外语教学指导与学术研究系列丛书

A New English Collection of Popular Science

新编科普英语

◎ 黄吟 关琳 主编

北京理工大学出版社
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内容简介

《新编科普英语》是一本以英语分门别类介绍科普常识的读本。本书旨在把物理、化学、电子科学、仿生学、医学、天文、地理科学、生物学和生理学等方面较新的、有实际应用效果或与生活常识相关的内容用英语汇编成册，供普及科学知识之用。

本书采用较新科普知识，内容涉及面广，语言规范，有一定实际应用价值。适合各类科学爱好者，大、中学生，教师扩大自然科学知识面以弥补偏科不足。本书主要包含以下内容：科普英语篇章导读；原文科普读物；相关词汇及注释。

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Unit 1 Physics

A. Newton's Second Law

本文介绍了牛顿第二定律的主要内容。牛顿第二定律是经典力学的基础和核心，可以简单地表述为“物体随着时间变化的动量变化率和所受外力之和成正比”。牛顿第二定律清晰地阐释了力的瞬时作用规律，为物理学的研究奠定了基础。

We have made use, in statics, of Newton's first law, which states that when the resultant force on a body is zero, the acceleration of the body is also zero. The next logical step is to ask how a body behaves when the resultant force on it is not zero. The answer to this question is contained in Newton's second law, which states, in part, that when the resultant force is not zero, the body moves with accelerated motion. The acceleration, with a given force, depends on a property of the body known as its mass, and before proceeding with the discussion of the second law, we devote the next section to the concept of mass.

This part of mechanics, which includes both the study of motion and the forces that bring about the motion, is called dynamics. In its broadest sense, dynamics includes nearly the whole of mechanics. Statics treats of special cases in which the acceleration is zero, and kinematics deals with motion only.

The term mass, as used in mechanics, refers to that property of matter which in everyday language is described by the word inertia. We know from experience that an object at rest will never start to move of itself—a push or pull must be exerted on it by some other body. In more technical language, an external force is required to accelerate the body, and we say the force is needed because the body has inertia.

It is also a familiar fact that a force is required to slow down or stop a body which is already in motion, and that a sidewise force must be exerted on a moving body to deviate it from a straight line. In these instances also, we say the force is necessary because the body possesses inertia.

It will be seen that the processes above (i.e., speeding up, slowing down, or changing direction) involve a change in either the magnitude or the direction of the velocity of the body. In other words, in every case the body is accelerated. We may therefore say: inertia is that property of matter because of which a force must be exerted on a body in order to accelerate it.

To assign a numerical value to the inertia of any given body, we choose some body as a standard whose inertia is arbitrarily taken as unity, and state the inertia of all other bodies in terms of this standard. The inertia of a body, when stated in this quantitative way, is called its mass. Mass is a quantitative measure of inertia.

The mass of a body is an invariant property of the body, independent of its velocity, acceleration, position on the earth's surface or height above the earth's surface. In the latter two respects it differs from the weight of the body, which varies with position and elevation.

The standard of mass in both the "mks" and "egs" systems is a platinum-iridium cylinder called the standard kilogram. The original standard is kept in Sevres, France, and one or more accurate duplicates are possessed by most other countries. They are not all identical in mass with the original standard, but this is not of importance, since their masses relative to the standard are accurately known.

The unit of mass in the "mks" system is the mass of the standard kilogram. The unit of mass in the "egs" system is 1/1,000 as great as the mass of the standard kilogram and is called one gram.

There is no mass standard in the English gravitational system of units. That is, government laboratories do not preserve in their vaults a certain piece of matter whose mass is equal to the unit mass. The English system is based on standards of force, length, and time, and the unit of mass is defined in terms of these standards, as will be explained shortly.

The pound of force was defined as the force of the earth's gravitational attraction at sea level and 45° latitude on a specified body called the standard pound. To avoid the unnecessary duplication in maintaining two such standard bodies, the standard kilogram and the standard pound, the latter is now defined in terms of the standard kilogram by the relation that its mass shall equal 0.4536924277 kilograms.

For Newton's second law, the observations described at the beginning of the preceding section point to a connection between force, mass, and acceleration. To obtain the quantitative relation between them, consider the following series of (idealized) experiments.

A block of any arbitrary mass is placed on a level, frictionless surface and accelerates along the surface by a horizontal force exerted on it by a spring balance. For concreteness, suppose the balance has been calibrated in pounds. With the calibrated balance we can exert forces of 1, 2, 3, etc., 1b on the block, and measure with a scale and stop to watch the corresponding accelerations. The results of this series of experiments will show that with a constant mass, the acceleration is directly proportional to the accelerating force and is in the same direction as the force.

For the second series of experiments, we may start with our standard kilogram and prepare a number of duplicates of it, testing them for equality of mass by observing that all accelerate at the same rate when acted on by the same force. Combinations of these will give us masses of 2 kgm, 3 kgm, etc.

Now let us apply in successive experiments the same force (any force will do) to masses of 1 kgm, 2 kgm, 3 kgm, etc., and measure the accelerations. This series of experiments leads to the result that with a constant force, the acceleration is inversely proportional to the mass. The results of both series of experiments may now be expressed by the single relation.

Words

statics	静力学
mass	质量
mechanics	机械学
acceleration	加速
inertia	惯性
gravitational	重力的
duplication	复制，副本
frictionless	光滑的
platinum	白金
iridium	铱
cylinder	气缸

B. Radioactivity and Nuclear Physics

本文介绍放射性物质的特征和原子物理的概况。放射性物质可以产生三种常见射线：阿尔法射线、贝塔射线和伽马射线。这三种射线性质各异，能分别释放出不同数量的电子和中子。

In studying the fluorescence and phosphorescence of compounds irradiated with visible light, Becquerel, in 1896, performed a crucial experiment which led to a deeper understanding of the properties of the nucleus of an atom. After illuminating some pieces of uranium-potassium sulfate with visible light, Becquerel wrapped them in black paper and separated the package from a photographic plate by a piece of silver. After several hours' exposure the photographic plate was developed and showed a blackening due to something that must have been emitted from the compound and was able to penetrate both the black paper and the silver.

Rutherford showed later that the emanations given off by uranium sulfate were capable of ionizing the air in the space between two oppositely charged metallic plates (an ionization chamber). The current registered by a galvanometer in series with the circuit was taken to be a measure of the "activity" of the compound.

A systematic study of the activity of various elements and compounds led Madame Curie to the conclusion that it was an atomic phenomenon and, by the methods of chemical analysis, she and her husband, Pierre Curie, found that "ionizing ability" or "activity" was associated not only with uranium but with two other elements that they discovered, radium and polonium. The activity of radium was found to be more than a million times that of uranium. Since the pioneer days of the Curies, many more radioactive substances have been discovered.

The activity of radioactive material may be easily shown to be the result of three different kinds of emanations. A small piece of radioactive material is placed at the bottom of a long groove in a lead block. Some distance above the lead block a photographic plate is placed, and the whole apparatus is highly evacuated. A strong magnetic field is applied at right angles to the plate of the diagram. After developing the plate, three distinct spots are found, one in the direct line of the groove in the lead block, one deflected to one side, and one to the other side. From the knowledge of the direction of the magnetic field, it is concluded that one of the emanations is positively charged (alpha-particles), one is negatively (beta-particles), and one is neutral (gamma-rays).

Further investigation showed that all three emanations are not emitted simultaneously by all radioactive substances. Some elements emit alpha-particles, others emit beta-particles, while gamma-rays sometimes accompany one and sometimes the other. Furthermore, no simple macroscopic physical or chemical process, such as raising or lowering the temperature, chemical combination with other nonradioactive substances, etc., could change or affect in any way the activity of a given sample. As a result, it was suspected from the beginning that radioactivity is a nuclear process and that the emission of a charged particle from the nucleus of an atom results in leaving behind a different atom, occupying a different place in the periodic table. In other words, radioactivity involves the transmutation of elements.

In the preceding section it was shown that alpha-particles are positively charged. To determine the magnitude of the charge, experiments were first performed to determine the number of alpha-particles emitted per second per unit mass of radioactive material. This was accomplished with the aid of a device called "Geiger counter," one of the most important instruments of modern physics.

Geiger counter consists of a metal cylinder and a wire along the axis. The cylinder contains a gas such as air or argon at a pressure of from 50 to 100 mm of mercury. A difference of potential slightly less than that necessary to produce a discharge is maintained between the wire and the cylinder wall. Alpha-particles (or, for that matter, any particles to be studied) can enter through a thin glass or mica window. The particle entering the counter produces ionization of the gas molecules. These ions are accelerated by the electric field and produce more ions by collisions, causing the ionization current to build up rapidly. The current, however, decays rapidly since the circuit has a small time constant. There is therefore a momentary surge of current or a momentary potential surge which may be amplified and made to actuate a relay to advance a mechanical counter, or to produce a click in a loudspeaker.

Placing a known mass of radium a known distance from the window of a Geiger counter, Rutherford and Geiger counted the number of alpha-particles emitted in a known time interval. They found that 3.57×1010 alpha-particles were emitted per second per gram of radium. They then allowed the alpha-particles from the same source to fall upon a plate and measured its rate of increase of charge. Dividing the rate of increase of charge by the number emitted per second, Rutherford and Geiger determined the charge on an alpha-particle to be 3.19×10-19 coulomb, or practically twice the charge on an electron, but opposite in sign.

The next problem was to determine the mass of an alpha-particle. This was accomplished by measuring first the ratio of charge to mass by the electric and magnetic deflection method. The ratio was found by Rutherford and Robinson to be 4.82×107 coulombs per kilogram. Combining this result with the charge of an alpha-particle, the mass was found to be 6.62×10-27 kgm, almost exactly four times the mass of a hydrogen atom.

Since a helium atom has a mass four times that of a hydrogen atom and, stripped of its two outer electrons (as a bare nucleus) has a charge equal in magnitude and opposite in sign to two electrons, it seemed certain that alpha-particles were helium nuclei. To make the identification certain, however, Rutherford and Royds collected the alpha-particles in a glass discharge tube over a period of about six days and then established an electric discharge in the tube. Examining the spectrum of the emitted light, they identified the characteristic helium spectrum and established without doubt that alpha-particles are helium nuclei.

The speed of an alpha-particle emitted from a given radioactive source such as radium may be measured by observing the radius of the circle traversed by the particle in a magnetic field perpendicular to the motion. The results of such experiments show that alpha-particles are emitted with very high speeds, of the order of 1.6×107 m/sec or about 10,000 miles/sec.

Beta-particles are negatively charged and are therefore deflected in an electric or magnetic field. Deflection experiments similar to those described in prov conclusively that beta-particles have the same charge and mass as electrons. They are emitted from the nuclei of radioactive atoms with tremendous speeds, some reaching a value of 0.9995 that of light.

Unlike alpha-particles, which are emitted from a given nucleus with one or a few definite velocities, beta-particles are emitted with a continuous range of velocities, from zero up to a maximum which depends on the nature of the emitting nucleus. If the principles of conservation of energy and of momentum are to hold in nuclear processes, it is necessary to assume that the emission of a beta-particle