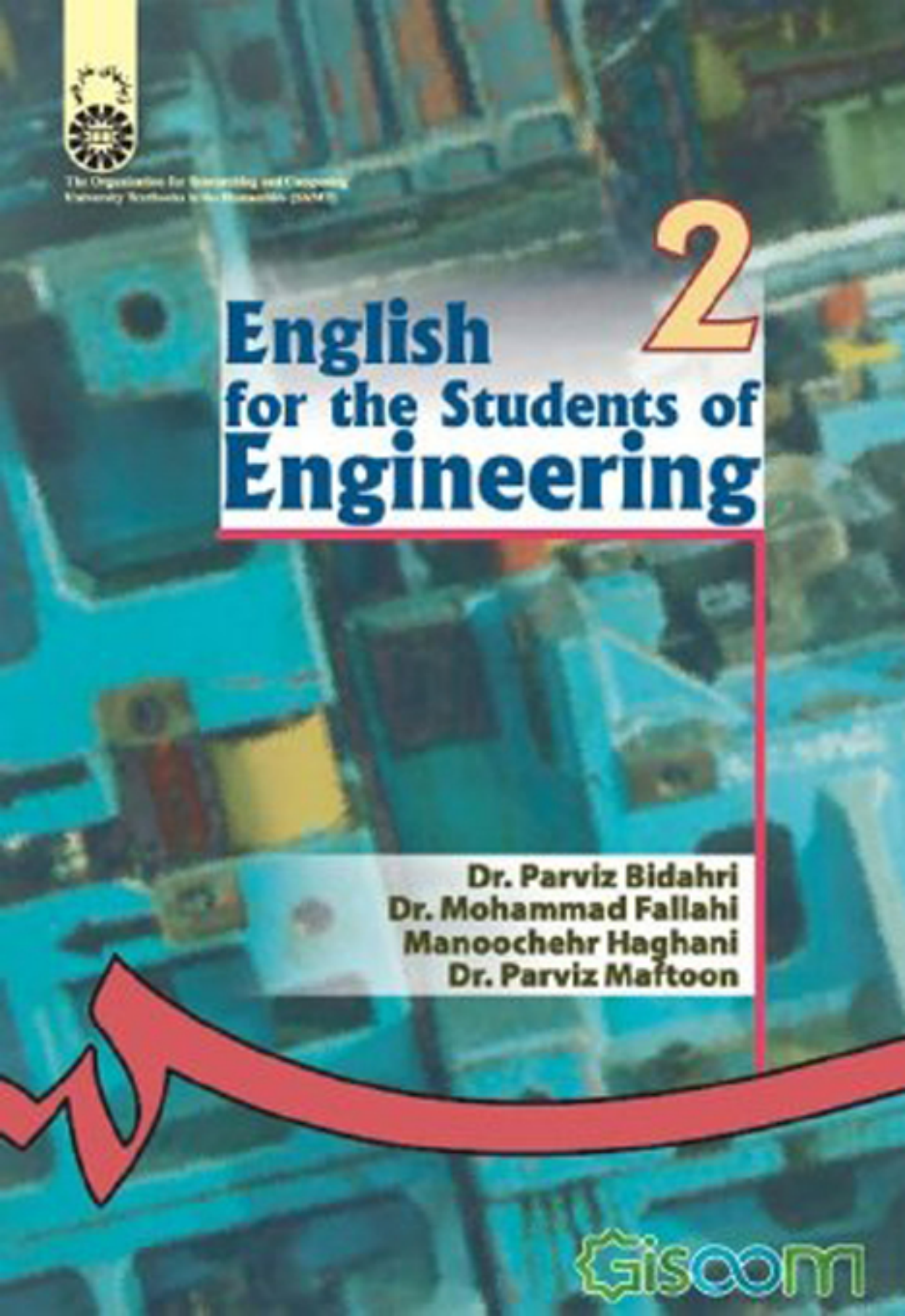
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Lesson 2

What Is Energy?

Part I: Pre-Reading

A. Pronunciation Practice

spe.cial (spĕsh´ əl)
ma.te.ri.al (mə-tîr´ē-əl)
cur.rent (kûr´ənt)
mus.cle (mŭs´əl)
mus.cu.lar (mŭs´kyə-lər)
wind.mill (wĭnd´mĭl)
me.chan.i.cal (mĭ-kăn´ĭ-kəl)
gas.o.line (găs´ə-lēn)
har.ness (här´nĭs)
water (wô´tər)
var.i.ous (vâr´ē-əs)
fu.el (fyo͞o´əl)
huge (hyo͞oj)
a.mount (ə-mount´)
dis.cov.er (dĭ-skŭv´ər)
source (sôrs)
ki.net.ic (kĭ-nĕt´ĭk)
po.ten.tial (pə-tĕn´shəl)
grav.i.ty (grăv´ĭ-tē)
twist (twĭst)
wound (waund)
wind (wīnd)
sur.round (sə-round´)
down.ward (doun´wərd)
pull (po͝ol)

B. Word Study: Definitions

matter:	substance of which a physical thing is made
current:	flow of electricity
mechanical:	of machines; connected with machines; produced by machines
windmill:	mill operated by the wind
water wheel:	wheel made to rotate by the flow of water
gasoline:	petrol; motor spirit
kinetic:	of motion; caused by motion
pull:	force
gravity:	force of attraction between any two objects, especially that force which attracts objects towards the center of the earth
potential:	that can or may come into existence or action

C. Word Study: Definitions and Exemplifications

take up: occupy time or space; fill time or space
Gases take up the whole space of their containers.

bring about: cause to happen
Heat often brings about chemical changes in matter.

lock up: hold
A great amount of energy is locked up in the atom.

bend: cause something to be out of a straight line or surface
When rays of light pass through a piece of glass, they bend.

twist: turn especially by the use of force
We can twist a strong wire and make a spring.

D. Grammatical Points

An adjective clause is usually introduced by a relative pronoun: that, which, who, whom, etc. It always follows the noun modified, but it may be reduced to a prepositional adjective either single or compound.

1. Model: a. Water which is running has kinetic energy.
   b. Running water has kinetic energy.
2. Model: a. This energy is stored in the stone which is lifted.
   b. This energy is stored in the lifted stone.

However, if an adjective clause is in the passive form, the relative pronoun and the verb 'be' may be deleted, and the remaining adjective phrase kept after the noun.

3. Model: a. Rubber which is produced by a chemical process in factories is known as synthetic rubber.
   b. Rubber produced by a chemical process in factories is known as synthetic rubber.

The majority of statements in technical writing are in the passive form because the technical writer wants to be objective and impersonal. The form of the passive is as follows:

(Pro)noun+a form of be+past participle+the agent

In technical writing, however, it is not usual to add the name of the agent to a sentence if the agent is a person. But very often the agent is not a person, and it may be necessary to add it.

4. Model: a. Such things as heat, light, sound, and electric current bring about many changes in matter.
   b. Many changes in matter are brought about by such things as heat, light, sound, and electric current.

Part II: Reading for Comprehension

What Is Energy?

In science, we have a special word for all materials. We call all materials matter. Matter is anything that takes up space and has weight. Plants, animals, air, water, soil, rock—all living and non-living things—are made from matter. Matter itself is made up of very small particles called molecules, and molecules are made up of tiny particles called atoms.

Many changes in matter are brought about by such things as heat, light, sound, and electric current. Yet these things are not matter because they do not take up space and do not have weight. So there is something besides matter in our world which makes matter move or change. We have a special word for it; we call it energy. Heat, light, sound, and electric current are just some of its different forms. The energy of the muscles that move the parts of your body is called muscular energy. Mechanical devices such as windmills, water wheels, and steam or gasoline engines harness various forms of energy and change them into another form, called mechanical energy. Mechanical energy can be used to run our machines.

Another form of energy is stored in the molecules of some materials. We call this form chemical energy. Coal, gasoline, and other fuels have chemical energy stored in them. When any fuel is burned, the stored energy is released. Huge amounts of still another form of energy are locked up in atoms. This kind of energy is called atomic energy. As new and better ways of releasing atomic energy are discovered, atoms will become one of our most important sources of energy.

Though energy exists in various forms, scientists have found that there are really just two kinds of energy. Running water, a falling weight, or any moving object has energy. You know that this is true because of what happens when they strike something. This kind of energy is called kinetic energy. It is the kind of energy that matter has because of its motion. However, materials and objects often have energy even if they are not moving. If you lift a stone, energy has to be used to overcome the downward pull of gravity. This energy is stored in the lifted stone. When you release the stone it falls back to the ground. And the energy stored in the stone is set free. So the other kind of energy is the energy stored in matter. We call this kind potential energy. Springs that have been pulled, pressed, bent, twisted, or wound up contain energy stored as potential energy.

Energy does not take up space and does not have weight, but we can often feel or see what it does. Whenever matter moves or changes, it is energy that causes this to happen. Also, when matter changes, the form or kind of energy, or both will change. For example, when light energy from the sun strikes the earth, much of it is changed into heat energy. But some of it is changed into chemical energy and stored in the food made by green plants. When this food is used in our bodies, the chemical energy is changed into muscular energy and heat.

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements. Base your answers on the information in this passage only, even if you disagree with what the author has said.

..... 1. Water above a dam has potential energy which is released when the water rushes down the spillway.

..... 2. We cannot see or feel what energy does.

..... 3. Heat, light, sound, and electric current are the materials that bring about many changes in matter.

..... 4. A stretched rubber band has kinetic energy.

..... 5. The metabolism of food in our bodies results in muscular energy and heat.

B. Circle a, b, c, or d which best completes the following items.

1. Paragraph 3 mainly discusses ..... .
   a. how chemical energy is released
   b. the importance of atomic energy
   c. chemical energy and atomic energy
   d. atomic energy stored in matter
2. To run a machine, a gasoline engine harnesses ..... energy.
   a. mechanical energy and changes it into chemical
   b. chemical energy and changes it into mechanical
   c. heat energy and changes it into chemical
   d. mechanical energy and changes it into heat
3. The food that we obtain from green plants is the result of the change of ..... energy.
   a. light energy into heat
   b. chemical energy into muscular
   c. light energy into chemical
   d. chemical energy into heat

4. It is **not** true that matter ..... .
   a. is anything that occupies space and has weight
   b. is of fundamental importance in the composition of the universe
   c. and energy are the two fundamental factors in the composition of the universe
   d. is the only factor that brings about various changes in the forms of energy
5. It is **not** true that energy ..... .
   a. can cause matter to move
   b. can take up space
   c. has different forms
   d. has two main kinds

C. Answer the following questions orally.

1. How do you define the two main kinds of energy?
2. What is energy? Can you name at least five different forms of energy mentioned in the passage?
3. Why does a stone fall to the ground when you lift and release it?
4. What is an example of the change of chemical energy into heat energy?
5. What is the scientific word for all materials?

Part III: Homework

Section One: Vocabulary Exercises

A. Fill in the blanks with the words from the following table to complete the sentences. Base your choices on the items of the table only. Make necessary changes if required.

Verb	Noun	Adjective	Adverb
exist	existence	existing	——
specialize	specialist	special	——
mechanize	mechanics	mechanical	mechanically
press	pressure	——	——

1. They have invented an instrument for measuring the ..... of liquids or gases.
2. Some of the ..... elements can not be found in the pure state in nature.
3. If you ..... that button, a bell will ring.

4. We have a good ..... working with us in our field of study.
5. Farming is ..... in order to increase the amount of grains produced.
6. When a man troubled or worried about a problem, he is sometimes unable to concentrate; therefore, he does his work ..... .
7. Our ..... depends upon the energy we receive from the sun.
8. Some of the students at the anthropology department will ..... in economic anthropology.
9. Her work is entirely .....; it does not involve imagination or innovation.
10. Most scientists think that water does not ..... on the surface of the moon.
11. The science that deals with energy and forces and their effect on bodies is ..... .
12. Each department in a university has regulations of its own; in other words, each department has ..... regulations.

B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

transformed	rotary	capacity	attraction
reaction	force	thermal	weightless
potential	mass	motion	measured

1. The downward ..... exerted by an object is the same as its weight.
2. It is known that energy can be ..... from one system to another.
3. In water turbines, the kinetic energy of running or falling water is converted into mechanical ..... motion.
4. A nuclear reactor serves to convert nuclear energy into ..... energy.
5. The force of attraction exerted by the ..... of the earth is called gravity.
6. When a force acts upon a rigid body, it is balanced by an equal ..... force acting in the opposite direction.
7. Energy is commonly defined as the ..... of a system to do work.
8. When a body escapes from gravity, it becomes ..... .

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, ... in the parentheses provided. There are more options in Column II than required.

Column I		Column II
1. transmit	( )	a. something invented or adapted for a special
2. rotate	( )	purpose

3. define ( ) b. make or become larger
4. principle ( ) c. very great
5. device ( ) d. pass on or hand on
6. huge ( ) e. explain the meaning of
f. special quality that belongs to something
g. basic truth; general law of cause and effect
h. cause to move round a central point
i. succeed in doing or getting

Section Two: Grammatical Exercises

A. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. The machine broke with a sound which was frightening.
   b. .....
2. a. Last night we saw an unidentified object which was flying.
   b. .....
3. a. High buildings must be strong enough to resist the forces which are damaging.
   b. .....
4. a. Induction motors operate through the medium of a magnetic field which is moving.
   b. .....
5. a. Sound waves from an object which is vibrating move in every direction.
   b. .....
6. a. The needs which were growing for rubber were satisfied after synthetic rubber was produced.
   b. .....
7. a. The industrial areas which were developing were too far from the rubber plantations.
   b. .....

B. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. The plastic which is heated is injected into a mold and so takes its shape.
   b. .....

2. a. In this area only water which is pumped is available.
   b. .....
3. a. The original book is in English; the one I have is a copy which is translated.
   b. .....
4. a. Those cards which are punched are fed into the machine.
   b. .....
5. a. The clay that is compressed is strong enogh to withstand great pressure.
   b. .....
6. a. The latex which has been dried is despatched to other countries.
   b. .....
7. a. The plantations which were established had to be in countries with a hot, humid climate.
   b. .....

C. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. The exhaust steam is passed over tubes which are filled with cold water.
   b. .....
2. a. The efficiency of an engine is the ratio of the work which is done to the heat which is received.
   b. .....
3. a. The power which is demanded from modern turbines is continually increasing.
   b. .....
4. a. The research which is being carried out on this subject is extensive.
   b. .....
5. a. The torque which is exerted on the crankshaft should be even.
   b. .....
6. a. Generators which are not required for service are stopped.
   b. .....
7. a. Industry could not depend on supplies which were stopped by war or shipping troubles.
   b. .....

D. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. Coal miners produce millions of tons of coal every week.
   b. .....
2. a. Scientists know that matter is made up of very small particles.
   b. .....
3. a. A skilled operator can carry out many operations on a lathe.
   b. .....
4. a. Mechanical devices harness various forms of energy.
   b. .....
5. a. Scientists call the form of energy stored in the molecules of some materials chemical energy.
   b. .....
6. a. That country does not produce any heavy industrial machinery.
   b. .....
7. a. The operator selected the appropriate gear for the job.
   b. .....

Section Three: Reading Comprehension Exercises

Read the following text carefully and then select a, b, c, or d which best completes the following items.

Power is any amount of energy that can be used to do work. One of the great natural sources of power is water. Water power can be changed into electrical power in the following way.

First, water is stored in a reservoir behind a dam. The water is then channeled in a certain way so that its power turns a fan-shaped wheel called a turbine. The turbine, in turn, runs a dynamo, which is a machine that turns coils of copper wire within a magnetic field. This action causes electric currents to flow in the copper wires. This is the process that makes electricity. Thus, water power helps make electrical power.

1. A dynamo is a machine that ..... .
   a. turns a fan-shaped wheel
   b. turns coils of copper wire
   c. channels water
   d. runs a turbine
2. Electric currents flow in the copper wires when ..... .
   a. the dynamo turns the turbine
   b. the coils of copper wire are turned

c. the turbine turns the fan-shaped wheel
d. the water is channeled into the dynamo

3. 'which' in line 6 refers to ..... .
   a. turbine
   b. wheel
   c. dynamo
   d. machine
4. A turbine usually runs by ..... .
   a. electricity
   b. a dynamo
   c. a wheel
   d. water
5. A reservoir behind a dam is a place where ..... .
   a. water is stored
   b. turbines are kept
   c. electricity is produced
   d. energy is generated
6. The main idea of the passage is that ..... .
   a. electrical power can be used to do work
   b. energy is used to do work
   c. turbines are used to make electrical power
   d. water power can be used to produce electrical power
7. 'channel' in line 5 means ..... .
   a. store
   b. draw
   c. direct
   d. change
8. 'amount' in line 1 means ..... .
   a. quantity
   b. cost
   c. worth
   d. degree

Section Four: Translation Practice and Terminology Equivalents

A. Translate the following passage into Persian.

There are several kinds of energy. Kinetic energy is the force embodied in moving objects. The force needed to set a roller skate rolling is stored in the skate while it is moving. This energy is either used up slowly in friction or is suddenly released if the skate hits a barrier. Potential energy is another form of energy stored in objects that have been lifted up. A rubber ball lifted from the floor and then dropped yields as much energy when it hits the ground as was used to raise it. Rest-mass energy is stored in atoms. It is the energy released when matter is destroyed. The scientific Law of Conversion of Mass-Energy states that there is a fixed amount of matter or of energy in the universe. Matter may turn into energy, but the total amount of both taken together never varies.

B. Determine the Persian equivalents of the following technical terms and write them in the spaces provided.

anthropology	matter .....
chemical energy	mechanize .....
compress	nuclear energy .....
crankshaft	potential energy .....
device	pressure .....
dynamo	principle .....
earthquake	ratio .....
economic	rest-mass energy .....
efficiency	rotary .....
generator	rotate .....
gravity	sound waves .....
induction	thermal .....
kinetic energy	torque .....
latex	transmit .....
magnetic field	turbine .....
mass	vibrate .....

Lesson 4

What Is Electricity?

Part I: Pre-Reading

A. Pronunciation Practice

an.cient (ān´shənt)
meant (mĕnt)
re.la.tion.ship (rĭ-lā´shən-shĭp)
light.ning (līt´nĭng)
ap.pre.ci.ate (ə-prē´shē-āt)
rheu.ma.tism (rōō´mə-tĭzəm)
fos.sil (fŏs´əl)
res.in (rĕz´ĭn)
de.rive (dĭ-rīv´)
mag.ne.sia (măg-nē´zhə)
at.trac.tion (ə-trăk´shən)
re.pul.sion (rĭ-pŭl´shən)
mag.net.ic (măg-nĕt´ĭk)
in.vis.i.ble (ĭn-vĭz´ə-bəl)
hy.dro.e.lec.tric´i.ty (hīdrō-ĭ-lĕk-trĭsĭ-tē)
ef.fect (ĭ-fĕkt´)
gen.er.ate (jĕn´ə-rāt)
dy.na.mo (dī´nə-mō)
volt.age (vōl´tĭj)
re.sis.tance (rĭ-zĭs´təns)
con.se.quent.ly (kŏn´sĭ-kwĕntlē)
com.pare (kəm-pâr´)
con.sid.er (kən-sĭd´ər)
vol.ume (vŏl´yōōm)
cer.tain (sûrt´n)
am.pere (ăm´pîr)
po.ten.ti.al (pə-tĕn´shē-əl)
ohm (ōm)
e.lec.tric (ĭ-lĕk´trĭk)

B. Word Study: Definitions

magnet:	piece of iron or steel able to attract iron
magnetic:	relating to a magnet or to magnetism
magnetism:	science of magnetic phenomena and properties
lightning:	flash of bright light produced by natural electricity in the sky
resin:	sticky substance that flows out from most plants when cut
property:	special quality that belongs to something
charge:	quantity of unbalanced electricity in a body
charge:	fill; give an electric charge to

electrify: charge something with electricity
attract: pull towards
repel: drive back or away
dynamo: electromagnetic machine which converts mechanical energy into a.c. or d.c. electrical supply
volume: space occupied by a substance
resistance: power of standing against the force of something

C. Word Study: Definitions and Exemplifications

appreciate: understand
They did not ***appreciate*** how lightning was caused.

eel: snake-like fish
An ***eel*** can often give a powerful electric shock.

subject: cause a thing or a person to experience something
The fuse wire burnt out because it was ***subjected*** to a high voltage.

rheumatism: painful disease with inflation of the muscles and joints
The physician diagnosed the disease as ***rheumatism.***

derive: get from a source
Thousands of English words are ***derived*** from Latin.

rub: move one thing backwards and forwards on the surface of another
The little boy was ***rubbing*** his hands together to make them warm.

mineral: substance got from the earth by mining
Coal and oil are examples of ***minerals.***

invisible: that cannot be seen
Millions of stars are ***invisible*** to the human eye.

effect: result; outcome
The ***effect*** of heat upon metals is quite noticeable.

consequently: therefore
The fossil resin called 'elektron' got electrified when rubbed; ***consequently,*** the force it acquired came to be known as electricity.

D. Grammatical Points

Some verbs can take wh-clauses as their objects.

1. Model: a. They saw lightning.
The lightning was caused by natural electricity in the sky. (appreciate)
b. They saw lightning, but did not appreciate how it was caused.

With reference to the grammatical point explained in Lesson 2, notice the following Model sentences.

2. Model: a. They also knew that a mineral which had a dark color had the properties of attraction and repulsion.
b. They also knew that a dark-colored mineral had the properties of attraction and repulsion.

Part II: Reading for Comprehension

What Is Electricity?

To the ancients, electricity meant many things. They had no idea that there was any relationship between electricity and magnetism. They saw lightning, but did not appreciate how it was caused. They knew that a certain fish called an 'electric eel' could give a powerful electric shock; indeed, Roman emperors were subjected to this as a cure for rheumatism. The Greeks knew that the fossil resin called elektron, from which our word 'electricity' was derived, became electrified when rubbed. They also knew that a dark-colored mineral found at Magnesia had the properties of attraction and repulsion which we now call magnetic.

However, all this was some time ago, and we now believe that we have an answer to the question "What is electricity?" Electricity is an invisible force that can produce heat, light, motion, and many other physical effects. The force is an attraction or repulsion between electric charges. Electricity is generated at large power stations by big machines known as generators. They are, in fact, large dynamos driven by powerful engines which derive their power from water or steam. The electricity which derives its power from water is known as hydroelectricity.

Electricity can also be explained in terms of current, voltage, and resistance. The flow of electricity, the electric current, along a wire may be compared to the flow of water along a pipe. If you consider water flowing along a pipe, the volume of water passing a certain point in a given time is similar to the electric current. Electric current is measured in amperes. The pressure of the water in the pipe may be compared to the electric potential. Potential is

measured in volts. The resistance of the walls of the pipe to the water current may be compared to the resistance of the wire to the electric current, i.e. a narrow pipe offers more resistance than a wide pipe, and, similarly, a thin wire offers more resistance than a thick wire of the same metal. Resistance is measured in ohms.

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

..... 1. Electricity is the force generated by big machines.
..... 2. The word 'elektron' is derived from the word 'electricity'.
..... 3. Hydroelectricity is the production of electricity by water power.
..... 4. The attraction and repulsion characteristics of a mineral called magnetic properties.
..... 5. The ancients had no ideas at all about electricity.

B. Circle a, b, c, or d which best completes the following items.

1. Generators transform ..... .
   a. chemical energy into mechanical energy
   b. electrical energy into mechanical energy
   c. chemical energy into electrical energy
   d. mechanical energy into electrical energy
2. It is **not** true that ..... .
   a. Roman emperors very often experienced the electric shock given by an eel to cure rheumatism
   b. electric potential is the same as the pressure of water in a pipe
   c. a thin wire offers more resistance than a thick wire of the same metal
   d. Roman emperors were unaware of electricity and its effect on rheumatism.
3. In line 10, 'this' refers to ..... .
   a. a dark-colored mineral found at Magnesia
   b. the electron being electrified when rubbed
   c. the fact that ancient people did not know much about electricity
   d. properties of attraction and repulsion
4. In paragraph 3, the writer does not compare ..... .
   a. flow of water and flow of electricity
   b. resistance of the walls of a pipe to water and resistance of a wire to electric current
   c. volume of pipes and volume of wires

d. pressure of water and electric potential

5. The contrast in paragraphs 1 and 2 is between ..... .
   a. the relationship between lightning and magnetism on the one hand and electricity on the other
   b. the past and present knowledge of electricity
   c. electricity produced by nature and electricity generated by machines
   d. static electricity and hydroelectric current

C. Answer the following questions orally.

1. What is electricity?
2. What do we call the force which is the result of attraction or repulsion between electric charges?
3. What important quantities are **involved** in the description of electricity?
4. How does water power lead to electricity?
5. What is the relationship between electricity and magnetism?
6. How is hydroelectricity defined?
7. How do you explain electric current, electric potential, and electric resistance?

Part III: Homework

Section One: Vocabulary Exercises

A. Fill in the blanks with the words from the following table to complete the sentences. Base your choices on the items of the table only. Make necessary changes if required.

Verb	Noun	Adjective	Adverb
electrify	electricity	electric	electrically
magnetize	magnet	magnetic	magnetically
produce	production	productive	productively
measure	measurement	measurable	measurably

1. In some countries, agricultural ..... has been mechanized.
2. The standard unit of mass is the kilogram; however we ..... very small masses in grams.
3. ..... currents cannot flow easily in all substances.
4. Iran ..... a large quantity of oil every day.

5. Copper allows ..... to flow easily through it.
6. Of all the metals, iron, cobalt, and nickel have the greatest ..... properties.
7. A ..... produces a magnetic field in the space around it.
8. In physics, the researchers came within ..... distance of success.
9. If we ..... an iron bar, the quality of attracting pieces of iron will be found at two regions at the ends of the bar.
10. Accurate ..... is essential for making good quality machines and parts.
11. The ..... lands of Iran are mostly located in the Northern part of the country.
12. Scientists are experimenting on cars that run ..... .

B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

field	current	properties	electrical
repel	element	electrons	resistance
magnet	positive	potential	attraction

1. Unlike poles attract whereas like poles ..... one another.
2. If there is a potential difference between the ends of a conductor, a ..... will flow along it.
3. The magnetic ..... increases with an increase in the current.
4. Resistors are devices whereby ..... is interposed in a circuit.
5. Generally speaking, mixtures of metals containing a magnetic substance have magnetic ..... .
6. The magnetic force of ..... is concentrated near the ends of the magnet.
7. Generators are machines used for the large-scale production of ..... energy.
8. A substance which is attracted by a magnet can itself be made into a ..... .

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, ... in the parentheses provided. There are more options in Column II than required.

Column I		Column II
1. electromagnetism	( )	a. work got out of a machine divided by the work put in
2. efficiency	( )	
3. magnetization	( )	b. cause to exist or occur; produce
4. loop	( )	c. multiplying by two

5. electrify ( ) d. science of the properties and relations
6. generate ( ) between magnetism and electric currents
7. kinetic ( ) e. process of turning a piece of magnetic material into a magnet
f. charge something with electricity
g. made into liquid by heat
h. due to motion; moving
i. of magnets
j. simple closed connection; part of a circuit

Section Two: Grammatical Exercises

A. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. He bought the watch.
   The watch was made **in Switzerland.** (know)
   b. .....
2. a. She heard the noise.
   The noise was made **by a tractor.** (realize)
   b. .....
3. a. We felt very cold.
   The cold came in from **the open window upstairs.** (find out)
   b. .....
4. a. The workers welcomed the raise in salary.
   The raise was decided upon **because the workers had worked hard.** (know)
   b. .....
5. a. Early men discovered fire.
   Fire was produced by **lightning.** (appreciate)
   b. .....
6. a. The poor woman received some money every month.
   Her neighbors sent it. (discover)
   b. .....

B. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. One of the largest hospitals of the city was built by a man who had a good heart.
   b. .....

2. a. The policeman easily caught the thief who had red hair.
   b. .....
3. a. The soldier was shot by an enemy with a hard heart.
   b. .....
4. a. On my way to college, I usually see an old man with long hair.
   b. .....
5. a. I borrowed the money from a woman who had a bad temper.
   b. .....
6. a. Mr Hosseini visited a doctor who had a good temper.
   b. .....

Section Three: Reading Comprehension Exercises

Read the following text carefully and then select a, b, c, or d which best completes the following items.

One hundred times a second lightning strikes somewhere on the earth. It is a great killer which causes a lot of damage. Hundreds of deaths are caused by lightning each year, and most of the forest fires are set off by lightning. Therefore, scientists are very interested in controlling lightning.

In ancient times, people thought that lightning was fire thrown from heaven to earth by the angry gods. Modern scientists, however, know that thunder clouds, like all clouds, are filled with ions–atoms with either too many or too few electrons. The scientists cannot understand why the ions separate in the clouds, but the positive ions move to the top of the cloud, and the negative ions move to the bottom. The negative ions in the bottom of the cloud repel, or push against, the negative ions in the earth below. But they attract the positive ions in the ground. The amount of electrical force between the cloud and the earth becomes great. A lot of ionized particles then suddenly break away toward the ground to combine the cloud's negative ions and the earth's positive ones.

Scientists are trying to control this lightning. They drop a lot of tiny pieces of aluminum-covered glass into the cloud. These tiny pieces of glass act like magnets and build fields of magnetic force within the cloud. This lets the electrons in the cloud move from top to bottom. The electric force is lessened and lightning is prevented.

1. After the ions separate in the clouds, ...
   a. the negative ions move down

b. the negative ions in the earth push against the top of the cloud
c. the positive ions move down
d. the positive ions in the cloud repel the negative ions in the earth

2. In line 11, 'they' refers to ..... .
   a. the negative ions in the ground
   b. the positive ions in the cloud
   c. the negative ions in the cloud
   d. the positive ions in the ground
3. It is **not** true that lightning ..... .
   a. is responsible for many deaths
   b. starts many forest fires
   c. strikes everywhere on earth simultaneously
   d. causes a lot of damage
4. In line 18, 'This' refers to ..... .
   a. tiny pieces of glass
   b. lightning caused by thunderstorms
   c. the dropping of aluminum-covered glass
   d. the formation of magnetic fields within the cloud
5. It is **not** true that ..... .
   a. in the past people thought that gods caused lightning
   b. all clouds have ions in them
   c. scientists can explain why ions separate in the clouds
   d. people of the past believed that lightning was fire thrown from heaven to earth

Section Four: Translation Practice and Terminology Equivalents

A. Translate the following passage into Persian.

When a plastic ruler has been rubbed against wool, it will attract small pieces of paper. To explain why this takes place, we must refer to our knowledge of the electrical balance of the atom. As we know, electrons orbit the nucleus, just as planets orbit the sun. But there is a difference: the latter maintain their orbits by gravitational attraction, whereas the former maintain their orbits by electrical attraction since unlike charges attract each other, thus making the whole atom electrically neutral. But if electrons are removed from, or added to, an atom, it will then carry an electric charge, and such charged atoms are known as ions. The simplest method of achieving this is by friction. Electrons are dislodged from the atoms of the plastic ruler, leaving them with too few, and thus carrying a positive charge. Electrons are added to the atoms of the

Lesson 15

Gasoline Engine

Part I: Pre-Reading

A. Pronunciation Practice

de.scend (dĭ-sĕnd´)
cy.cle (sī´kəl)
al.ter.na.tive (ôl-tûr´nə-tĭv)
in.stan.ta.ne.ous (ĭnstən-tā´nē-əs)
oth.er.wise (ŭth´ər-wīz)
pres.sure (prĕsh´ər)
ex.pan.sion (ĭk-spăn´shən)
as.sist (ə-sĭst´)
clear.ance (klîr´əns)
prop.a.ga.tion (prŏp ə-gā´shən)
flame (flām)
tur.bu.lence (tûr´byə-ləns)
def.i.nite (dĕf´ə-nĭt)
reg.u.lar (rĕg´yə-lər)
se.quence (sē´kwəns)
torque (tôrk)
im.part (ĭm-pärt´)
un.e.ven (ŭnē´vən)
li.a.ble (lī´ə-bəl)
fly.wheel (flī´hwēl)
damp (dămp)
var.i.a.tion (vâr ē-ā´shən)
ap.pro.pri.ate (ə-prō´prē-ĭt)
ac.tu.ate (ăk´chōō-āt)
cam.shaft (kăm´shăft)
ef.fi.cien.cy (ĭ-fĭsh´ən-sē)
quar.ter (kwôr´tər)
steam (stēm)
wheel (hwēl)
mo.tor.car (mō´tər-kär)
jour.ney (jûr´nē)
tire (tīr)
rub.ber (rŭb´ər)
flag (flăg)
im.prove (ĭm-prōōv´)
com.fort.a.ble (kŭm´fər-tə-bəl)
in.vent (ĭn-vĕnt´)
weigh (wā)
pound (pound)
horse.pow.er (hôrs´pouər)
in.flam.ma.ble (ĭn-flăm´ə-bəl)
charge (chärj)
en.er.gy (ĕn´ər-jē)
mix.ture (mĭks´chər)
ig.nite (ĭg-nīt´)
spark (spärk)
com.pres.sion (kəm-prĕsh´ən)
dis.trib.u.tor (dĭ-strĭb´yə-tər)
prod.uct (prŏd´əkt)
ex.pand (ĭk-spănd´)
re.cip.ro.cate (rĭ-sĭp´rə-kāt)
pis.ton (pĭs´tən)
ro.ta.tion (rō-tā´shən)
move.ment (mōōv´mənt)
crank.shaft (krăngk´shăft)
cyl.in.der (sĭl´ən-dər)
stroke (strōk)

B. Word Study: Definitions

cylinder:	tubular chamber in which the piston of an engine reciprocates
pound:	unit of weight
horse power:	unit of mechanical power equal to the power needed to raise 33,000 pounds at the rate of one foot per minute
energy:	capacity of a body for doing work
ignite:	heat a gaseous mixture to the temperature at which combustion occurs
spark:	flash of a discharge of electric current
compression:	stroke during which the working agent is compressed in an internal combustion engine
distributor:	device for distributing electric current to the spark plugs of a gasoline engine so that they fire in proper order
reciprocate:	move backward and forward alternately
piston:	cylindrical metal piece which reciprocates in a cylinder
rotation:	act of turning on an axis or hub
crankshaft:	main shaft of an engine which carries a crank or cranks for the attachment of connecting rods
connecting rod:	in a reciprocating engine, the rod connecting the piston to the crank
texhaust valve:	valve controlling the discharge of the exhaust gas in an internal combustion engine
valve:	any device which controls the passage of a fluid through a pipe
exhaust:	steam or gas carried off after use
cylinder head:	closed end of the cylinder of an internal combustion engine
stroke:	piston travel in the cylinder of an engine
inlet valve:	inlet port; induction valve; induction port; port or valve through which the charge is induced into the cylinder during the suction stroke
top dead center:	inner dead center; piston position at the beginning of the outstroke, i.e., when the crank-pin is nearest to the cylinder
clearance:	distance between two objects or between a moving and stationary part of a machine
propagation:	extending through space as light
turbulence:	fluid flow in which the particle motion at any point

varies rapidly in magnitude and direction

fire: become ignited; ignite

torque: turning moment exerted by a tangential force acting at a distance from the axis of rotation or twist

flywheel: heavy wheel attached to a shaft either to reduce the speed fluctuation or to store up kinetic energy

camshaft: shaft on which cams are keyed or formed integrally, used to operate the valves of internal combustion engines

C. Word Study: Definitions and Exemplifications

take: need; require
The project ***took*** us three months to complete.

tire: rubber on the rim of a motor-car wheel
He put a new ***tire*** on the wheel.

warn: give somebody notice of possible danger or unpleasant consequences; inform in advance of what may happen
I ***warned*** him not to go skating on such thin ice.

inflammable: easily ignited
Kerosene is used for burning in lamps; gasoline is too ***inflammable*** for this purpose.

charge: load
It is important to control the ***charge*** all the time.

mixture: something made by putting different things together
Molten metals are put together; the ***mixture,*** then, is put into a mold.

product: that which is produced
Gasoline and kerosene are ***products*** of crude petroleum.

expand: make or become longer
Metals ***expand*** when they are heated.

descend: come or go down
It is advisable to use engine braking when ***descending*** a steep hill.

cycle: series of events taking place in a regularly repeated order
The burnt gases in the cylinder are exhausted at the end of the ***cycle.***

alternative: choice between two things

Your plan is not applicable; we must try to think of an ***alternative.***

instantaneously: happening or done in an instant

An excess amount of air entered the furnace ***instantaneously.***

otherwise: in another or different way

You think he should have been working, but he was ***otherwise*** doing his military service.

pressure: force exerted on a body tending to change its shape or volume

A safety valve is provided to allow excess ***pressure*** to escape.

expansion. becoming longer or bigger

When substances are heated, ***expansion*** takes place.

definite: clear; not doubtful or uncertain

A good chairman helps his committee members reach ***definite*** decisions.

sequence: connected line of events; order in which events occur

Piston travels in the cylinder occur in a ***sequence.***

impart: give or pass on a share of something

Thermal energy must be ***imparted*** to the molecules to free them.

liable: have a tendency to; be likely to

Since gasoline is an inflammable substance, an explosion is ***liable*** to occur at any minute in a gas station.

damp out: cause to die away

The purpose of springing is to ***damp out*** the short, sharp jolts from the road.

actuate: cause to act; put into motion

The pistons are ***actuated*** by the mixture of air and gasoline in the cylinder.

phase: stage in development

The initial ***phase*** of the building operation was completed in eight months.

efficiency: ratio of energy expended to power produced

The ***efficiency*** of a gasoline engine is higher than that of a steam engine.

quarter: one of four equal parts of anything
It took me a ***quarter*** of an hour to assemble the spark plug.

steam: water in the vapor state
The first ***steam*** engine was built during the nineteenth century.

D. Grammatical Points

In Lesson 6, a grammatical point concerning the structure of the sentence in the passive voice was mentioned. Here the same point is of concern. Pay close attention to the verb form in the following sentences.

1. Model: a. We have used the gasoline engine to drive almost every kind of vehicle running on wheels.
   b. The gasoline engine has been used to drive almost every kind of vehicle running on wheels.

One of the structures expressing result was mentioned in Lesson 1. Another commonly-used structure for the same purpose is as follows:

such+adjective+noun+that

Notice that 'such a' and 'such an' are used before singular count nouns. 'Such' is used before mass nouns and plural nouns.

2. Model: a. The cars made a lot of noise.
   Everyone knew when they were coming.
   b. The cars made such a noise that everyone knew when they were coming.

This structure is also used to express emphasis.

Part II: Reading for Comprehension

Internal Combustion Engine: Gasoline Engine

The gasoline engine is an internal combustion engine. The gasoline engine has been used to drive almost every kind of vehicle running on wheels—motor-cars, motor-bicycles, trucks, etc. It is also used in many kinds of airplanes. Journeys that used to take weeks can now be made in a day.

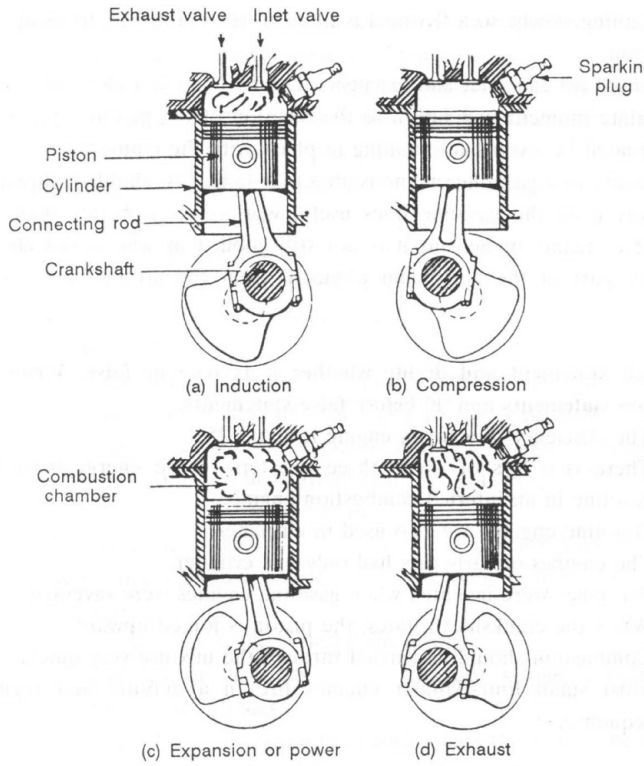
The first car driven by an internal combustion engine was seen on the roads

in 1894. Early cars were very strange; their engines had only one cylinder and the tires on the wheels were made of iron or of solid rubber. The cars made such a noise that everyone knew when they were coming. In those days, a cart with an engine instead of a horse was thought to be dangerous. A man, carrying a red flag, had to walk in front of a car to warn people of the danger. From that time motor-cars have been greatly improved. Now we can ride very comfortably and quietly in a car which on a good road can easily reach 70 miles an hour. Racing cars, with more powerful engines, can travel much faster. At the moment, the greatest speed reached by a racing car is about 600 miles an hour, and perhaps by the time you read this, men will have traveled at even greater speeds.

A gasoline engine is excellent for an airplane because it is not heavy; in fact, airplanes only became possible when this kind of engine had been invented. Airplane engines are now made so that they weigh little more than one pound for every horse-power. Thus a 1,000 horse-power engine weighs little more than 1,000 pounds. The engine works in the same way as the motor-car engine, but it is much more powerful.

In the internal combustion engine, heat is generated by the combustion of an inflammable charge inside a cylinder, and the heat energy is immediately converted into mechanical energy. Some heavy internal combustion engines use a gas fuel or diesel oil, and the fuel-air mixture may be ignited either by a spark or by compression of the mixture. However, for small internal combustion engines, such as those which are used in motor-cars, the charge is a mixture of gasoline and air, and the mixture is ignited by a spark from the distributor.

When the mixture is ignited, the products of combustion expand down the cylinder, which is fitted with a reciprocating piston. The downward movement of the piston is converted into a rotational movement of the crankshaft by means of a connecting rod. As the crankshaft rotates, the piston is driven upwards again, and the exhaust gases are forced out through the exhaust valve in the cylinder head. When the piston nears the top of this stroke, the inlet valve is opened and the exhaust valve closed. The piston then descends on the induction stroke and draws a fresh charge into the cylinder. As the piston rises again on the compression stroke, the charge is compressed and ignited, and the cycle begins again. This is the four-stroke cycle which is in common use. An alternative cycle is the two-stroke cycle, which combines the exhaust and compression strokes into one.



four-stroke cycle

The combustion of the mixture does not take place instantaneously. The spark is therefore timed to occur before the piston reaches top dead center; otherwise, maximum pressure would not be reached in time. By the time the piston is at top dead center, combustion is well under way and the expansion of the gases is beginning. Once combustion starts, it should be carried through the mixture very rapidly, and this is assisted by making the clearance space above the piston as small as possible and by careful design of the cylinder head. Rapid propagation of the flame through the compressed gas is also assisted by creating turbulence in the gas.

Most small internal combustion engines in common use have four cylinders, which fire in a definite and regular sequence. This is necessary, otherwise the torque which the pistons impart to the crankshaft will be irregular and uneven. The torque is liable to be uneven in any case when the

engine is running slowly, so a flywheel is fitted to the crankshaft to damp out these variations.

It is essential for the inlet and exhaust valves to open and close at exactly the appropriate moment in relation to the position of the piston. Therefore, they are actuated by a camshaft running in phase with the crankshaft.

The efficiency of a gasoline engine is about 25%; that is, about one quarter of the energy from the gasoline does useful work. This is better than the efficiency of a steam engine, but it is not still good. Gasoline is not cheap; only a small part of the petroleum obtained from the ground consists of gasoline.

A. Read each statement and decide whether it is true or false. Write 'T' before true statements and 'F' before false statements.

..... 1. The efficiency of a steam engine is about 25%.
..... 2. There is a loss of about three quarters of the energy from the gasoline in an internal combustion engine.
..... 3. Gasoline engines are also used in airplanes.
..... 4. The engines of early cars had only one cylinder.
..... 5. Airplanes were invented when gasoline engines were invented.
..... 6. When the crankshaft rotates, the piston is forced upward.
..... 7. Combustion should be carried through the mixture very quickly.
..... 8. Most small four-cylinder engines fire in a definite and regular sequence.

B. Circle a, b, c, or d which best completes the following items.

1. In the time of early cars, everybody knew when a car was coming because ..... .
   a. the car made a lot of noise
   b. a man warned people of the danger
   c. somebody had to walk in front of the car
   d. it was thought to be dangerous
2. The writer compares a gasoline engine with a steam engine by stating that the efficiency of ..... .
   a. a gasoline engine is about 25%, but that of a steam engine is about one quarter of the energy
   b. a gasoline engine is better than that of a steam engine
   c. a steam engine is better than that of a gasoline engine
   d. a steam engine is about 25%, and that of a gasoline engine is about one quarter of the energy

3. Heat is generated in an internal combustion engine by ..... .
   a. an inflammable charge inside a cylinder
   b. the conversion of the heat energy into mechanical energy
   c. the compression of the combustible mixture inside the cylinder
   d. the burning of the charge present in the cylinder
4. The mixture of gasoline and air is ignited because ..... .
   a. they are too inflammable
   b. the mixture is compressed
   c. a spark is produced by the distributor
   d. a pressure is developed in the engine
5. It is **not** true that ..... .
   a. when the mixture is ignited, combustion forces the cylinder downward
   b. some heavy internal combustion engines use a gas fuel
   c. the charge in a motor-car engine is usually a mixture of gasoline and air
   d. a reciprocating piston is fitted with the cylinder
6. The piston is forced upward because ..... .
   a. the crankshaft rotates
   b. the connecting rod is actuated
   c. the inlet valve is closed
   d. the cylinder nears top dead center
7. It is true that ..... .
   a. as the piston rises, the cycle begins again
   b. when the piston descends on the induction stroke, a fresh charge is drawn into the cylinder
   c. the inlet valve closes when the piston nears the top of the stroke
   d. the movement of the piston starts when a rotational movement is produced
8. In line 47, 'it' refers to ..... .
   a. piston
   b. expansion
   c. combustion
   d. top dead center

C. Answer the following questions orally.

1. What does the author mean when he says that the efficiency of a gasoline engine 'is not still good'?
2. What were the tires of early cars made of?
3. Why are gasoline engines appropriate for airplanes?
4. What is the function of an internal combustion engine?
5. What is the function of a connecting rod?
6. Why is the spark timed to occur before the piston reaches top dead center?

Part III: Homework

Section One: Vocabulary Exercises

A. Fill in the blanks with the words from the following table to complete the sentences. Base your choices on the items of the table only. Make necessary changes if required.

Verb	Noun	Adjective	Adverb
endanger	danger	dangerous	dangerously
empower	power	powerful	powerfully
generate	generation	generative	generatively
———	efficiency	efficient	efficiently

1. I will do everything in my ..... to help you.
2. Your carelessness will ..... your chances of success.
3. The heat which is ..... in an air compressor must be kept to a minimum.
4. The ..... capability of these new turbines to produce electricity is beyond one's imagination.
5. Since you study more ..... nowadays, you will certainly pass your courses with better grades.
6. In this case, the ..... stress was produced by centrifugal force.
7. He was critically ill, but the doctors say that he is now out of ..... .
8. For rapid production of steam, ... water circulation in the boiler is necessary.
9. Members of the assembly are ..... to pass laws.
10. The ..... of electricity by water power is still common.
11. Walking near the edge of the cliff can be ..... .
12. The ratio of the work done to the energy supplied is called the ..... of a machine.

B. Fill in the blanks with the appropriate words from the list below. There are more options than required.

fires	ignited	movements	distribute
drawn	imparted	converted	propagate
charges	products	combustion	exhausted
mixture	variation	compression	

1. Farenheit temperatures are ..... into Centigrade by a simple formula.
2. Rapid closing of the valve is effected by the ..... in the fuel supply.
3. The operator ..... the boiler mechanically or manually.
4. The burned gases in the cylinder are ..... by the rising piston.
5. The mixture is ..... by a spark from the ignition system.
6. A quantity of heat is ..... to the gas through conduction.
7. Ignition can be produced either by a spark or by the ..... of the mixture.
8. If the furnace is overcharged with fuel, heavy smoke will be produced through poor ..... .
9. A fresh charge of gasoline and air is ..... into the cylinder.
10. By a series of rapid ....., the general placed his forces in an advantageous position.

C. Match the words in Column I with their appropriate equivalents in Column II. Insert the letters a, b, c, ... in the parentheses provided. There are more options in Column II than required.

Column I		Column II
1. friction	( )	a. improvement
2. propagate	( )	b. rubbing of one thing against another
3. dislodge	( )	c. force something out from its place
4. reciprocate	( )	d. cut with something sharp
5. weigh	( )	e. come to; arrive at
6. property	( )	f. acquire control of
7. reach	( )	g. measure how heavy something is
8. betterment	( )	h. remove a burden
		i. spread more widely
		j. move backward and forward
		k. equip or prepare in advance
		l. special quality that belongs to something

Section Two: Grammatical Exercises

A. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. The mechanic has changed the spark plugs.
   b. .....
2. a. They have used this oil to lubricate the machine.
   b. .....

3. a. We have used this jack to raise the car.
   b. .....
4. a. I have replaced the electric light bulb.
   b. .....
5. a. He has separated the contact surfaces by a layer of lubricant.
   b. .....
6. a. They have already finished the foundation of the bridge.
   b. .....
7. a. The operator has observed safety precautions.
   b. .....
8. a. The operator has handled the machine with great care.
   b. .....

B. Do the following exercises according to the explanations given in the Pre-Reading Part. Write your sentences in the spaces provided.

1. a. The engine produced great heat.
   We had to stop it.
   b. .....
2. a. The boilers produced high temperatures.
   Some method of cooling had to be adapted.
   b. .....
3. a. The river had a great flow.
   It took away their boat.
   b. .....
4. a. It was a foggy day.
   We could not see the road.
   b. .....
5. a. The metal shows great resistance to corrosion.
   It is commonly used in modern industry.
   b. .....
6. a. The engine made a great noise.
   The mechanic became surprised.
   b. .....
7. a. The tornado struck with great force.
   It lifted automobiles off the ground.
   b. .....
8. a. Maryam is an energetic child.
   She runs and jumps all day.
   b. .....

9. a. The exhaust gases possess great heat.
They can be used to heat the incoming air to the boiler.
b. .....

Section Three: Reading Comprehension Exercises

Read the following text carefully and then select a, b, c, or d which best completes the following items.

An engine that converts heat energy into mechanical work is called a heat engine, and the car engine is one type of heat engine. It derives heat from the burning or combustion of a fuel and converts this heat into useful work for driving the car.

The fuel used in the vast majority of car engines is gasoline, which is one of the many products obtained from crude oil. Gasoline, when mixed with the right amount of air, will burn when a flame or spark is applied to it.

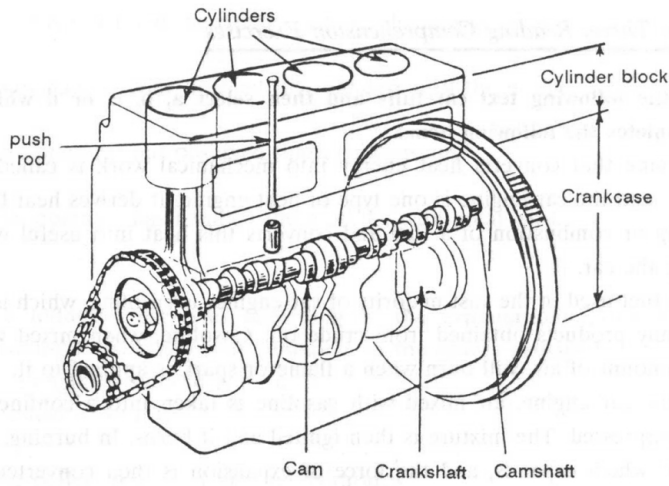
In the car engine, air mixed with gasoline is taken into a confined space and compressed. The mixture is then ignited and it burns. In burning, it heats the air, which expands, and the force of expansion is then converted into a rotary movement to drive the wheels of the car.

To be able to use this energy effectively, we have to control the combustion process and the force of expansion. Firstly, we need a tube or cylinder, closed at one end, in which to compress and burn the gasoline and air mixture. Then we need a piston which can slide freely in the cylinder and which can be driven outwards by the force of expansion. To convert the outward movement of the piston into a rotary movement, we must join it by a connecting rod to a crankshaft. We need one passage for the entry of the mixture into the cylinder and another to let out the used gases. To control the entry of the mixture and the exhaust of the gases, we need valves; these are called the inlet and exhaust valves. Finally, we need some means of igniting the mixture in the top of the cylinder, the part called the combustion chamber, and for this we use a spark plug.

By timing the opening and closing of the valves and by timing the arrival of the spark, we can control the whole sequence of events and make the piston move in and out over and over again.

Motor-car engines may have four, six, or eight cylinders. Look at the following figure. The cylinders are usually mounted in a cylinder block on top of the engine. Beneath the cylinder block is the crankcase, which contains two shafts, the crankshaft and the camshaft. The crankshaft is revolved by the

outward movement of the pistons in the cylinders. This rotary movement of the crankshaft transmits the power developed by the engine through the gearbox to the driving wheels and sets the car in motion.



cylinder block

When the crankshaft rotates, it also causes the rotation of the camshaft, which lies alongside it in the crankcase. As the camshaft rotates, it pushes up rods alongside each cylinder to open and shut the valves at the top of the cylinder.

There are two valves to each cylinder. The inlet valve lets air and gasoline into the combustion chamber of the cylinder when it is opened. When the exhaust valve is opened, the gases formed after the combustion in the chamber are allowed to escape. These gases are led away from the car through an exhaust pipe.

1. The best title for this passage is ..... .
   a. 'The Engine Operation'
   b. 'Motor Cars'
   c. 'Cylinders'
   d. 'The Internal Combustion Engine'
2. In line 2, 'It' refers to ..... .
   a. heat energy
   b. mechanical work
   c. heat engine
   d. car engine
3. In line 5, 'vast majority' means ..... .
   a. some
   b. many
   c. a few
   d. much

4. In line 17, 'it' refers to ..... .
   a. engine
   b. piston
   c. cylinder
   d. tube
5. In line 24, 'By timing' means by ..... .
   a. arranging the time of
   b. measuring the time of
   c. controlling the sequence of
   d. ordering the process of
6. In line 28, 'mounted in' means ..... .
   a. provided for
   b. moved in
   c. revolved by
   d. fixed into
7. In line 39, 'it' refers to ..... .
   a. the exhaust pipe
   b. the inlet valve
   c. the exhaust valve
   d. the combustion chamber
8. The rotation of the camshaft is due to ..... .
   a. the rotation of the crankshaft
   b. the rise of the pistons
   c. the movement of the connecting rods
   d. the closure of the exhaust valve
9. The outward movement of the pistons causes ..... .
   a. the gases to expand
   b. the crankshaft to revolve
   c. the power to develop
   d. the wheels to drive
10. To develop a rotary movement, the piston is connected to ..... .
    a. a cylinder
    b. a connecting rod
    c. a crankshaft
    d. a crankcase
11. The valves at the top of the cylinder are opened and closed by the action of ..... .
    a. the pistons
    b. the rods
    c. the camshaft
    d. the crankshaft
12. The rotary movement is developed ..... .
    a. to drive the car wheels
    b. to heat the air
    c. to expand the air
    d. to do useful work
13. In the cylinder, ... mixture is burned.
    a. the air
    b. the gasoline
    c. the compressed
    d. the combustible
14. The crankcase is under ..... .
    a. the camshaft
    b. the cylinder block
    c. the crankshaft
    d. the connecting rod
15. The spark plug applies a spark to ..... .
    a. the combustion chamber
    c. the gasoline

b. the cylinder
d. the combustible mixture

16. The exhaust valve is needed ..... .
    a. to expel the burned gases
    b. to let in fresh air
    c. to control the entry of the mixture
    d. to force out the produced heat

Section Four: Translation Practice and Terminology Equivalents

A. Translate the following passage into Persian.

The gasoline engine, like the diesel engine, is an internal combustion engine. The thermal energy which is released when the fuel is burned is converted into mechanical energy. The gasoline engine differs from the diesel engine in that the liquid fuel is mixed with air—usually in a device called a carburetor—to form a combustible mixture, which is compressed in the cylinder and finally ignited by an electric spark produced between the electrodes of a spark plug. The gases which are formed in the cylinder by the combustion of the gasoline and air mixture expand and thrust the piston downwards. Acting through the connecting rod, the piston imparts a rotary motion to the crankshaft. The spent burned gases must then be removed from the cylinder and be replaced by fresh gasoline and air mixture, so that a fresh cycle can begin.

B. Determine the Persian equivalents of the following technical terms and write them in the spaces provided.

assemble	corrosion .....
boiler	crankcase .....
camshaft	crankshaft .....
centrifugal force	cycle .....
charge	cylinder block .....
circulation	cylinder head .....
clearance	damp out .....
compression	diesel oil .....
conduction	distributor .....
connecting rod	efficiency .....
contact surface	exhaust valve .....