

科学分类手册
FACTS ON FILE SCIENCE LIBRARY

物理 PHYSICS

戴尔格兰姆专业小组 著
张国辉 译

光明日报出版社

FACTS ON FILE SCIENCE LIBRARY



在美国
连续再版四次

……对高中生和大学生大有裨益

……美国书讯

科学分类手册丛书

随着科技的发展,现在要想直接地、迅速地得到基础性科学和物理学问题的解答,对学生和教师而言,正变得越来越困难。因此,他们会欢迎美国 Facts On File 出版社的《科学分类手册·物理》一书。《科学分类手册》系列涵盖了如下学科:物理、生物、化学、地球科学、海洋科学、空间与天文学、天气与气候、代数、微积分和几何,是一套不可多得的、按照系统学科分类的英汉双语词典丛书。

美国 Facts On File 出版社出版的《科学分类手册·物理》包含以下几个部分:

■**术语** 全书共有 1400 多个词条,许多条目还附有简图,以帮助解释术语的含义。主题包括:加速度、沸点、催化剂、数据通讯、电解、 γ 辐射、透镜、微波、相对原子质量、热传导以及 X 射线等。

■**人物** 介绍了从古至今的 300 多位物理学家,他们的发现促进了人类对物理学的认识与理解。这些科学家包括:A.G.贝尔、A.H.康普顿、皮埃尔·居里、C.多普勒、阿尔伯特·爱因斯坦、欧几里得、G.D.华伦海特、H.W.盖革、S.霍金、毕达哥拉斯、E.瓦尔顿和 R.耶洛等。

■**大事记** 跨越了近 9000 多年的物理学发展史,包含了有关物理学的重大发现和重要事件:古希腊哲学家恩培多克勒希提出物质的四元素(火、气、水、土)理论(公元前 440 年);算盘作为辅助计算工具在欧洲使用(公元 500 年);英国数学家 W.奥特雷德引入“ \times ”符号表示乘法(1631 年);德国物理学家 E.戈德斯坦发现阴极射线(1876 年)等。

由美国 Facts On File 出版社出版的本套丛书都附有便捷的索引,这将方便学生和教师快速查证。本书把物理学置于科学的大背景之下,突出了所有学科之间的紧密联系,更可以比较、融会各学科领域中的信息。

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THE FACTS ON FILE
PHYSICS
HANDBOOK

THE DIAGRAM GROUP



Facts On File, Inc.

SECTION ONE

GLOSSARY

- A(r)** The symbol for relative atomic mass.
- ab-** An abbreviation for “absolute” and a prefix applied to practical electrical units, such as volt (abvolt), ampere (abampere), or coulomb (abcoulomb), to convert them to units in the absolute electromagnetic system of units.
- aberration** A defect in the image produced by a lens or mirror caused when rays do not converge accurately to the focus. It is technically difficult to produce a lens or mirror without aberration. *See also* chromatic aberration, spherical aberration.
- absolute code** Computer program code in a form that can be used directly by the central processing unit. More commonly known as machine code.
- absolute zero** The lowest possible temperature. Zero on the Kelvin scale or -273°C (-460°F). Absolute zero is unattainable, but temperatures within one millionth of a degree have been reached. At temperatures approaching absolute zero matter exhibits some unexpected properties. Electrical conductors become superconducting and some fluids lose their viscosity (superfluidity). In the Kelvin scale, which has no negative figures, the symbol for degrees is not used after the number. So the freezing point of water is 273K, not 273°K .
- absorbed dose** (of ionizing radiation) The energy absorbed in body tissue by ionizing radiation; unit of measurement, the gray (joule per gram).
- absorption** (1) The assimilation of radiation into a body with its partial or complete conversion into another form of energy (such as heat, light, sound, etc.).
 (2) The way in which certain wavelengths in a beam of radiation are removed when passing through a substance. The resulting spectrum of radiation can be used in spectroscopy to analyze the substance.
 (3) The process by which one material, e.g., water, is taken up by another, e.g., a sponge.
- absorption factor** Energy absorbed by a body depends on the nature of its surface. Shiny, light-colored surfaces absorb less than dark, matte surfaces.
- absorption spectrum** The spectrum that forms when radiation with a range of wavelengths passes through a sample. Some wavelengths are absorbed by the sample, leaving gaps in the spectrum.
- AC** Abbreviation for alternating current.

acceleration A measure of how the velocity of a body changes with time. It occurs if there is a change in the body's speed or direction of motion; a force is required to effect such a change. A falling body whose motion is solely governed by the downward force of gravity is said to be in free fall. The body moves with constant acceleration. In SI units, acceleration is expressed in meters per second per second. It can be calculated by subtracting the final velocity from the initial velocity and dividing the result by the time. Acceleration is a vector quantity. If velocity is plotted against time on a graph, the acceleration at any moment is given by the slope of the graph at that moment.

acceptors Atoms of an element such as boron added to a silicon lattice to affect the conducting properties of semiconductors. The acceptor atoms create holes in the valence band to carry current; this is a p-type (positive carrier) semiconductor.

access time The time taken to retrieve a small item of data from any form of storage in, or connected to, a computer. Access time from RAM may be a very small fraction of a second; from a large magnetic tape store it may be several minutes. Floppy disk drives have longer access times than hard disks, and most CD-ROM drives also have longer access times than hard disks.

accommodation The adjustment of the focus of the eye so that, whatever the range of gaze, a sharp image is formed on the retina. Accommodation is achieved by the internal crystalline lens, which in young people is naturally so elastic that it would tend to approximate to a sphere but for the pull all around its equator by delicate ligaments that suspend it from a circular muscle. When this muscle contracts, the circle becomes smaller and the pull on the lens is less, thus making it a more powerful converger of light and allowing focusing of the image from near objects. When the ciliary muscle relaxes, more distant objects can be focused. The stimulus for accommodation is the degree of convergence of the rays of light, which can be detected by the variations in depth to which the rays penetrate the light-sensitive cells of the retina.

accumulator (1) An electric battery in which the passage of an electric current from an external source brings about a reversible chemical change by which energy is stored. When the electrodes are joined, a current flows and the previous chemical state is restored.
(2) In computing, an accumulator is a small memory or buffer that briefly holds the results of successive operations by the arithmetic and logic unit of the central processing unit.

AC electric motor An electric motor that operates from an alternating electric current supply.

achromatic lens A lens that is free from chromatic aberration. An achromatic lens is constructed from two types of glass, each having a different refractive index, so that the dispersions cancel each other. This form of double lens has the effect of reducing the dispersion of light of different wavelengths, producing a sharper focus with greatly reduced color fringes around the edges of the image.

acoustic coupler An early form of modem that can be temporarily attached to a normal telephone. The digital signal to be transmitted is converted into a two-tone sound that is emitted by a small loudspeaker pressed to the telephone microphone. The received signal is picked up by a microphone held close to the telephone earpiece. The system allows modem communication from any location where there is a telephone, but the speed of transmission is low. Acoustic couplers are now seldom used.

actinic radiation Radiation, especially light and ultraviolet radiation, that can cause a chemical change, such as the latent image on a photographic emulsion or the breakdown of biological or other molecules. The Sun is a major source of actinic electromagnetic radiation.

actinium series A series of radioactive elements each of which derives from the radioactive decay of its predecessor and ends in a stable atom. The actinium series starts with uranium-235 and ends in an isotope of lead. Two other such series occur naturally, one starting with uranium-238 (uranium series) and the other with thorium-232 (thorium series), both also ending with an isotope of lead.

action at a distance Forces such as gravity and magnetism can affect objects not in direct contact with the force. The space through which the forces operate is called a field. For example, a gravitational field is a region in which there are gravitational forces.

activation energy The energy barrier to be overcome in order for a reaction to occur. Many chemical reactions require heat energy to be applied to reactants in order to initiate a reaction.

active device A component in an electronic circuit that consumes power to effect a change, such as amplification or current switching. Transistors are active devices; resistors, capacitors, and inductors are passive devices that do not consume power.

- activity** (of a radioactive source) The number of ionizing particles emitted per second from a radioactive source, measured in becquerels.
- activity series** A listing of elements where the position of an element shows how reactive it is. Its position is governed by the ease with which the element releases electrons.
- addition reaction** An addition reaction occurs when at least two molecules react together to form a single molecule (e.g., the polymerization of alkenes).
- address** A known location in a computer memory at which a single item of data, usually a byte, can be found. The address is simply a number that identifies the location. A computer instruction might be to take the number held in a particular address, multiply it by the number in another address, and put the answer in a third address. An address bus is a set of wires along which signals travel to reach addresses. Data can then be taken from these addresses by way of a data bus.
- adiabatic change** A change that occurs without thermal transfer to a system. When a change of volume is made very quickly, without allowing any transfer of thermal energy, the change in volume is an adiabatic change. Adiabatic work is work done on a system that does not gain or lose heat to the surroundings.
- admittance** The reciprocal of impedance.
- adsorption** The process by which molecules of gases, liquids, or finely divided solids become attached to the surface of another substance to form a very thin layer, often only one molecule thick. Adsorption involves interaction between molecules at a surface. Powdered activated charcoal is a highly effective adsorbent and will remove color from liquids, poisons from liquids in the intestines, and poisonous gases from air passed through it. In adsorption, the absorbed substance is taken up by the absorbing substance and distributed throughout it, in the manner of blotting paper drawing up water by capillary action.
- aeration** The purification of a substance by exposure to the mechanical or chemical action of air.
- aerial** The part of a radio or television system that transmits or receives radio waves. *See* antenna.
- aerodynamics** The study of the dynamic motion of gases, particularly the branch of science studying the motion and control of bodies in air.

- affinity** The attraction of two substances for each other, leading to the substances combining together.
- algol** A high-level computer programming language designed primarily for producing problem-solving programs for mathematical and scientific use. The name is an abbreviation of the phrase "algorithmic language." Algol passed through several generations, introduced a number of important new concepts, and was highly influential in the development of programming languages.
- algorithm** A sequence of instructions to be followed with the intention of finding a solution to a problem. Each step must specify precisely what action is to be taken and, although there may be many alternative routes through the algorithm, there is only one starting point and one end point. Various nodes occur at which decisions must be made and these are decided by questions that can be answered "yes." or "no." The direction taken at these nodes is determined by the answer. A computer program commonly involves algorithms, and the preliminary studies for a program are often expressed in a particular set of symbols known as a flow chart. This is also an algorithm.
- allotrope** An element that can exist in different physical forms while in the same state. Carbon can occur as two common allotropes, diamond and graphite. (A third, buckminsterfullerene, has been discovered recently.) The physical properties of these allotropes are very different.
- alloy** A metallic material made of two or more metals or of a metal and nonmetal. By mixing metals in certain proportions, alloys with specific properties can be made.
- alphanumeric characters** The 26 letters of the alphabet and the decimal digits 0 to 9. Each of these, and many other characters, are represented in computers by a code such as the ASCII code.
- alpha particle** (α particle) A particle released during radioactive decay. It consists of two neutrons and two protons and is the equivalent of the nucleus of a helium atom. Energy is released by this change, most of it accounted for by the kinetic energy of the alpha particle, which moves away at high speed but which rapidly loses energy by collision and ionization of other atoms and molecules and is easily stopped by a piece of paper. Their range in air is only a few centimeters and shielding against them is easy. Alpha rays are streams of fast-moving alpha particles.

alternating current (AC) A continuous electric current that varies in strength, regularly reversing its direction.

amines A group of organic compounds containing the amino functional group -NH_2 .

amino acid A group of organic compounds containing both the carboxyl group (-COOH) and the amino group (-NH_2).

amorphous Lacking form, shape, or crystal structure; amorphous substances have no fixed melting point.

ampere SI unit of electrical current, equal to one coulomb per second.

amphoteric Exhibiting properties of both an acid and a base. An amphoteric compound reacts with both acids and bases to form salts.

amplifier An electronic device for increasing the strength of a varying electrical signal, ideally with minimal alteration to its characteristics (minimal distortion). Amplifiers use low-power transistors to amplify voltage and power transistors to amplify current. Many amplifiers now consist of integrated circuits except for the power output stages. Negative feedback is used to reduce distortion and increase the frequency range over which the amplifier will work well.

amplitude The size of the maximum displacement from the equilibrium position of an oscillation or wave. For an alternating current, the amplitude is the peak value of the current. For a pendulum, the amplitude is half the length of the swing.

amplitude modulation Used in radio transmissions in the long, medium, and short wavebands. A second wave motion is added to a carrier wave to carry the signal to a receiver. The characteristics of this audio-frequency signal vary the amplitude of the carrier wave.

analog In physical science, a continuous representation, of any kind, of a varying quantity. Thus, the movement of the needle of an electric meter over the scale as the current varies is an analog representation of changing voltage. *Compare* digital.

analog to digital converter An electronic device that converts a varying signal, especially a voltage, to a series of numbers. This is done by sampling the signal repeatedly at short intervals, usually many times a second, and expressing each momentary magnitude as a number that can be represented in the form of binary digits. Since almost all information processing is now done by digital computers and almost

all information derived from natural sources is analog, the importance of analog to digital conversion can be appreciated.

anechoic chamber An irregularly shaped room in which the walls are covered with small cones or wedges of sound-absorbent material so as to avoid the formation of stationary waves and hence echoes and resonances. Anechoic chambers are acoustically “dead” and are used to test various instruments, such as microphones, and to conduct research into noise and other acoustical phenomena.

anemometer An instrument for measuring windspeed.

angle A measure of the space between two straight lines diverging from a common point of contact.

angle of declination The angle made by a compass needle with the direction of the geographic North Pole, giving a measure of the difference between the geographic and magnetic poles.

angle of deviation The angle between the incident ray and the refracted ray when a light ray passes from one medium to another.

angle of dip The angle made by a suspended magnetic needle to the horizon.

angstrom A very small unit of length equal to one tenth of a nanometer, or one hundred millionth of a centimeter. The angstrom is used to represent the wavelength of radiation at the short wavelength (high frequency) end of the electromagnetic spectrum. It was named after the Swedish physicist Anders Ångström. The angstrom has now been largely replaced by the nanometer.

angular acceleration A measure of how the angular velocity of a spinning body changes with time. The rate of change of angular velocity.

angular magnification The ratio of the angle formed at the eye by the final image to that formed at the eye by the object. This is also known as the magnifying power of the system. Linear magnification, on the other hand, is the ratio of the height of the image to that of the object.

angular momentum The angular velocity of an object multiplied by its moment of inertia (i.e., in the case of a simple rotating wheel, multiplied by its mass multiplied by the square of the distance from its axis of rotation). It is the product of rotational inertia and angular velocity.

angular velocity The rate at which a rotating body moves through an angle about an axis. Speed of motion in a circle, or, more precisely, the rate of change of angular displacement with time.

anhydrous Containing no water, a term applied to salts without water of crystallization.

anion An ion having negative charge.

anode The electrode carrying the positive charge in a solution undergoing electrolysis. A positive electrode toward which negative particles, such as electrons or negative ions, are attracted. Negative ions are called anions. In an electric cell or battery, the anode is the electrode that attracts electrons to itself from the external circuit.

ANSI Abbreviation for American National Standards Institute, a body that lays down various standards for computers, computer connections, connecting pin positions, disk and tape drives, software, and so on. Many ANSI standards are observed worldwide, and many personal computers have in their operating system directory an ANSI.SYS file that can be read by the machine at the time of switching on.

antenna or **aerial** An electrical conductor, taking a variety of forms, from which radio signals are transmitted or by which they are received. Antennas may consist of long wires suspended high above the ground, dipoles with twin arms insulated from each other, or short ferrite rods incorporated in small transistor receivers. Often their dimensions are calculated to resonate with the principal wavelength or waveband of interest. They may have reflectors behind them and directors in front of them and may have to be accurately aligned. Antennas for microwaves often consist of a parabolic reflector with the actual antenna set at the focus of the parabola. The gain of an aerial is the degree to which its performance matches that of an approved standard. Transmitting antennas correspond dimensionally to effective receiving antennas but have to handle power and may have thicker conductors.

antimatter Each subatomic particle has its antiparticle, its properties being equal and opposite to those of the particle. Antiparticles make up antimatter. Examples of antiparticles are antineutrons, antiprotons, antineutrinos, and positrons (the antiparticles of electrons). When an antiparticle meets its corresponding particle, both are annihilated and the corresponding energy released as photons of radiant energy. Some antiparticles have been produced by particle accelerator/collider experiments and some are put to practical use, as in the

positron emission tomography (PET) scanner. The theoretical grounds for the existence of antimatter were presented by the English physicist Paul Dirac in 1928 as a prediction of relativistic quantum mechanics.

antineutrinos *See* antimatter.

antinode In a standing (stationary) wave it is the point of maximum displacement (either positive or negative).

anti-phase Two waves with the same wavelength and frequency are in anti-phase if their phase difference is half a wave.

antiprotons *See* antimatter.

aperture The useful or effective diameter of a lens or curved mirror. In practical usage, especially in photography, the term is taken to mean the ratio of the focal length of the lens or mirror to its effective diameter. The numerical value of this ratio is known as the f-number of a lens or mirror. Thus a camera zoom lens set at a focal length of 50 mm and an effective diameter (aperture) of 25 mm would have an f-number of 2. Set at 100 mm the same aperture would give an f-number of 4 and only half the exposure for a given shutter speed.

applications software Programs that carry out specific functions, such as word processing, spreadsheet operations, database access, computer-assisted design, accountancy, and so on. Applications software is distinguished from computer operating systems.

Archimedes' principle The weight of liquid displaced by a body that is totally or partially immersed in the liquid is equal to the apparent loss of weight of the body.

architectural acoustics The study of the features of buildings and auditoriums that allow music and speech to be heard clearly and comfortably. Good hall acoustics imply the absence of undue echoes or of the emphasis of any particular pitches by resonances. Large, plane, unbroken surfaces reflect sound, and simple dimensions promote resonances. Good acoustics also imply that the reverberation time (the time taken for audible re-echoing to drop to an acceptable level) should be appropriate for the main purpose of the hall. Long reverberation times cause indistinct speech and blurred music; unduly short reverberation times produce a "dead" effect. Bare rooms with hard surfaces increase reverberation times; carpets, soft furnishing, and the presence of an audience reduce reverberation.

archiving The movement of a computer file from a position of immediate access, as on a hard disk, to one of less immediate access, as on a remote tape drive or on a remotely stored disk. Archiving may be performed deliberately by the operator or may occur automatically, after a designated period, as part of a programmed process. Archiving is not the same as backing up.

area A measure of the extent of a surface.

armature (1) Part of an electric machine, such as a bell, that vibrates when a magnetic field is applied.
(2) The moving soft-iron core structure around which wire is coiled in an electric motor.

association A term used in Boolean algebra.

astable circuit An electronic circuit that can be in one of two states, neither of which is permanently stable. Often used as an oscillator. An astable usually consists of two interconnected transistors, one turned on, the other turned off. Each of the pair alternately oscillates between the on and off state and, in so doing, switches the other to change its state. An astable circuit produces a square wave or pulse output and, if synchronized to an accurate frequency by a quartz crystal or other means, can operate as a timing clock for computers or other devices. Quartz watches and clocks use crystal-controlled astables to generate a high-frequency square wave, which is then repeatedly frequency-divided by bistables until a one-second square wave is reached.

astigmatism A property of a lens or mirror system in which a surface is not that of a perfect sphere or parabola, but has a greater degree of curvature in one meridian than in the meridian at right angles to that one. Such a toric surface produces two foci – one for rays in the plane parallel to that of greatest curvature and one for rays in the plane at right angles. Only one of these sets of rays can be focused at one time. The cornea of the eye is commonly astigmatic, usually being most steeply curved from top to bottom and least steeply curved from side to side. Ocular astigmatism is corrected by spectacles having cylindrical lenses set at the appropriate axis so that the steeper corneal curve is matched by the less steep spectacle lens curve.

astrophysics The study of the physics and chemistry of the stars, including their origin, evolution, and structure and the generation and movement of energy in and around them. Astrophysics is also concerned with the relationships and dynamics of star clusters and