Fizika I. félév

BUDAPESTI CORVINUS EGYETEM

SI mértékegységrendszer

Le Système international d'unités

The International System of Units

SI


BIPM
METPΩ XPΩ

Base quantities and dimensions used in the SI

Base quantity	Symbol for quantity	Symbol for dimension
length	l, x, r, etc.	L
mass	m	M
time, duration	t	T
electric current	I, i	I
thermodynamic temperature	T	Θ
amount of substance	n	N
luminous intensity	I_v	J

$$\dim Q = \mathsf{L}^{\alpha}\,\mathsf{M}^{\beta}\,\mathsf{T}^{\gamma}\,\mathsf{I}^{\delta}\,\Theta^{\varepsilon}\,\mathsf{N}^{\zeta}\,\mathsf{J}^{\eta}$$

Alapmennyiségek

Klasszikus meghatározások

The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.

Definition of the metre by the international Prototype (CR, 49)*

The unit of length is the metre, defined by the distance, **at 0°,** between the axes of the two central lines marked on the bar of platinum-iridium kept at the Bureau International des Poids et Mesures and declared Prototype of the metre by the 1st Conférence Générale des Poids et Mesures, this bar being subject to standard atmospheric pressure and supported on two cylinders of at least **one centimetre** diameter, symmetrically placed in the same horizontal plane at a distance of **571 mm** from each other.

The metre is the length equal to 1 650 763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels 2p10 and 5d5 of the krypton 86 atom.

The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.

Alapmennyiségek

The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.

a fény sebessége *c*= 299 792 458 m/s

a métert a fény sebessége alapján definiálják (2011 október)

XXIV. Általános Súly- és Mértékügyi Konferencia

(a XXV. konferencia 2014 novemberében lesz)

Alapmennyiségek

The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.

a Planck-állandó h = 6,62606×10^{-34} J s

a kilogrammot a Planck-állandó alapján (2011 október)

Alapmennyiségek

Klasszikus meghatározások

“The second is the fraction 1/31 556 925.9747 of the tropical year for 1900 January 0 at 12 hours ephemeris time.”

Ez az időpont polgári időszámítás szerint 1900 január 1-jén 0 óra volt

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.

The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.

Alapmennyiségek

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.

a cézium-133 által kibocsátott fény frekvenciája v = 9 192 631 770 Hz

a másodpercet a cézium-133 sugárzása alapján definiálták (2011 október)

Alapmennyiségek

Klasszikus meghatározások

The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.

az elemi töltés nagysága $e = 1{,}60217 \times 10^{-19}$ C

az ampert az elemi töltés értéke alapján határozzák meg (2011 október)

Alapmennyiségek

Klasszikus meghatározások

The kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water

This definition refers to water having the isotopic composition defined exactly by the following amount of substance ratios:
0.000 155 76 mole of ^{2}H per mole of ^{1}H,
0.000 379 9 mole of ^{17}O per mole of ^{16}O and
0.002 005 2 mole of ^{18}O per mole of ^{16}O.

A mólarányról van szó, tehát pl. ^{2}H per mól ^{1}H

$$t/℃ = T/K - 273.15.$$

In consequence the *Comité Consultatif de Thermométrie et Calorimétrie* (CCTC) considers that the zero of the centesimal thermodynamic scale must be defined as the temperature **0.0100 degree** below that of the triple point of water.

Alapmennyiségek

The kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water

a Boltzman-állandó $k = 1{,}3806\times10^{-23}$ J/K

a kelvint a Boltzman-állandó alapján határozzák meg (2011 október)

Alapmennyiségek

Klasszikus meghatározások

1. The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12; its symbol is “mol”.
2. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

In this definition, it is understood that unbound atoms of carbon 12, at rest and in their ground state, are referred to.

The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 × 10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

Alapmennyiségek

1. The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12; its symbol is “mol”.
2. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

az Avogadro állandó N_A = 6,02214×1023 mol^{-1}

a mól mértékegységet az Avogadro állandó alapján (2011 október)

Alapmennyiségek

The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

a fényhasznosítás értéke K_{cd} = 683 lm/W

a kandelát a fényhasznosítás maximális értéke alapján határozzák meg (2011 október)

Alapegységek

Table 1. SI base units

Base quantity		SI base unit	
Name	Symbol	Name	Symbol
length	*l*, *x*, *r*, etc.	metre	m
mass	*m*	kilogram	kg
time, duration	*t*	second	s
electric current	*I*, *i*	ampere	A
thermodynamic temperature	*T*	kelvin	K
amount of substance	*n*	mole	mol
luminous intensity	I_v	candela	cd

Table 2. Examples of coherent derived units in the SI expressed in terms of base units

Derived quantity		SI coherent derived unit	
Name	Symbol	Name	Symbol
area	A	square metre	m^2
volume	V	cubic metre	m^3
speed, velocity	v	metre per second	m/s
acceleration	a	metre per second squared	m/s^2
wavenumber	σ, $\tilde{\nu}$	reciprocal metre	m^{-1}
density, mass density	ρ	kilogram per cubic metre	kg/m^3
surface density	ρ_A	kilogram per square metre	kg/m^2
specific volume	v	cubic metre per kilogram	m^3/kg
current density	j	ampere per square metre	A/m^2
magnetic field strength	H	ampere per metre	A/m
amount concentration [(a)], concentration	c	mole per cubic metre	mol/m^3
mass concentration	ρ, γ	kilogram per cubic metre	kg/m^3
luminance	L_v	candela per square metre	cd/m^2
refractive index [(b)]	n	one	1
relative permeability [(b)]	μ_r	one	1

(*a*) In the field of clinical chemistry this quantity is also called substance concentration.

(*b*) These are dimensionless quantities, or quantities of dimension one, and the symbol "1" for the unit (the number "one") is generally omitted in specifying the values of dimensionless quantities.

Units for dimensionless quantities, also called quantities of dimension one

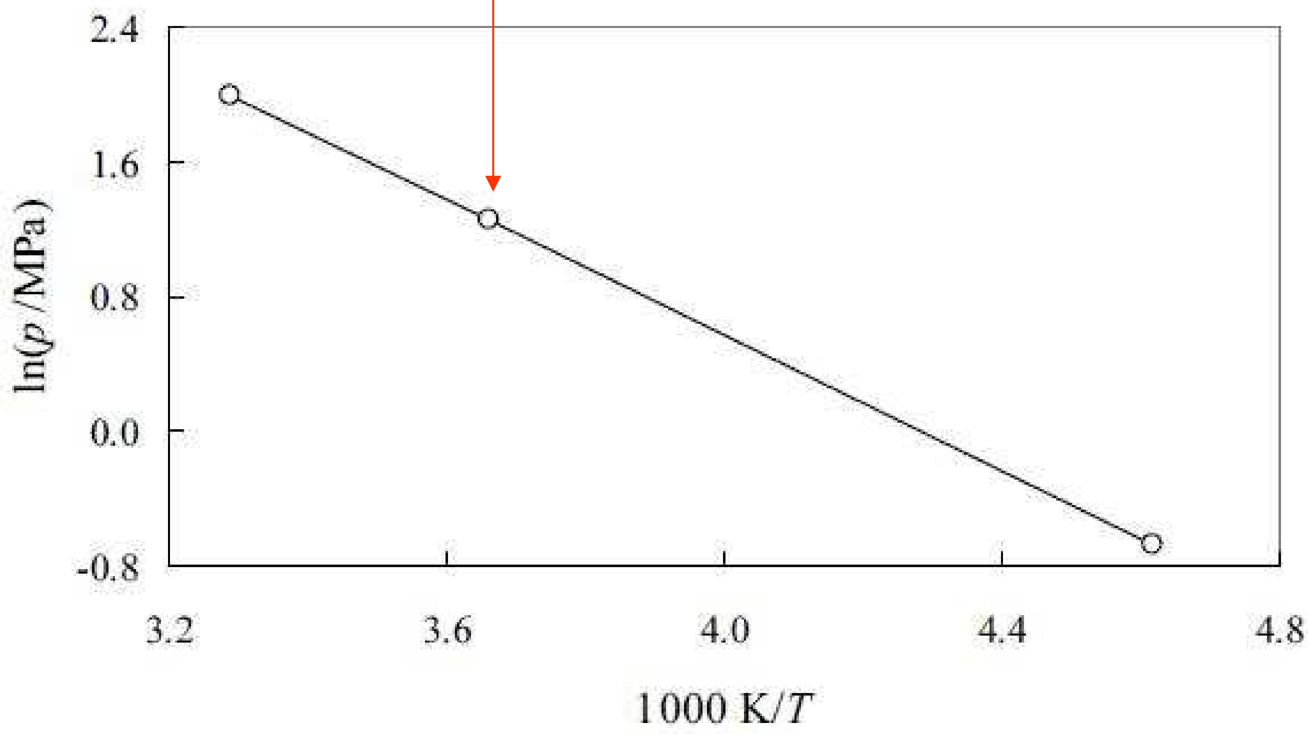
Certain quantities are defined as the ratio of two quantities of the same kind, and are thus dimensionless, or have a dimension that may be expressed by the number one. The coherent SI unit of all such dimensionless quantities, or quantities of dimension one, is the number one, since the unit must be the ratio of two identical SI units. The values of all such quantities are simply expressed as numbers, and the unit one is not explicitly shown. Examples of such quantities are refractive index, relative permeability, and friction factor. There are also some quantities that are defined as a more complex product of simpler quantities in such a way that the product is dimensionless. Examples include the "characteristic numbers" like the Reynolds number $Re = \rho \upsilon l/\eta$, where ρ is mass density, η is dynamic viscosity, υ is speed, and l is length. For all these cases the unit may be considered as the number one, which is a dimensionless derived unit.

Another class of dimensionless quantities are numbers that represent a count, such as a number of molecules, degeneracy (number of energy levels), and partition function in statistical thermodynamics (number of thermally accessible states). All of these counting quantities are also described as being dimensionless, or of dimension one, and are taken to have the SI unit one, although the unit of counting quantities cannot be described as a derived unit expressed in terms of the base units of the SI. For such quantities, the unit one may instead be regarded as a further base unit.

In a few cases, however, a special name is given to the unit one, in order to facilitate the identification of the quantity involved. This is the case for the radian and the steradian. The radian and steradian have been identified by the CGPM as special names for the coherent derived unit one, to be used to express values of plane angle and solid angle, respectively, and are therefore included in Table 3.

T/K	10^3 K/T	p/MPa	ln(p/MPa)
216.55	4.6179	0.5180	–0.6578
273.15	3.6610	3.4853	1.2486
304.19	3.2874	7.3815	1.9990

The axes of a graph may also be labelled in this way, so that the tick marks are labelled only with numbers, as in the graph below.



Algebraically equivalent forms may be used in place of 10^3 K/T, such as kK/T, or 10^3 $(T/\mathrm{K})^{-1}$.

A hómérséklet reciprokának az ezerszeresét tüntették fel

	Jean-Charles de	**Borda**	1733 V 4	Dax	1799 II 19	Paris
comte de	Jaques-Dominique	**Cassini**	1748 VI 30	Paris	1845 X 18	Thury
marquis de **Condorcet** Marie Jean Antoine Nicolas de **Caritat**			1743 IX 17	Ribemont (Aisne)	1794 III 28	Bourg-la-Reine
	Jean-Baptiste-Joseph	**Delambre**	1749 IX 19	Amiens	1822 VIII 19	Paris
	Antoine-Laurent de	**Lavoisier**	1743 VIII 26	Paris	1794 V 8	Paris
marquis	Pierre-Simon de	**Laplace**	1749 III 23	Beaumont-en-Auge	1827 III 5	Paris
comte de Joseph-Louis **Lagrange** Giuseppe Lodovico **Lagrange**			1736 I 25	Torinó	1813 IV 10	Paris
	Adrien-Marie	**Le Gendre**	1752 IX 18	Paris	1833 I 10	Paris
	Pierre Francis André	**Méchain**	1744 VIII 16	Leon	1804 IX 20	Castellón de la Plana
De la Placa	Jean-Baptiste-Marie-Charles	**Meusnier**	1754 VI 19	Tours	1793 VI 13	Mainz-Kastel
Comte de Péluse	Gaspard	**Monge**	1746 V 10	Beaune	1818 VII 28	Paris

TAI is a uniform time scale that does not keep in step with the irregular rotation of the Earth. For practical purposes, another uniform scale has been defined (UTC), which differs from TAI by an integer number of seconds. To avoid the uniform scale diverging indefinitely from that of the Earth's rotation, **a leap second** is introduced in UTC whenever necessary. The choice of the dates and the announcement of the leap seconds is under the responsibility of the International Earth Rotation and Reference Systems Service (IERS) http://hpiers.obspm.fr/eop-pc.

1972 Jan. 1
1972 Jul. 1
1973 Jan. 1
1974 Jan. 1
1975 Jan. 1
1976 Jan. 1
1977 Jan. 1
1978 Jan. 1
1979 Jan. 1
1980 Jan. 1
1981 Jul. 1
1982 Jul. 1
1983 Jul. 1
1985 Jul. 1
1988 Jan. 1
1990 Jan. 1