng lượng. Tia anpha chỉ đi được tối đa 8cm trong không khí và không xuyên qua được một tấm thuỷ tinh mỏng.

b. Tia bêta: Có hai loại: Loại phổ biến gồm các hạt bêta trừ, ký hiệu õ$^{-}$; đó chính là các electron, nên tia õ$^{-}$ bị lệch về phía bản dương của tụ điện và lệch nhiều hơn so với tia α. Đồng vị ${}^{14}_{6}C$ là cácbon phóng xạ, phát xạ tia õ$^{-}$.

Một loại tia bêta khác hiếm hơn gồm các hạt bêta cộng, kí hiệu õ$^{+}$, còn gọi là các êlêctrôn dương hay pôzitôn vì nó có cùng khối lượng với êlêctrôn nhưng lại mang một điện tích nguyên tố dương. Đồng vị ${}^{11}_{6}He$ cũng là cacbon phóng xạ nhưng phát ra tia õ$^{+}$

Các hạt bêta được phóng ra với vận tốc rất lớn, có thể gần bằng vận tốc ánh sáng.

Tia bêta cũng làm iôn hoá môi trường nhưng yếu hơn so với tia anpha nên tia bêta có tầm bay dài hơn, có thể tới hàng trăm mét trong không khí.

c. Tia gamma: Ký hiệu ɣ, là sóng điện từ có bước sóng rất ngắn (dưới 0,01nm), cũng là hạt phôtôn có năng lượng cao, nó không bị lêch trong điện trường và có khả năng đâm xuyên rất lớn, có thể đi qua lớp chì dầy hàng đêximet và nguy hiểm cho con người. Các tia phóng xạ đều có năng lượng (động năng của các hạt, năng lượng của sóng điện từ) nên sự phóng xạ toả ra năng lượng, một phần năng lượng này biến thành nhiệt làm nóng bình đựng chất phóng xạ.

2. Các định luật bảo toàn trong phản ứng hạt nhân

Các định luật bảo toàn sau đây đã được kiểm nghiệm là hoàn toàn đúng đối với các phản ứng hạt nhân.

a. Bảo toàn số nuclôn (số khối A): Prôtôn có thể biến thành nơtrôn và ngược lại, nhưng các nuclôn ở vế trái và vế phải của phương trình ${}^{a}_{z}X \rightarrow {}^{4}_{2}He + {}^{A'}_{Z'}Y$ bao giờ cũng bằng nhau. Bảo toàn số nuclôn cũng là bảo toàn số khối A.

b. Bảo toàn điện tích (hoặc nguyên tử số Z): Các hạt nhân trong phản ứng chỉ tương tác với nhau, không tương tác với vật nào khác nên họp thành một hệ kín, cô lập về điện. Ta biết rằng điện tích của một hệ kín là không đổi, nghĩa là tổng đại số các điện tích là một hằng số. Tổng điện tích ((tổng nguyên tử số Z) các hạt ở vế trái và vế phải của phương trình $A \rightarrow B + C$ bao giờ cũng bằng nhau.

c. Bảo toàn năng lượng và bảo toàn động lượng của hệ các hạt tham gia phản ứng: Khi nghiên cứu thế giới vĩ mô, tức là các vật rất lớn so với phân tử, nguyên tử (thí dụ các vật mà mắt ta trông thấy được) ta đã thấy rằng năng lượng, và động lượng của một hệ kín được bảo toàn. Vật lí hạt nhân đã đi tới kết luận rằng hai định luật bảo toàn này vẫn đúng đối với thế giới vi mô, nghĩa là đúng với hệ kín gồm nguyên tử, hạt nhân v.v.. Cần lưu ý rằng không có định luật bảo toàn khối lượng của hệ.

***3.* Máy gia tốc**

Dùng hạt nhân làm đạn chỉ thực hiện được một số nhỏ phản ứng hạt nhân vì có vận tốc nhỏ, không thắng được lực đẩy Culông của hạt nhân chứa nhiều prôtôn. Cần có những hạt đạn có vận tốc đủ lớn để tiến gần tới hạt nhân trong phạm vi tác dụng của lực hạt nhân. Do đó trong vật lí hạt nhân xuất hiện nhu cầu chế tạo các thiết bị để tăng tốc các hạt tích điện như prôtôn, hạt anpha, các iôn…; các thiết bị này gọi là máy gia tốc. Có nhiều loại máy gia tốc.

Xiclôtroon là máy gia tốc chế tạo đầu tiên (1932). Máy gồm có hai hộp hình chữ D dặt trong chân không. Có một từ trường B vuông góc với các hộp; lực lorenxơ làm các hạt tích điện (do nguồn đặt ở tâm của máy phát ra.)chuyển động tròn trong lòng hộp với bán kính $R = \frac{mv}{qB}$ trong đó m và q là khối lượng và điện tích của hạt, v là vận tốc của nó. Có thể chứng minh rằng tần số quay của hạt không phụ thuộc vào bán kính quỹ đạo hoặc vận tốc của hạt.

Giữa hai hộp D có một hiệu điện thế xoay chiều có cùng tần số với tần số quay của hạt được tăng tốc. Ở cuối đường này khi động năng đã đủ lớn thì chùm hạt được lái để đập vào bia.

Xiclôtrôn có thể tăng tốc hạt prôtôn tới động năng vài chục MeV. Quá giới hạn này thì do hiệu ứng tương đối tính sự đồng bộ giữa hiệu điện thế xoay chiều và sự quay của hạt mất đi và người ta phải dùng các máy gia tốc khác như Xincrôxiclôtrôn, xincrôphazôtrôn v.v...

Các máy gia tốc hiện đại là những thiết bị rất vĩ đại. Máy gia tốc ở Giơnevơ hoạt động từ 1977 có bán kính buồng chân không bằng 1,1 km và truyền cho prôtôn động năng tới 400GiV (Giga=tỉ). Gần đây, ngưới ta còn chế tạo máy gia tốc có hai chùm hạt được gia tốc riêng rẽ rồi va chạm vào nhau, như vậy động năng tương đối lên tới cỡ 1TeV (Têra=ngàn tỉ). Với thiết bị này người ta hi vọng phá vỡ được cả nuclôn để tìm hiểu cấu tạo của nó.

(*From* **Vat li 12,** published by Educational Publishing House, Hanoi, 2000)

KEY TERMS

Alchemist (n): a scientist in the Middle Ages who tried to discover how to change ordinary into gold. To alchemize (v); alchemy (n) the process of alchemizing. *Thợ giả kim thuật*

Background radiation (n): the natural radiation from radioactive elements and cosmic rays in our environment. *Phông phóng xạ*

Beta decay (n): The process in which either an electron or a positron is emitted from a radioactive nucleus**.** *Phân rã bêta*

Beta particle (n): An electron or a positron. *Hạt bêta*

Breeder reactor (n): A nuclear reactor which produces nuclear fuel as a byproduct of its fission reaction**.** *Lò phản ứng nhân; briđơ*

Capacitor (n): An electric component that has an appreciable capacitance. It consists of at least one pair of conductors, or of a conductor plus semiconductor. Each is separated by a dielectric (an insulator). For most types of capacitor, the value of the capacitance depends on the geometry of the device and the electrical properties of the dielectric, which may be solid, liquid, or gaseous. The capacitance may be fixed or a variable value. *Tụ điện*

Chain reaction (n): When one event triggers other similar events, which in turn trigger others, and so on. *Phản ứng chuỗi*

Gamma emission (n): The process in which a nucleon of a radioactive nucleus moves to a lower-energy state and emits gamma ray**.** *Phát xạ gamma*

Gamma ray (n): A high-energy photon, released when a proton or a neutron moves to a lower-energy state in a nucleus. *Tia gamma*

Macro world (n): the world of study concerning with things of large size and scope. *Thế giới vĩ mô*

Micro world (n): the world of study concerning with things of very small in size and scope. *Thế giới vi mô*

Nuclear fission (n): The splitting of a nucleus. *Phản ứng phân hạch*

Nuclear fusion (n): The building of a larger nucleus from a smaller ones. *Phản ứng nhiệt hạch*

Nuclear reactor (n): A device using nuclear fission to generate heat that may be used to generate electric power. *Lò phản ứng hạt nhân*

Nucleus (n): The tiny center of an atom composed of protons and neutrons (thus having a positive charge) and containing almost all of the atom's mass. *Hạt nhân*

Parent nucleus (n): A nucleus that decays to form a different nucleus which is called the daughter nucleus**.** *Hạt nhân mẹ*

Positron (n): A particle with the mass of an electron but with an opposite charge to the electron's charge. The antiparticle of the electron. *Phản hạt của electron*

Quarks and leptons (n): believed to be the most elementary particles today, the particles that make up all the other known particles. *Hạt quak và lepton (những hạt được coi là cơ bản nhất tạo nên tất cả những hạt đã biết)*

Radioactive nuclei (n): Unstable nuclei that emit either gamma rays or particles in the act of losing energy to be come more stable. *Hạt nhân phóng xạ*

Secular equilibrium (n): whenever the amount of a radioactive isotope remains constant because nuclei are being added to the isotope at the same rate at which nuclei are disintegrating. *Sự cân bằng lâu dài*

Stable atom (n): An atom whose nucleus is stable, that is, un-changing in time (unless-disrupted by an external source). *Nguyên tử ổn định*

Strong interaction (n): The short-ranged but extremely strong attractive force between the nucleons of the nucleus. *Lực tương tác mạnh*

FREE-READING PASSAGE

It is advisable that you read the following passage to learn more about nuclear physics. You can do some translation practice on this passage and pick up some new vocabulary items.

Light-Water and Heavy-Water Reactors

A variety of reactor types, characterized by the type of fuel, moderator, and coolant used, have been built throughout the world for the production of electric power. In the United States, with few exceptions, power reactors use nuclear fuel in the form of uranium oxide isotopically enriched to about three percent uranium-235. The moderator and coolant are highly purified ordinary water. A reactor of this type is called a light-water reactor (LWR).

In the pressurized-water reactor (PWR), a version of the LWR system, the water coolant operates at a pressure of about 150 atmospheres. It is pumped through the reactor core, where it is heated to about 325° C (about 620° F). The superheated water is pumped through a steam generator, where, through heat exchangers, a secondary loop of water is heated and converted to steam. This steam drives one or more turbine generators, is condensed, and is pumped back to the steam generator. The secondary loop is isolated from the water in the reactor core and, therefore, is not radioactive. A third stream of water from a lake, river, or cooling tower is used to condense the steam. The reactor pressure vessel is about 15 m (about 49 ft) high and 5 m (about 16.4 ft) in diameter, with walls 25 cm (about 10 in) thick. The core houses some 82 metric tons of uranium oxide contained in thin corrosion-resistant tubes clustered into fuel bundles.

In the boiling-water reactor (BWR), a second type of LWR, the water coolant is permitted to boil within the core, by operating at somewhat lower pressure. The steam produced in the reactor pressure vessel is piped directly to the turbine generator, is condensed, and is then pumped back to the reactor. Although the steam is radioactive, there is no intermediate heat exchanger between the reactor and turbine to decrease efficiency. As in the PWR, the condenser cooling water has a separate source, such as a lake or river.

The power level of an operating reactor is monitored by a variety of thermal, flow, and nuclear instruments. Power output is controlled by inserting or removing from the core a group of neutron-absorbing control rods. The position of these rods determines the power level at which the chain reaction is just self-sustaining.

During operation, and even after shutdown, a large, 1,000-megawatt (MW) power reactor contains billions of curies of radioactivity. Radiation emitted from the reactor during operation and from the fission products after shutdown is absorbed in thick concrete shields around the reactor and primary coolant system. Other safety features include emergency core cooling systems to prevent core overheating in the event of malfunction of the main coolant systems and, in most countries, a large steel and concrete containment building to retain any radioactive elements that might escape in the event of a leak.

Although more than 100 nuclear power plants were operating or being built in the United States at the beginning of the 1980s, in the aftermath of the Three Mile Island accident in Pennsylvania in 1979 safety concerns and economic factors combined to block any additional growth in nuclear power. No orders for nuclear plants have been placed in the United States since 1978, and some plants that have been completed have not been allowed to operate. In 1996 about 22 percent of the electric power generated in the United States came from nuclear power plants. In contrast, in France almost three-quarters of the electricity generated was from nuclear power plants.

In the initial period of nuclear power development in the early 1950s, enriched uranium was available only in the United States and the Union of Soviet Socialist Republics (USSR). The nuclear power programs in Canada, France, and the United Kingdom therefore centered about natural uranium reactors, in which ordinary water cannot be used as the moderator because it absorbs too many neutrons. This limitation led Canadian engineers to develop a reactor cooled and moderated by deuterium oxide (D2O), or heavy water. The Canadian deuterium-uranium reactor known as CANDU has operated satisfactorily in Canada, and similar plants have been built in India, Argentina, and elsewhere.

In the United Kingdom and France the first full-scale power reactors were fueled with natural uranium metal, were graphite-moderated, and were cooled with carbon dioxide gas under pressure. These initial designs have been superseded in the United Kingdom by a system that uses enriched uranium fuel. In France the initial reactor type chosen was dropped in favor of the PWR of U.S. design when enriched uranium became available from French isotope-enrichment plants. Russia and the other successor states of the USSR had a large nuclear power program, using both graphite-moderated and PWR systems.

(*From* **http://encarta.com**)

APPENDIX

1. SCOPE OF FIELDS IN PHYSICS

Acoustics: The science of the production, transmission, and effects of sound. **Âm học**

Atomic Physics: A branch of physics concerned with the structures of the atom, the characteristics of the electrons and other elementary particles of which the atom is composed, the arrangement of the atom's energy states, and the processes involved in the radiation of light and x-rays. **Vật lý nguyên tử**

Fluid Mechanics: The science concerned with fluids, either at rest or in motion, and dealing with pressures, velocities, and accelerations in the fluid, including fluid deformation and compression or expansion. **Cơ học chất lỏng**

Mechanics: The branch of physics which seeks to formulate general rules for predicting the behavior of a physical system under the influence of any type of interaction with its environment. **Cơ học**

Nuclear Physics: The study of the characteristics, behavior, and internal structure of the atomic nucleus. **Vật lý hạt nhân**

Optics: The study of phenomena associated with the generation, transmission, and detection of electromagnetic radiation in the spectral range extending from the long-wave edge of the x-ray region to the short-wave edge of the radio region, and the science of light**. Quang học**

Particle physics: The branch of physics concerned with understanding the properties, behavior, and structure of elementary particles, especially through study of collisions or decays involving energies of hundreds of MeV or more. **Vật lý hạt**

Physics: The science concerned with those aspects of nature which can be understood in terms of elementary principles and laws. **Vật lý** (lý thuyết)

Plasma Physics: The study of highly ionized gases. **Vật lý Plasma**

Quantum Mechanics: The modern theory of matter, of electromagnetic radiation, and of the interaction between matter and radiation; it differs from classical physics, which it generalizes and supersedes, mainly in the realm of atomic and subatomic phenomena. **Cơ lượng tử**

Relativity: The study of physics theory which recognizes the universal character of the propagation speed of light and the consequent dependence of space, time, and other mechanical measurements on the motion of the observer performing the measurements, the two main divisions are special theory and general theory. **Tương đối**

Solid-state Physics: The branch of physics centering on the physical properties of solid materials, it is usually concerned with the properties of crystalline material only, but it is sometimes extended to include the properties of glasses or polymers. **Vật lý chất rắn**

Spectroscopy: The branch of physics concerned with the production measurement, and interpretation of electromagnetic spectra arising from either emission ro absorption of radiant energy by various substances.

Statistical Mechanics: That branch of physics which endeavors to explain and predict the macroscopic properties and behavior of a system on the basis of the known characteristics and interactions of the microscopic constituents of the system, usually when the number of such constituents is very large. **Cơ học thống kê**

Thermodynamics: The branch of physics which seeks to derive, from a few basis postulates, relations between properties of substances, especially those which are affected by changes in temperature, and a description of the conversion of energy from one form to another. **Nhiệt động lực học**

2. Type of radioactivity

Type	Symbol	*Particles emitted*	*Change in atomic number, ΔZ*	*Change in atomic mass number, ΔA*
Alpha	α	Helium nucleus	-2	-4
Beta negatron	β^-	Negative electron and antineutrino	+1	0
Beta positron	β^+	Positive electron and neutrino	-1	0
Electron capture	EC	Neutrino	-1	0
Isomeric transition	IT	Gamma rays or conversion electrons or both (and positive-negative electron pair)	0	0
Proton	ρ	Proton	-1	-1
Spontaneous fission	SF	Heavy fragments and neutrons	Various	Various
Isomeric spontaneous fission	ISF	Heavy fragments and neutrons	Various	Various
Beta-delayed spontaneous fission	$(EC+\beta^+)$-SF	Positive electron, neutrino, heavy fragments, and neutrons	Various	Various
	β^-SF	Negative electron, antineutrino, heavy	Various	Various

		fragments, and neutrons		
Beta-delayed neutron	β^{-n}	Negative electron, and antineutrino, neutron	+1	-1
Beta-delayed two-neutron (three-neutron)	$\beta^{-2n(3n)}$	Negative electron, antineutrino, and two (three) neutrons	+1	-2 (-3)
Beta-delayed proton	$\beta^{+\rho}$ or $(\beta^{+}EC)\rho$	Positive electron, neutrino, and proton	-2	-1
Beta-delayed two-proton	$\beta^{+2\rho}$	Positive electron, neutrino, and two protons	-3	-2
Beta-delayed triton	$\beta^{-}{}^{3}_{1}H$	Negative electron, antineutrino and triton	0	-3
Beta-delayed alpha	$\beta^{+}\alpha$	Positive electron, neutrino and alpha	-3	-4
	$\beta^{-}\alpha$	Negative electron, antineutrino, and alpha	-1	-4
Beta-delayed alpha-neutron	$\beta^{-}\alpha,n$	Negative electron, antineutrino, alpha, and neutron	-1	-5
Double beta decay	$\beta^{-}\beta^{-}$	Two negative electrons and two antineutrinos	+2	0
	$\beta^{+}\beta^{+}$	Two positive electrons and two neutrinos	-2	0
Double electron capture	EC EC	Two neutrinos	-2	0
Two-proton	2ρ	Two protons	-2	-2
Neutron	N	Neutron	0	-1
Two-neutron	2n	Two neutrons	0	-2
Heavy clusters	${}^{14}_{6}C$	${}^{14}_{6}C$ nucleus	-6	-14

	${}^{20}_{8}O$	${}^{20}_{8}O$ nucleus	-8	-20
	${}^{24}_{10}Ne$	${}^{24}_{10}Ne$ nucleus	-10	-24

3. Electromagnetic spectrum

Frequency Hz	*Wavelength, m*	*Nomenclature*	*Typical source*
10^{23}	3×10^{-15}	Cosmic photons	Astronomical
10^{22}	3×10^{-14}	γ-rays	Radioactive nuclei
10^{21}	3×10^{-13}	γ-rays, X-rays	
10^{20}	3×10^{-12}	X-rays	Atomic inner shell, positron-electron annihilation
10^{19}	3×10^{-11}	Soft X-rays	Electron impact on a solid
10^{18}	3×10^{-10}	Ultraviolet, X-rays	Atoms in sparks
10^{17}	3×10^{-9}	Ultraviolet	Atoms in sparks and arcs
10^{16}	3×10^{-8}	Ultraviolet	Atoms in sparks and arcs
10^{15}	3×10^{-7}	Visible spectrum	Atoms, hot bodies, molecules
10^{14}	3×10^{-6}	Infrared	Hot bodies, molecules
10^{13}	3×10^{-5}	Infrared	Hot bodies, molecules
10^{12}	3×10^{-4}	Far-infrared	Hot bodies, molecules
10^{11}	3×10^{-3}	Microwaves	Electronic devices
10^{10}	3×10^{-2}	Microwaves, radar	Electronic devices
10^{9}	3×10^{-1}	Radar	Electronic devices, interstellar hydrogen
10^{8}	3	Television, FM radio	Electronic devices
10^{7}	30	Short-wave radio	Electronic devices

10^6	300	AM radio	Electronic devices
10^5	3000	Long-wave radio	Electronic devices
10^4	3×10^4	Induction heating	Electronic devices
10^3	3×10^5		Electronic devices
100	3×10^6	Power	Rotating machinery
10	3×10^7	Power	Rotating machinery
1	3×10^8		Commutated direct current
0	Infinity	Direct current	Batteries

4. SI prefixes

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10^{24}	yotta	Y	10^{-1}	deci	d
10^{21}	zeta	Z	10^{-2}	centi	c
10^{18}	exa	E	10^{-3}	milli	m
10^{15}	peta	P	10^{-6}	micro	µ
10^{12}	tera	T	10^{-9}	nano	n
10^{9}	giga	G	10^{-12}	pico	p
10^{6}	mega	M	10^{-15}	femto	f
10^{3}	kilo	k	10^{-18}	atto	a
10^{2}	hector	h	10^{-21}	zepto	z
10^{1}	deka	da	10^{-24}	yocto	y

5. Some physical properties

AIR (dry, at 20^0 C and 1 atm)	

Density Specific heat at constant pressure Ratio of specific heats Speed of sound Electrical breakdown strength Effective molar mass	1.21 kg/m^3 1010J/kg.K 1.40 343m/s 3 x10^6 0.0289kg/mol
WATER	
Density Speed of sound Specific heat at constant pressure Heat of fusion(0^{0}C) Heat of evaporation (100^{0}C) Index of refraction (λ = 589nm) Molar mass	1000kg/m^3 1460 m/s 4190J/kg.K 333kJ/kg 2269kJ/kg 1.33 0.0180kg/mol
EARTH	
Mass Mean radius Free-fall acceleration at the Earth's surface Standard atmosphere Period of satellite at 100-km altitude Radius of the geosynchronous orbit Escape Speed Magnetic dipole moment Mean electric field at surface	5.9810^{24}kg 6.37 x 19^6 m 9.8m/s^2 1.01 x10^6 Pa 86.3min 42,200km 11.2km/s 8.0 x10^{22}A.m^2 150V/m
DISTANCE TO:	
Moon Sun Nearest star	x 10^{8}m 1.50 x 10^{11}m 4.04 x 10^{16}m

Galactic center	2.2 x 10^{20}m
Andromeda galaxy	2.1 x 10^{22} m
Edge of the observable universe	~ 10^{26}m

6. Greek letters

Alpha	α	Nu	ν
Beta	β	Xi	ξ
Gamma	γ	Omicron	o
Delta	$\triangle$	Pi	π
Epsilon	ε	Rho	ρ
Zeta	ζ	Sigma	σ
Eta	η	Tau	τ
Theta	θ	Upsilon	υ
Iota	ι	Phi	φ
Kappa	κ	Chi	x
Lambda	λ	Psi	ψ
Mu	μ	Omega	ω

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