



牛津英语百科分类词典系列

Oxford

DICTIONARY OF

SCIENCE

牛津科学词典



上海外语教育出版社
SHANGHAI FOREIGN LANGUAGE EDUCATION PRESS



图书在版编目(CIP)数据

牛津科学词典: 英文 / (英) 艾萨克 (Isaacs, A.) 编.

—上海: 上海外语教育出版社, 2000

(牛津英语百科分类词典系列)

书名原文: Oxford Concise Colour Science Dictionary

ISBN 7-81080-005-1

I. 牛… II. 艾… III. 科学技术-词典-英文 IV. N61

中国版本图书馆CIP数据核字(2000)第74401号

图字: 09-1999-311号

出版发行: **上海外语教育出版社**

(上海外国语大学内) 邮编: 200083

电 话: 021-65425300 (总机), 65422031 (发行部)

电子邮箱: bookinfo@sflep.com.cn

网 址: <http://www.sflep.com.cn> <http://www.sflep.com>

责任编辑: 钱明丹

印 刷: 上海古籍印刷厂

经 销: 新华书店上海发行所

开 本: 850×1092 1/32 印张 25.125 字数 1400 千字

次: 2000年12月第1版 2001年8月第2次印刷

印 数: 3 200 册

书 号: ISBN 7-81080-005-1 / H · 005

定 价: 31.50 元

本版图书如有印装质量问题, 可向本社调换

*Oxford University Press, Great Clarendon Street, Oxford OX2 6DP
Oxford New York*

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*This colour edition, first published 1997 as an Oxford University Press
paperback, uses the text of the third edition of the Concise Science Dictionary*

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*British Library Cataloguing in Publication Data
Data available*

*Library of Congress Cataloging in Publication Data
Data available
ISBN 0-19-280069-8(pbk)*

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出版说明

随着改革开放的不断深入以及国际交流的日趋广泛,外语学习已经不仅仅局限于语言技能的培养。通过英语获取专业知识、提高专业水平、跟踪学科的最新发展已经成为时代的要求。因此,目前国内急需一批用英语编纂的专业词典。

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该系列词典可作为大专院校各专业的学生以及专业技术人员学习专业知识、提高专业英语能力的参考书。

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Preface

The new edition of the *Concise Science Dictionary* aims to provide school and first-year university students with explanations of unfamiliar words they might come across in the course of their studies, in their own or adjacent disciplines. For example, chemistry students will find all they are likely to need to know about the life sciences, and vice versa. The dictionary will also provide a handy reference source for non-scientists who require accurate definitions of the scientific terms they are likely to encounter in their work or general reading.

At this level the dictionary provides full coverage of terms and concepts relating to physics, chemistry, biology, biochemistry, palaeontology, and the earth sciences. There is also coverage of key terms in astronomy, mathematics, and computer technology. For this new edition 1000 terms have been added, particularly in the fields of nuclear and particle physics, cosmology, low-temperature physics, nanotechnology, supramolecular and fullerene chemistry, laboratory techniques, environmental science, human biology, genetics, biotechnology, molecular biology, ecology, and immunology.

In compiling the dictionary, the contributors and editors have made every effort to make the entries as concise and comprehensible as possible, always bearing in mind the needs of the readers. Particular features of the book are its lack of unnecessary scientific jargon and its extensive network of cross-references. An asterisk placed before a word used in an entry indicates that this word can be looked up in the dictionary and will provide further explanation or clarification. However, not every word that appears in the dictionary has an asterisk placed before it. Some entries simply refer the reader to another entry, indicating either that they are synonyms or abbreviations or that they are most conveniently explained in one of the dictionary's longer articles. Synonyms and abbreviations are usually placed within brackets immediately after the headword. Terms that are explained within an entry are highlighted by being printed in italic type.

Where appropriate, the entries have been supplemented by fully labelled line-drawings or tables *in situ*. In addition, the Appendices at the end of the book include the periodic table, a table of elements, tables of SI units and conversion tables to and from other systems of units, and summary classifications of the plant and animal kingdoms.

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Oxford Dictionary of
Science

Oxford New York
OXFORD UNIVERSITY PRESS
1997

A

AAS See **atomic absorption spectroscopy**.

ab- A prefix attached to the name of a practical electrical unit to provide a name for a unit in the *electromagnetic system of units, e.g. abampere, abcoulomb, abvolt. The prefix is an abbreviation of the word 'absolute' as this system is also known as the *absolute system*. Compare *stat-*. In modern practice both absolute and electrostatic units have been replaced by *SI units.

abdomen The posterior region of the body trunk of animals. In vertebrates it contains the stomach and intestines and the organs of excretion and reproduction. It is particularly well defined in mammals, being separated from the *thorax by the *diaphragm. In many arthropods, such as insects and spiders, it may be segmented.

Abelian group See **group**.

aberration 1. (*in optics*) A defect in the image formed by a lens or curved mirror. In *chromatic aberration* the image formed by a lens (but not a mirror) has coloured fringes as a result of the different extent to which light of different colours is refracted by glass. It is corrected by using an *achromatic lens. In *spherical aberration*, the rays from the object come to a focus in slightly different positions as a result of the

curvature of the lens or mirror. For a mirror receiving light strictly parallel with its axis, this can be corrected by using a parabolic surface rather than a spherical surface. Spherical aberration in lenses is minimized by making both surfaces contribute equally to the ray deviations, and can (though with reduced image brightness) be reduced by the use of diaphragms to let light pass only through the centre part of the lens. See also *astigmatism*; *coma*. 2. (*in astronomy*) The apparent displacement in the position of a star as a result of the earth's motion round the sun. Light appears to come from a point that is slightly displaced in the direction of the earth's motion. The angular displacement $\alpha = v/c$, where v is the earth's orbital velocity and c is the speed of light.

abiogenesis The origin of living from nonliving matter, as by *biopoiesis. See also *spontaneous generation*.

abiotic factor Any of the nonliving factors that make up the *abiotic environment* in which living organisms occur. They include all the aspects of climate, geology, and atmosphere that may affect the biotic environment. Compare **biotic factor**.

abomasum One of four chambers that form the stomach of ruminants. The abomasum is referred to as the 'true

Group	Antigens on red cell surface	Antibodies in serum	Blood group of people donor can receive blood from	Blood group of people donor can give blood to
A	A	anti-B	A, O	A, AB
B	B	anti-A	B, O	B, AB
AB	A and B	none	A, B, AB, O	AB
O	neither A nor B	anti-A and anti-B	O	A, B, AB, O

The ABO blood group system

stomach' as it is in this chamber that protein digestion occurs, in acidic conditions. *See Ruminantia.*

ABO system One of the most important human *blood group systems. The system is based on the presence or absence of *antigens A and B on the surface of red blood cells and *antibodies against these in blood serum. A person whose blood contains either or both these antibodies cannot receive a transfusion of blood containing the corresponding antigens as this would cause the red cells to clump (*see agglutination*). The table illustrates the basis of the system: people of blood group O are described as 'universal donors' as they can give blood to those of any of the other groups. *See also immune response.*

abscisic acid A naturally occurring plant *growth substance that promotes leaf ageing, leaf fall (*see abscission*), and *apical dominance and induces *dormancy in seeds and buds.

abscissa *See Cartesian coordinates.*

abscission The separation of a leaf, fruit, or other part from the body of a plant. The process is controlled by growth substances, notably *abscisic acid; it involves the formation of an *abscission zone*, at the base of the part, within which a layer of cells (*abscission layer*) breaks down.

absolute **1.** Not dependent on or relative to anything else, e.g. *absolute zero. **2.** Denoting a temperature measured on an *absolute scale*, a scale of temperature based on absolute zero. The usual absolute scale now is that of thermodynamic *temperature; its unit, the kelvin, was formerly called the degree absolute (°A) and is the same size as the degree Celsius. In British engineering practice an absolute scale with Fahrenheit-size degrees has been used: this is the Rankine scale.

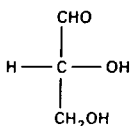
absolute alcohol *See ethanol.*

absolute configuration A way of denoting the absolute structure of an optical isomer (*see optical activity*). Two conventions are in use: The D-L convention relates the structure of the

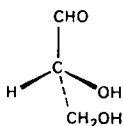
molecule to some reference molecule. In the case of sugars and similar compounds, the dextrorotatory form of glyceraldehyde ($\text{HOCH}_2\text{CH}(\text{OH})\text{CHO}$), 2,3-dihydroxypropanal) was used. The rule is as follows. Write the structure of this molecule down with the asymmetric carbon in the centre, the -CHO group at the top, the -OH on the right, the $-\text{CH}_2\text{OH}$ at the bottom, and the -H on the left. Now imagine that the central carbon atom is at the centre of a tetrahedron with the four groups at the corners and that the -H and -OH come out of the paper and the -CHO and $-\text{CH}_2\text{OH}$ groups go into the paper. The resulting three-dimensional structure was taken to be that of *D*-glyceraldehyde and called *D*-glyceraldehyde. Any compound that contains an asymmetric carbon atom having this configuration belongs to the *D*-series. One having the opposite configuration belongs to the *L*-series. It is important to note that the prefixes *D*- and *L*- do not stand for dextrorotatory and laevorotatory (they are not the same as *d*- and *l*-). In fact the arbitrary configuration assigned to *D*-glyceraldehyde is now known to be the correct one for the dextrorotatory form, although this was not known at the time. However, all *D*-compounds are not dextrorotatory. For instance, the acid obtained by oxidizing the -CHO group of glyceraldehyde is glyceric acid (1,2-dihydroxypropanoic acid). By convention, this belongs to the *D*-series, but it is in fact laevorotatory; i.e. its name can be written as *D*-glyceric acid or *l*-glyceric acid. To avoid confusion it is better to use + (for dextrorotatory) and - (for laevorotatory), as in *D*(+)-glyceraldehyde and *D*(-)-glyceric acid.

The *D*-*L* convention can also be used with alpha amino acids (compounds with the $-\text{NH}_2$ group on the same carbon as the $-\text{COOH}$ group). In this case the molecule is imagined as being viewed along the H-C bond between the hydrogen and the asymmetric carbon atom. If the clockwise order of the other three groups is $-\text{COOH}$, -R, $-\text{NH}_2$, the amino acid belongs to the *D*-series; otherwise it belongs to the *L*-series. This is known as the *CORN rule*.

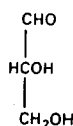
The *R*-*S* convention is a convention based on priority of groups attached to



planar formula

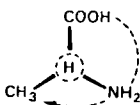
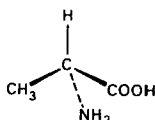


structure in 3 dimensions

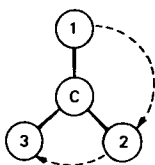


Fischer projection

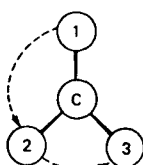
D - (+) - glyceraldehyde (2,3-dihydroxypropanal)



D - alanine (R is CH_3 in the CORN rule). The molecule is viewed with H on top



R - configuration



S - configuration

R-S system. The lowest priority group is behind the chiral carbon atom

the chiral carbon atom. The order of priority is I, Br, Cl, SO_3H , OCOCH_3 , OCH_3 , OH, NO_2 , NH_2 , COOCH_3 , CONH_2 , COCH_3 , CHO, CH_2OH , C_6H_5 , C_2H_5 , CH_3 , H, with hydrogen lowest. The molecule is viewed with the group of lowest priority behind the chiral atom. If the clockwise arrangement of the other three groups is in descending priority, the compound belongs to the R-series; if the descending order is anticlockwise it is in the S-series. D-(+)-glyceraldehyde is R-(+)-glyceraldehyde. See illustration.

absolute expansivity See *expansivity*.

absolute humidity See *humidity*.

absolute permittivity See *permittivity*.

absolute pitch (perfect pitch) The ability of a person to identify and reproduce a note without reference to a tuned musical instrument.

absolute temperature See *absolute; temperature*.

absolute value (modulus) The square root of the sum of the squares of the real numbers in a *complex number, i.e. the absolute value of the complex number $z = x + iy$ is $|z| = \sqrt{x^2 + y^2}$.

absolute zero Zero of thermodynamic *temperature (0 kelvin) and the lowest temperature theoretically attainable. It is the temperature at which the kinetic energy of atoms and molecules is minimal. It is equivalent to -273.15°C or -459.67°F . See also *zero-point energy*; *cryogenics*.

absorbance Symbol α . The ratio of the radiant or luminous flux absorbed by a body to the flux falling on it. Formerly called *absorptivity*, the absorbance of a *black body is by definition 1.

absorption 1. (in chemistry) The take up of a gas by a solid or liquid, or the

take up of a liquid by a solid. Absorption differs from *adsorption in that the absorbed substance permeates the bulk of the absorbing substance. **2. (in physics)** The conversion of the energy of electromagnetic radiation, sound, streams of particles, etc., into other forms of energy on passing through a medium. A beam of light, for instance, passing through a medium, may lose intensity because of two effects: *scattering of light out of the beam, and absorption of photons by atoms or molecules in the medium. When a photon is absorbed, there is a transition to an excited state.

3. (in biology) The movement of fluid or a dissolved substance across a cell membrane. In animals, for example, soluble food material is absorbed into the circulatory system through cells lining the alimentary canal. In plants, water and mineral salts are absorbed from the soil by the *roots. See **osmosis**.

absorption coefficient **1. (in physics)** See **Lambert's laws**. **2. (in chemistry)** The volume of a given gas, measured at standard temperature and pressure, that will dissolve in unit volume of a given liquid.

absorption indicator See **adsorption indicator**.

absorption spectrum See **spectrum**.

absorptivity See **absorbance**.

ABS plastic Any of a class of plastics based on acrylonitrile-butadiene-styrene copolymers.

abundance **1.** The ratio of the total mass of a specified element in the earth's crust to the total mass of the earth's crust, often expressed as a percentage. For example, the abundance of aluminium in the earth's crust is about 8%. **2.** The ratio of the number of atoms of a particular isotope of an element to the total number of atoms of all the isotopes present, often expressed as a percentage. For example, the abundance of uranium-235 in natural uranium is 0.71%. This is the *natural abundance*, i.e. the abundance as found in nature before any enrichment has taken place.

abyssal zone The lower depths of the ocean (below approximately 2000 metres),

where there is effectively no light penetration. Abyssal organisms are adapted for living under high pressures in cold dark conditions.

a.c. See **alternating current**.

acceleration Symbol *a*. The rate of increase of speed or velocity. It is measured in m s^{-2} . For a body moving linearly with constant acceleration *a* from a speed *u* to a speed *v*,

$$a = (v - u)/t = (v^2 - u^2)/2s$$

where *t* is the time taken and *s* the distance covered.

If the acceleration is not constant it is given by $\text{d}v/\text{d}t = \text{d}^2s/\text{d}t^2$. If the motion is not linear the vector character of displacement, velocity, and acceleration must be considered.

acceleration of free fall Symbol *g*. The acceleration experienced by any massive object falling freely in the earth's gravitational field. Experimentally this is almost constant for all positions near the earth's surface, independent of the nature of the falling body (provided air resistance is eliminated). This is taken to indicate the strict proportionality of *weight (the force causing the acceleration) and *inertial mass, on the basis of *Newton's second law of motion. There is some variation of *g* with latitude, because of the earth's rotation and because the earth is not completely spherical. The standard value is taken as 9.80665 m s^{-2} . The acceleration of free fall is also called the *acceleration due to gravity*.

accelerator **1. (in physics)** An apparatus for increasing the kinetic energies of charged particles, used for research in nuclear and particle physics. See **cyclotron**; **linear accelerator**; **synchrocyclotron**; **synchrotron**. **2. (in chemistry)** A substance that increases the rate of a chemical reaction, i.e. a catalyst.

acceptor **1. (in chemistry and biochemistry)** A compound, molecule, ion, etc., to which electrons are donated in the formation of a coordinate bond. **2. (in physics)** A substance that is added as an impurity to a *semiconductor because of its ability to accept electrons from the valence bands, causing *p*-type

conduction by the mobile positive holes left. *Compare* donor.

acceptor levels Energy levels of an acceptor atom in a *semiconductor, such as aluminium, in silicon. These energy levels are very near the top of the valence band, and therefore cause p-type conduction. *See also* energy bands.

acclimatization 1. The progressive adaptation of an organism to any change in the environment that subjects it to physiological stress. 2. The overall sum of processes by which an organism attempts to compensate for conditions that would substantially reduce the amount of oxygen delivered to its cells.

accommodation 1. (*in animal physiology*) Focusing: the process by which the focal length of the *lens of the eye is changed so that clear images of objects at a range of distances are displayed on the retina. In man and some other mammals accommodation is achieved by reflex adjustments in the shape of the lens brought about by relaxation and contraction of muscles within the *ciliary body. 2. (*in botany*) The ability of a plant to adapt itself to gradually changing environmental conditions. 3. (*in animal behaviour*) Adjustments made by an animal's nervous or sensory systems in response to continuously changing environmental conditions.

accretion disc A disc-shaped rotating mass formed by gravitational attraction. *See* black hole; neutron star; white dwarf.

accumulator (secondary cell; storage battery) A type of *voltaic cell or battery that can be recharged by passing a current through it from an external d.c. supply. The charging current, which is passed in the opposite direction to that in which the cell supplies current, reverses the chemical reactions in the cell. The common types are the *lead-acid accumulator and the *nickel-iron and nickel-cadmium accumulators. *See also* sodium-sulphur cell.

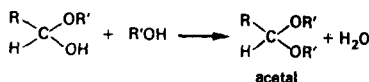
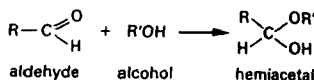
acellular Describing tissues or organisms that are not made up of separate cells but often have more than

one nucleus (*see* syncytium). Examples of acellular structures are muscle fibres. *Compare* unicellular.

acentric Describing an aberrant chromosome fragment that lacks a centromere. Such fragments are normally lost because they are unable to orientate properly during cell division.

acetaldehyde *See* ethanal.

acetal *See* aldol reaction.



Formation of acetals

acetals Organic compounds formed by addition of alcohol molecules to aldehyde molecules. If one molecule of aldehyde (RCHO) reacts with one molecule of alcohol (R'OH) a hemiacetal is formed (RCH(OH)OR'). The rings of aldose sugars are hemiacetals. Further reaction with a second alcohol molecule produces a full acetal (RCH(OR')₂). The formation of acetals is reversible; acetals can be hydrolysed back to aldehydes in acidic solutions. In synthetic organic chemistry aldehyde groups are often converted into acetal groups to protect them before performing other reactions on different groups in the molecule. *See also* ketals.

acetamide *See* ethanamide.

acetanilide A white crystalline primary amide of ethanoic acid, CH₃CONHC₆H₅; r.d. 1.2; m.p. 114.3°C; b.p. 304°C. It is made by reacting phenylamine (aniline) with excess ethanoic acid or ethanoic anhydride and is used in the manufacture of dyestuffs and rubber. The full systematic name is *N*-phenylethanamide.

acetate *See* ethanoate.

acetic acid *See* ethanoic acid.

acetoacetic acid *See* 3-oxobutanoic acid.

acetoacetic ester See ethyl 3-oxobutanoate.

acetone See propanone; ketone body.

acetylation See acylation.

acetyl chloride See ethanoyl chloride.

acetylcholine (ACh) A substance that is released at some (*cholinergic*) nerve endings (see *neurotransmitter*). Its function is to pass on a nerve **impulse* to the next nerve (i.e. at a **synapse*) or to initiate muscular contraction. Once acetylcholine has been released it has only a transitory effect because it is rapidly broken down by the enzyme **cholinesterase*.

acetylcholinesterase See cholinesterase.

acetyl coenzyme A (acetyl CoA) A compound formed in the mitochondria when an acetyl group ($\text{CH}_3\text{CO}-$), derived from the breakdown of fats, proteins, or carbohydrates (via **glycolysis*), combines with the thiol group ($-\text{SH}$) of **coenzyme A*. Acetyl CoA feeds into the energy generating **Kreb's cycle* and also plays a role in the synthesis and oxidation of fatty acids.

acetylene See ethyne.

acetylenes See alkynes.

acetyl group See ethanoyl group.

acetylide See carbide.

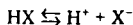
achene A dry indehiscent fruit formed from a single carpel and containing a single seed. An example is the feathery achene of *clematis*. Variants of the achene include the **caryopsis*, **cypsela*, **nut*, and **samara*. See also *etaerio*.

Acheson process An industrial process for the manufacture of graphite by heating coke mixed with clay. The reaction involves the production of silicon carbide, which loses silicon at 4150°C to leave graphite. The process was patented in 1896 by the US inventor Edward Goodrich Acheson (1856–1931).

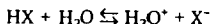
achromatic lens A lens that corrects for chromatic **aberration* by using a combination of two lenses, made of different kinds of glass, such that their **dispersions* neutralize each other although their **refractions* do not. The

aberration can be reduced further by using an *apochromatic lens*, which consists of three or more different kinds of glass.

acid 1. A type of compound that contains hydrogen and dissociates in water to produce positive hydrogen ions. The reaction, for an acid HX , is commonly written:

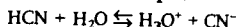


In fact, the hydrogen ion (the proton) is solvated, and the complete reaction is:

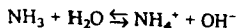


The ion H_3O^+ is the *oxonium ion* (or *hydroxonium ion* or *hydronium ion*). This definition of acids comes from the *Arrhenius theory*. Such acids tend to be corrosive substances with a sharp taste, which turn litmus red and give colour changes with other **indicators*. They are referred to as *protonic acids* and are classified into *strong acids*, which are almost completely dissociated in water (e.g. sulphuric acid and hydrochloric acid), and *weak acids*, which are only partially dissociated (e.g. ethanoic acid and hydrogen sulphide). The strength of an acid depends on the extent to which it dissociates, and is measured by its **dissociation constant*. See also *base*.

2. In the *Lowry–Brønsted theory* of acids and bases (1923), the definition was extended to one in which an acid is a proton donor, and a base is a proton acceptor. For example, in

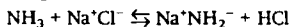


the HCN is an acid, in that it donates a proton to H_2O . The H_2O is acting as a base in accepting a proton. Similarly, in the reverse reaction H_3O^+ is an acid and CN^- a base. In such reactions, two species related by loss or gain of a proton are said to be *conjugate*. Thus, in the reaction above HCN is the *conjugate acid* of the base CN^- , and CN^- is the *conjugate base* of the acid HCN . Similarly, H_3O^+ is the conjugate acid of the base H_2O . An equilibrium, such as that above, is a competition for protons between an acid and its conjugate base. A strong acid has a weak conjugate base, and vice versa. Under this definition water can act as both acid and base. Thus in



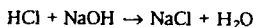
the H_2O is the conjugate acid of OH^- . The

definition also extends the idea of acid-base reaction to solvents other than water. For instance, liquid ammonia, like water, has a high dielectric constant and is a good ionizing solvent. Equilibria of the type

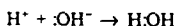


can be studied, in which NH_3 and HCl are acids and NH_2^- and Cl^- are their conjugate bases.

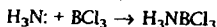
3. A further extension of the idea of acids and bases was made in the *Lewis theory* (G. N. Lewis, 1923). In this, a *Lewis acid* is a compound or atom that can accept a pair of electrons and a *Lewis base* is one that can donate an electron pair. This definition encompasses 'traditional' acid-base reactions. In



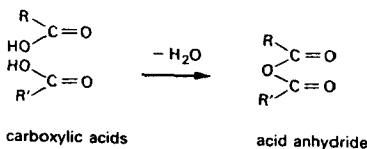
the reaction is essentially



i.e. donation of an electron pair by OH^- . But it also includes reactions that do not involve ions, e.g.



in which NH_3 is the base (donor) and BCl_3 the acid (acceptor). The Lewis theory establishes a relationship between acid-base reactions and *oxidation-reduction reactions.



Formation of a carboxylic acid anhydride

acid anhydrides (acyl anhydrides)

Compounds that react with water to form an acid. For example, carbon dioxide reacts with water to give carbonic acid:



A particular group of acid anhydrides are anhydrides of carboxylic acids. They have a general formula of the type $\text{R}:\text{CO}:\text{O}:\text{CO}:\text{R}'$, where R and R' are alkyl or aryl groups. For example, the compound ethanoic anhydride ($\text{CH}_3\text{CO}:\text{O}:\text{CO}:\text{CH}_3$) is the acid anhydride of ethanoic (acetic) acid. Organic acid anhydrides can be

produced by dehydrating acids (or mixtures of acids). They are usually made by reacting an acyl halide with the sodium salt of the acid. They react readily with water, alcohols, phenols, and amines and are used in *acylation reactions.

acid-base balance The regulation of the concentrations of acids and bases in blood and other body fluids so that the *pH remains within a physiologically acceptable range. This is achieved by the presence of natural *buffer systems, such as the haemoglobin, bicarbonate ions, and carbonic acid in mammalian blood. By acting in conjunction, these effectively mop up excess acids and bases and therefore prevent any large shifts in blood pH. The acid-base balance is also influenced by the selective removal of certain ions by the kidneys and the rate of removal of carbon dioxide from the lungs.

acid-base indicator See indicator.

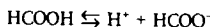
acid dissociation constant See dissociation.

acid dye See dye.

acid halides See acyl halides.

acidic 1. Describing a compound that is an acid. 2. Describing a solution that has an excess of hydrogen ions. 3. Describing a compound that forms an acid when dissolved in water. Carbon dioxide, for example, is an acidic oxide.

acidic hydrogen (acid hydrogen) A hydrogen atom in an *acid that forms a positive ion when the acid dissociates. For instance, in methanoic acid



the hydrogen atom on the carboxylate group is the acidic hydrogen (the one bound directly to the carbon atom does not dissociate).

acidic stains See staining.

acidimetry Volumetric analysis using standard solutions of acids to determine the amount of base present.

acidity constant See dissociation.

acid rain Precipitation having a pH value of less than about 5.0, which has adverse effects on the fauna and flora on

which it falls. Rainwater typically has a pH value of 5.6, due to the presence of dissolved carbon dioxide (forming carbonic acid). Acid rain results from the emission into the atmosphere of various pollutant gases, in particular sulphur dioxide and various oxides of nitrogen, which originate from the burning of fossil fuels and from car exhaust fumes, respectively. These gases dissolve in atmospheric water to form sulphuric and nitric acids in rain, snow, or hail (*wet deposition*). Alternatively, the pollutants are deposited as gases or minute particles (*dry deposition*). Both types of acid deposition affect plant growth – by damaging the leaves and impairing photosynthesis and by increasing the acidity of the soil, which results in the leaching of essential nutrients. This acid pollution of the soil also leads to acidification of water draining from the soil into lakes and rivers, which become unable to support fish life. Lichens are particularly sensitive to changes in pH and can be used as indicators of acid pollution (*see indicator species*).

acid salt A salt of a polybasic acid (i.e. an acid having two or more acidic hydrogens) in which not all the hydrogen atoms have been replaced by positive ions. For example, the dibasic acid carbonic acid (H_2CO_3) forms acid salts (hydrogencarbonates) containing the ion HCO_3^- . Some salts of monobasic acids are also known as acid salts. For instance, the compound potassium hydrogendifluoride, KHF_2 , contains the ion $[\text{F} \cdots \text{H} - \text{F}]^-$, in which there is hydrogen bonding between the fluoride ion F^- and a hydrogen fluoride molecule.

acid value A measure of the amount of free acid present in a fat, equal to the number of milligrams of potassium hydroxide needed to neutralize this acid. Fresh fats contain glycerides of fatty acids and very little free acid, but the glycerides decompose slowly with time and the acid value increases.

acinus The smallest unit of a multilobular gland, such as the pancreas. Each acinus in the pancreas is made up of a hollow cluster of *acinar cells*, which produce the digestive enzymes secreted in pancreatic juice. Minute ducts from

the pancreatic acini eventually drain into the pancreatic duct.

acoustics 1. The study of sound and sound waves. 2. The characteristics of a building, especially an auditorium, with regard to its ability to enable speech and music to be heard clearly within it. For this purpose there should be no obtrusive echoes or resonances and the reverberation time should be near the optimum for the hall. Echoes are reduced by avoiding sweeping curved surfaces that could focus the sound and by breaking up large plane surfaces or covering them with sound-absorbing materials. Resonance is avoided by avoiding simple ratios for the main dimensions of the room, so that no one wavelength of sound is a factor of more than one of them. If the reverberation time is too long, speech will sound indistinct and music will be badly articulated, with one note persisting during the next. However, if it is too short, music sounds dead. It is long in a bare room with hard walls, and can be deliberately reduced by carpets, soft furnishings and sound-absorbent ('acoustic') felt. Reverberation times tend to be reduced by the presence of an audience and this must be taken into account in the design of the building.

acoustoelectronic devices (*electroacoustic devices*) Devices in which electronic signals are converted into acoustic waves. Acoustoelectronic devices are used in constructing 'delay lines' and also in converting digital data from computers for transmission by telephone lines.

acquired characteristics Features that are developed during the lifetime of an individual, e.g. the enlarged arm muscles of a tennis player. Such characteristics are not genetically controlled and cannot be passed on to the next generation. *See also* Lamarckism; neo-Lamarckism.

acquired immune deficiency syndrome *See* AIDS.

Acrilan A trade name for a synthetic fibre. *See* acrylic resins.

acrolein *See* propenal.

acromegaly A chronic condition developing in adulthood due to overproduction of (or oversensitivity to) *growth hormone, usually caused by a tumour in the pituitary gland. This leads to a gradual enlargement of the bones, causing characteristic coarsening of the facial features and large hands and feet.

acrosome See spermatozoon.

acrylate See propenoate.

acrylic acid See propenoic acid.

acrylic resins Synthetic resins made by polymerizing esters or other derivatives of acrylic acid (propenoic acid). Examples are poly(propenenitrile) (e.g. *Acrilan*), and poly(methyl 2-methylpropenoate) (polymethyl methacrylate, e.g. *Perspex*).

acrylonitrile See propenenitrile.

ACTH (adrenocorticotrophic hormone, corticotrophin) A hormone produced by the anterior *pituitary gland in response to stress that controls secretion of certain hormones (the *corticosteroids) by the adrenal glands. It can be administered by injection to treat such disorders as rheumatic diseases and asthma, but it only relieves symptoms and is not a cure.

actin A contractile protein found in muscle tissue, in which it occurs in the form of filaments (called thin filaments). Each thin filament consists of two chains of actin molecules, around which is twisted a strand of *tropomyosin and interspersed *troponin. Units of muscle fibre (see *sarcomere*) consist of actin and *myosin filaments, which interact to bring about muscle contraction. Actin is also found in the microfilaments that form part of the *cytoskeleton of all cells.

actinic radiation Electromagnetic radiation that is capable of initiating a chemical reaction. The term is used especially of ultraviolet radiation and also to denote radiation that will affect a photographic emulsion.

actinides See actinoids.

actinium Symbol Ac. A silvery radioactive metallic element belonging to group 3 (formerly IIIA) of the periodic table; a.n. 89; mass number of most

stable isotope 227 (half-life 21.7 years); m.p. $1050 \pm 50^\circ\text{C}$; b.p. 3200°C (estimated). Actinium-227 occurs in natural uranium to an extent of about 0.715%. Actinium-228 (half-life 6.13 hours) also occurs in nature. There are 22 other artificial isotopes, all radioactive and all with very short half-lives. Its chemistry is similar to that of lanthanum. Its main use is as a source of alpha particles. The element was discovered by A. Debierne in 1899.

actinium series See radioactive series.

Actinobacteria (Actinomycetes; Actinomycota) A phylum of Gram-positive mostly anaerobic nonmotile bacteria. All species are fungus-like, with filamentous cells producing reproductive spores on aerial branches similar to the spores of certain moulds. The phylum includes bacteria of the genera *Actinomyces*, some species of which cause disease in animals and man; and *Streptomyces*, which are a source of many important antibiotics (including streptomycin).

actinoid contraction A smooth decrease in atomic or ionic radius with increasing proton number found in the *actinoids.

actinoids (actinides) A series of elements in the *periodic table, generally considered to range in atomic number from thorium (90) to lawrencium (103) inclusive. The actinoids all have two outer *s*-electrons (a $7s^2$ configuration), follow actinium, and are classified together by the fact that increasing proton number corresponds to filling of the *5f* level. In fact, because the *5f* and *6d* levels are close in energy the filling of the *5f* orbitals is not smooth. The outer electron configurations are as follows:

- 89 actinium (Ac) $6d^1 7s^2$
- 90 thorium (Th) $6d^2 7s^2$
- 91 protactinium (Pa) $5f^2 6d^1 7s^2$
- 92 uranium (U) $5f^3 6d^1 7s^2$
- 93 neptunium (Np) $5f^4 7s^2$ (or $5f^3 6d^1 7s^2$)
- 94 plutonium (Pu) $5f^6 7s^2$
- 95 americium (Am) $5f^7 7s^2$
- 96 curium (Cm) $5f^7 6d^1 s^2$
- 97 berkelium (Bk) $5f^9 6d^1 s^2$ (or $5f^{10} 7s^2$)
- 98 californium (Cf) $5f^{10} 7s^2$
- 99 einsteinium (Es) $5f^{11} 7s^2$

100 fermium (Fm) $5f^{12}7s^2$
 101 mendelevium (Md) $5f^{13}7s^2$
 102 nobelium (Nb) $5f^{14}7s^2$
 103 lawrencium (Lw) $5f^{14}6d^1s^2$

The first four members (Ac to Ur) occur naturally. All are radioactive and this makes investigation difficult because of self-heating, short lifetimes, safety precautions, etc. Like the *lanthanoids, the actinoids show a smooth decrease in atomic and ionic radius with increasing proton number. The lighter members of the series (up to americium) have *f*-electrons that can participate in bonding, unlike the lanthanoids. Consequently, these elements resemble the transition metals in forming coordination complexes and displaying variable valency. As a result of increased nuclear charge, the heavier members (curium to lawrencium) tend not to use their inner *f*-electrons in forming bonds and resemble the lanthanoids in forming compounds containing the M^{3+} ion. The reason for this is pulling of these inner electrons towards the centre of the atom by the increased nuclear charge. Note that actinium itself does not have a 5*f* electron, but it is usually classified with the actinoids because of its chemical similarities. See also **transition elements**.

actinometer Any of various instruments for measuring the intensity of electromagnetic radiation. Recent actinometers use the *photoelectric effect but earlier instruments depended either on the fluorescence produced by the radiation on a screen or on the amount of chemical change induced in some suitable substance.

actinomorphism See **radial symmetry**.

Actinomycetes See **Actinobacteria**.

action at a distance The direct interaction between bodies that are not in physical contact with each other. The concept involves the assumption that the interactions are instantaneous. This assumption is not consistent with the special theory of *relativity, which states that nothing (including interactions) can travel through space faster than the *speed of light in a vacuum. For this reason it is more logical to describe interactions between bodies by *field theories or by the exchange of *virtual

particles rather than theories based on action at a distance.

action potential The change in electrical potential that occurs across a cell membrane during the passage of a nerve *impulse. As an impulse travels in a wavelike manner along the *axon of a nerve, it causes a localized and transient switch in electric potential across the cell membrane from -60 mV (millivolts; the *resting potential) to +45 mV. The change in electric potential is caused by an influx of sodium ions. Nervous stimulation of a muscle fibre has a similar effect.

action spectrum A graphical plot of the efficiency of electromagnetic radiation in producing a photochemical reaction against the wavelength of the radiation used. For example, the action spectrum for photosynthesis using light shows a peak in the region 670–700 nm. This corresponds to a maximum absorption in the absorption *spectrum of chlorophylls in this region.

activated adsorption Adsorption that involves an activation energy. This occurs in certain cases of *chemisorption.

activated alumina See **aluminium hydroxide**.

activated charcoal See **charcoal**.

activated complex The association of atoms of highest energy formed in the *transition state of a chemical reaction.

activation analysis An analytical technique that can be used to detect most elements when present in a sample in milligram quantities (or less). In *neutron activation analysis* the sample is exposed to a flux of thermal neutrons in a nuclear reactor. Some of these neutrons are captured by nuclides in the sample to form nuclides of the same atomic number but a higher mass number. These newly formed nuclides emit gamma radiation, which can be used to identify the element present by means of a gamma-ray spectrometer. Activation analysis has also been employed using charged particles, such as protons or alpha particles.

activation energy Symbol E_a . The minimum energy required for a