原淑芳 王福生 主编
徐达山 策划

大学专业英语阅读教程

（机电类）

COLLEGE SPECIALIZED ENGLISH READING

哈尔滨工程大学出版社

大学专业英语阅读教程
（机电类）

原淑芳　　王福生　　主　编
徐达山　　　　　　策　划
马宁慈　　于　航　　副主编
何　畏　　马　欣
李　岩　　徐明义　　主　审

葛丛梅　　付静媛　　编　委
赵龙武　　霍跃民

哈尔滨工程大学出版社

大学专业英语阅读教程(机电类)
原淑芳　王福生　主编
徐达山　　　　　责任编辑
*　*　*
哈尔滨工程大学出版社出版发行
新　华　书　店　经　销
哈尔滨地图出版社印刷厂印刷
*　*　*
开本　850×1168　1/32　印张　9　字数 324 千字
1997 年 4 月第 1 版　　1997 年 4 月第 1 次印刷
印数:1～4000 册
ISBN 7－81007－761－9
H·50　定价:13.00 元

前　言

《大学专业英语阅读系列教程》是一套供高等院校各专业在完成四个学期的基础英语学习之后，第五、六学期使用的教材。根据“高等学校英语教学大纲”的要求，该教材做到基础英语与专业英语的有机衔接。系列教程共分为电、机、理、文、经等五大类。

公外大学生三、四年级的专业外语学习目前处于比较分散的状态，多数院校自编教材，同时教学安排和任课教师也极不统一，有的是外语教师授课，有的是专业教师讲解，各有长处和弱点，难以完整地结合，这样很大程度上影响了教学质量。

教学大纲明确地规定了公外学生的最终目的是借助工具书阅读本专业的文章，把外语做为辅助本门业务的工具。为了更好地贯彻这一精神，培养学生的专业阅读能力，在国家教委高教司有关领导的大力支持下，我们用了近三年的时间，广泛选材，反复审核，编写了这套教程。本书力求既提供专业阅读的需要又体现外语的特点，使学生在校期间能以此为入门向导，为今后熟练阅读打下坚实基础。

电专业英语由哈尔滨理工大学、燕山大学、哈尔滨工程大学、武汉纺织工学院等有丰富经验的外语教师和经贸类专家协同编写而成。全书可供大三年级两学期使用，每周一个单元。课文选材尽量照顾本学科的各个领域，文章均选自有典型性的原文。

每个单元分课文、生词、注解、阅读理解练习、补充阅读、答案、译文等部分。练习题紧紧围绕课文内容而出，便于加深对文章的领会；补充阅读密切配合课文以扩大选材范围。书后答案仅供参考，师生可适当发挥不受拘泥。

本书可为理、工、农、电、机等专业的学生作教材使用，也可供自学进修者使用。

限于编者水平，时间仓促，错误不足之处在所难免，恳请使用者批评指出，以利改正。

编者

1997.4

Contents

TEXT

电专业译文与答案

Unit One

ELECTRIC CHARGE

At one time or another each of us has walked across a rug and then received a shock in touching a doorknob. Our shoes rubbing the rug fibers gave us an *electric charge*, which for convenience we will just call *charge*[1]. In touching the doorknob we lost this charge.

About 200 years ago, scientists began a serious study of electric charges. They did not get the charges for their studies by walking across rugs. There are more convenient ways for getting charges. A glass rod becomes charged when rubbed with silk, as does a hard-rubber rod when rubbed with fur. Using charges gotten in these and other ways, scientists made many discoveries.

They found that charges produce forces of repulsion and attraction. These are usually small forces, though, best observed on light objects such as small balls made of pith. (Pith is the soft, spongy material in the centers of some plant stems.) If two pith balls are hung from thread a few centimeters apart (1 in = 2.54cm, exactly) and touched with a charged glass rod, the balls fly apart and remain apart. The same thing happens when both balls are touched with a charged hard-rubber rod. But when one pith ball is touched with a charged glass rod and the other with a charged rubber rod, the balls move toward each other: they attract one another.

A reasonable explanation for these results is that the charge on the glass rod differs from that on the rubber rod. Scientists called the charge on the glass rod, *positive charge* and that on the rubber rod, *negative charge* — names first used by Benjamin Franklin[2]. Scientists have never found a third type of charge.

From the forces of repulsion and attraction on the pith balls, scientists concluded that negative charges *repel* negative charges, positive charges *repel* positive charges, and negative and positive charges *attract* each other. In short, *like charges repel and unlike charges attract*. French physicist Charles A. Coulomb (1736—

1806) discovered that each force is directly proportional to the product of the charges and inversely proportional to square of the distance between them. This is *Coulomb's law*.

On further study of charges scientists found that all negative charges are integer multiples of a certain very small charge. And with this charge there is a very small particle with a mass of 9.107×10^{-31}kg and a radius of about 2×10^{-13}cm. They called this particle an *electron* and the small basic unit of negative charge simply *the charge of an electron*[3]. Scientists have never found a charge smaller than that of an electron. Scientists also discovered that positive charges are integer multiples of a very small charge, the same amount as an electron—but positive. The *proton* has this charge. A proton has 1836 times the mass of an electron but about the same radius.

Rubbing a glass rod with a silk cloth or a hard-rubber rod with fur does not create charge. In general, charge cannot be created or destroyed, a fact called the *Law of Conservation of Charge*. The movement of electrons produces charges on the glass and rubber rods. Before being rubbed, both rods are *neutral* or uncharged in that they have equal amounts of positive and negative charge. Rubbing the glass rod with a silk cloth removes electrons from the rod and puts them on the cloth. This charge transfer causes a charge unbalance on both the rod and cloth. The loss of electrons by the rod gives it a greater positive charge, and so it becomes positive. The gain of electrons by the silk cloth gives it a greater negative charge, and so it becomes negative. The opposite happens with the rubbing of the rubber rod with fur. The rod gains electrons from the fur to become negative. In losing these electrons the fur becomes positive.

Where do these electrons come from for this charge transfer? The answer is from *atoms*, as we will now consider[4]. To know what an atom is we need to know what an *element* is. There are about 100 elements. Some common ones are hydrogen, oxygen, nitrogen, copper, iron, lead, silver, and gold. Elements or mixtures or chemical combinations of them form all matter: all gases, liquids, and solids.

Air is a mixture of nitrogen, oxygen and some other gases. Water is a chemical combination of hydrogen and oxygen.

If we divide any element into smaller and smaller pieces, eventually we come to a piece so small that we cannot divide it further without destroying the characteristics of the element. This smallest piece is an atom of the element.

What is inside an atom is somewhat of a mystery. From experiments, scientists believe that each atom has a positively charged core called a *nucleus* around which electrons whirl much like planets travel around the sun. Hydrogen has the simplest atom, having a proton for the nucleus and a single electron traveling around it, as shown in Fig. 1. 1 (a). The next simplest atom is that of helium, as shown in Fig. 1. 1 (b). It has two orbiting electrons and a nucleus with two protons and two neutrons. A neutron has about the same mass as a proton but is neutral. A more complex atom has more neutrons and protons in its nucleus and more orbiting electrons. For all undisturbed atoms the number of electrons equals the number of protons, which means that each undisturbed atom is electrically neutral.

The centrifugal force from its rotation keeps each negative electron from being pulled into the nucleus by the positive protons. Centrifugal force is a common force. It is the force that keeps water from falling out of a bucket when the bucket is whirled around at the end of a rope. And it keeps planets from being pulled into the sun by the force of gravity.

No one knows what keeps the protons together in a nucleus against their strong forces of repulsion.

Electrons of an atom have orbits at different distances from the nucleus. For some atoms the electrons in the farthest orbits have only weak forces binding them to the atoms. With a little added energy these outermost electrons in some atoms can separate from the atoms. These separated electrons are "free" electrons, free to move about to produce a current. Each atom that loses an electron has a net positive charge because it has one more proton than electron. An atom with an unbalanced charge is called an *ion*. Ions are charged

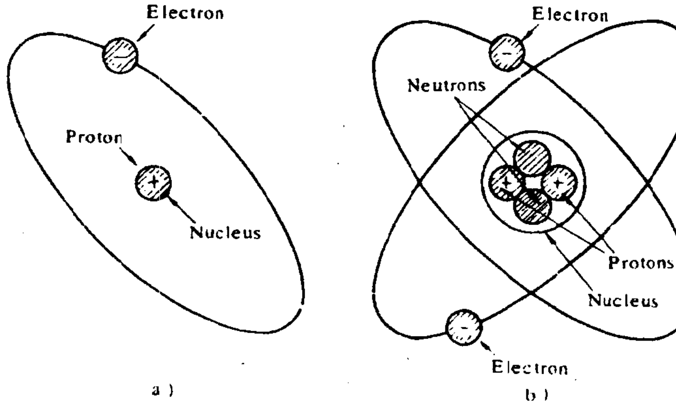


Fig. 1. 1

particles that would produce a current if they could move. But they cannot move in solids because they are a part of the solid structure. Electrons are the only charged particles that can move in solids. But ions, as well as electrons, can move in liquids and gases, which fact is not important to our study of electric circuits.

Now we know where the electrons came from that moved when the glass rod was rubbed with a silk cloth and the rubber rod with fur. The electrons came from atoms in the glass rod and from atoms in the fur. The rubbing supplied enough energy to free these electrons.

In metals the most common way for electrons to become free is from heat energy. Even at normal room temperatures the outer electrons in metals receive enough heat energy to become free, especially for silver, copper, gold, and aluminum[5]. Light energy can also free electrons.

The charge of an electron or of a proton is much too small to be the basic quantity of charge for almost all practical applications. The SI unit of charge is the *coulomb*, with the symbol C. A coulomb of negative charge equals that of 6.242×10^{18} electrons. The coulomb is a *derived* SI unit, which means that it can be derived from SI base units.

The *quantity symbol* for charge is *Q* or *q*. The capital letter *Q* is for constant charge and the lowercase *q* for a charge that changes or varies with time. In general, constant or average electrical quantities have capital-letter quantity symbols. Electrical quantities with different values at different times have lowercase quantity symbols.

Do not confuse quantity symbols with SI unit symbols. Quantity symbols are like a name or a label for an electrical quantity. But an SI unit symbol gives the unit of measurement of the quantity. Also, quantity symbols are not unique: the same quantity symbol may be used for several different electrical quantities. This is true of *Q*, as we shall see. Or, a quantity may have several comon quantity symbols. In contrast, SI unit symbols are unique.

Vocabulary

repulsion n. 排斥（力）
integer n. 整数
multiple n. 倍数
mass n. 〔物〕质量
radius n. 半径 （〔复〕radii）
proton n. 〔物〕质子，〔电〕不带电的
neutral a. 〔化〕中性的
whirl v. 旋转
neutron n. 〔物〕中子
centrifugal a. 离心的
rotation n. 旋转
bucket n. 水桶
ion n. 〔物〕离子
coulomb n. 〔电〕库仑（电量单位）
constant n. 〔物〕常数，恒量
lowercase a. 小写的

at one time to another 常常，时常

in short 简言之
be proportional to 与…成比例
in that 因为，由于

Notes

1. Our shoes … call charge.

   鞋与地毯纤维摩擦使我们带上电荷(electric charge)，方便起见，称之为电荷 (charge)。这一句中动名词短语 our shoes rubbing the rug fibers 做了句子的主语，which 引导的非限定性定语从句修饰 electric charge。
2. Scientists called … by Beijamin Franklin.

   科学家称玻璃棒上的电荷为正电荷，硬橡胶棒上的电荷为负电荷——这些名称首先由本杰明·富兰克林提出。

   句中 that 用作代词代替前面提过的 charge，names first used by Benjamin Franklin 是对前面提到的 positive charge 和 negative charge 的进一步解释。
3. They call … the charge of an electron.

   他们称这种粒子为电子并把负电荷的这种基本单位简称为电子电荷。这是两个并列的带有复合宾语的句子，and 后面省略了 they call。
4. The answer is … consider.

   答案在于原子。下面我们将进行讨论。

   as 引导了一个非限定性定语从句，as 指代前句。
5. Even at normal … and aluminu.

   既使在正常的室温条件下，一些金属，特别是银，铜，金和铝的外层电子也能获得足够的热能而变成自由电子。

   for silver … 中的 for 指对…而言。

Exercises

Choose the best answer according to the passage:

1. Which of the followig statement is true?

   A. About 2 centuries ago, scientists got the charge by walking across rugs.

   B. When a glass rod robbed with a silk cloth, charge created.

C. In general , charge can not be created or destoryed.

D. The neutrons are created from the charge transfer.

2. In the following sentence what does " them" refer to?

" Elements or mixtures or chemical combinations of them form all matter".

A. elements

B. mixtures

C. elements and mixtures

D. chemical combination

3. The author's main purpose in writing the passage is to _____.

A. teach us how to find charge around us

B. give the general readers a general account of charge

C. give people some advice on that charge can't be created or destroyed

D. discuss with scientists how positive and negative charge got

4. In copper wires, _____ would produce a current if they could move.

A. Ions

B. electrons

C. protons

D. neutrons

5. According to the passage, a problem was not solved by scientists, that is " _________?"

A. Why do electrons of an atom whirl around the nucleus

B. Why do electrons of an atom have orbits at different distances from the nucleus

C. Why is the protons kept together in a nucleus

D. Why can heat energy free electrons

Unit Two

THERMAL NOISE OR JOHNSON NOISE

The thermal energy of matter is basically the random vibrational energy of the atoms: the higher the temperature, the more violent the motion and the larger the thermal energy per atom. The famous equipartition theorem of statistical mechanics says that for every mathematical degree of freedom of a physical system in equilibrium at T K or absolute (℃ + 273° = K) there is associated an average energy of $kT/2$, where k = Boltzmann's constant = 1.38×10^{-23} J/K, and T is the absolute temperature in K. Thus a point mass with three degrees of freedom for motion in the x, y, and z directions will on the average have $3\,kT/2$ energy. Examples are free atoms and free electrons. A free electron at room temperature, T = 20℃ = 293 K, will have

$$E = \frac{3}{2}kT = \frac{3}{2}(1.38 \times 10^{-23}\text{J/K})293\text{K} = 6.1 \times 10^{-21}\text{J}$$

However, this is the *average* energy; some electrons will have more, some less. According to classical theory, this random thermal energy will completely die out as the temperature approaches absolute zero[1]. Quantum theory, however, predicts a small residual or *zero-point* vibrational energy even at absolute zero.

Because many of the electrons in a resistance are essentially free and in constant, random, vibrational motion, the voltage difference between the two ends of any resistance will fluctuate randomly. J. B. Johnson, in 1928, showed that the power associated with such fluctuations varied linearly as the bandwidth B_W of the measuring instrument. For example, a sensitive rms power meter with a response from dc to 1000 Hz placed across a resistance might measure 0.01 μW noise power, but a power meter with a response from dc to 2000 Hz would measure 0.02 μW noise power. Johnson also found that the square of the noise voltage varied linearly with the resistance R. Noise power is proportional to the mean-square noise voltage[2], and the expression for the mean-square noise voltage generated by a resistance R at T degrees absolute in a bandwidth B_w is

$$\overline{e_n^2} = 4kTRB_W \qquad (2.1)$$

where k is Boltzmann's constant. The bar over e_n^2 indicates an average. The root-mean-square or rms noise voltage is

$$(\overline{e_n^2})^{1/2} = (4kTRB_W)^{1/2} \qquad (2.2)$$

This noise is commonly referred to as *Johnson noise*, *thermal noise*, or *resistor noise*.

An approximate derivation follows from the equipartition theorem. The random statistical fluctuations of the electrons in the resistor produce a fluctuating difference in the electron density at the two ends of the resistor. This difference in electron density produces a voltage difference between the two ends of the resistor, which, like all circuit elements, has an effective shunt capacitance C, as shown in Fig. 2. 1 (a). The energy associated with the voltage fluctuations is stored in the electric field of the shunt capacitance C. Thus, the energy of the voltage fluctuations is given by $E=CV^2/2$, where V is the instantaneous voltage difference across the capacitor. By the equipartition theory, if the resistor and capacitor are in thermal equilibrium at T K, the average energy stored in the capacitor

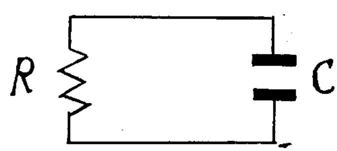
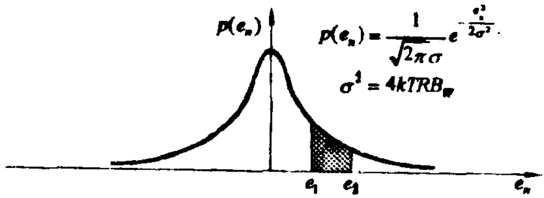


Fig. 2. 1 (a) equivalent circuit for resistance and its inherent shunt capacitance.

must equal $kT/2$. Thus

$$\frac{kT}{2} = \frac{C\overline{V^2}}{2} \text{ or } \overline{V^2} = \frac{kT}{C} \qquad (2.3)$$

where $\overline{V^2}$ is the average-squared noise volatage. The bandwidth B_w



(b) noise uoltage distribution.

Fig. 2. 1 Johnson noise.

of the parallel RC circuit is from dc out to the frequency where the total parallel impedance is 3 dB down from R.

$$B_W = \frac{1}{2\pi RC} \tag{2.4}$$

Solving equation (2. 4) for C and substituting in (2. 3), we obtain an expression for the average - squared noise voltage in terms of R:

$$\overline{V^2} = 2\pi kTRB_W \tag{2.5}$$

which is close to the exact equation, (2. 1).

The noise voltage e_n developed across R can be of either polarity, and its magnitude varies statistically according to a Gaussian distribution[3]:

$$P(e_n) = \frac{1}{\sqrt{2\pi}\sigma} e^{-e_n^2/2\sigma^2} \tag{2.6}$$

where $\sigma^2 = 4kTRB_W$

The expression $P(e_n)\,de_n$ is the probability that the noise voltage is between e_n and $e_n + de_n$. The probability that the noise voltage is between e_{n1} and e_{n2} is $\int_{e_{1n}}^{e_{2n}} P(e_n)\,de_n$, shown as the shaded area in Fig. 2. 1 (b). Notice that small noise voltages are more probable than