Fundamental Physical Constants — Frequently used constants

Quantity	Symbol	Value	Unit	Relative std. uncert. u_r
speed of light in vacuum	c, c_0	299 792 458	m s^{-1}	(exact)
magnetic constant	μ_0	$4\pi \times 10^{-7}$	N A^{-2}	
		$= 12.566\,370\,614... \times 10^{-7}$	N A^{-2}	(exact)
electric constant $1/\mu_0 c^2$	ϵ_0	$8.854\,187\,817... \times 10^{-12}$	F m^{-1}	(exact)
Newtonian constant of gravitation	G	$6.6742(10) \times 10^{-11}$	m^3 kg^{-1} s^{-2}	1.5×10^{-4}
Planck constant	h	$6.626\,0693(11) \times 10^{-34}$	J s	1.7×10^{-7}
$h/2\pi$	$\hbar$	$1.054\,571\,68(18) \times 10^{-34}$	J s	1.7×10^{-7}
elementary charge	e	$1.602\,176\,53(14) \times 10^{-19}$	C	8.5×10^{-8}
magnetic flux quantum $h/2e$	Φ_0	$2.067\,833\,72(18) \times 10^{-15}$	Wb	8.5×10^{-8}
conductance quantum $2e^2/h$	G_0	$7.748\,091\,733(26) \times 10^{-5}$	S	3.3×10^{-9}
electron mass	m_e	$9.109\,3826(16) \times 10^{-31}$	kg	1.7×10^{-7}
proton mass	m_p	$1.672\,621\,71(29) \times 10^{-27}$	kg	1.7×10^{-7}
proton-electron mass ratio	m_p/m_e	1836.152 672 61(85)		4.6×10^{-10}
fine-structure constant $e^2/4\pi\epsilon_0\hbar c$	α	$7.297\,352\,568(24) \times 10^{-3}$		3.3×10^{-9}
inverse fine-structure constant	α^{-1}	137.035 999 11(46)		3.3×10^{-9}
Rydberg constant $\alpha^2 m_e c/2h$	R_∞	10 973 731.568 525(73)	m^{-1}	6.6×10^{-12}
Avogadro constant	N_A, L	$6.022\,1415(10) \times 10^{23}$	mol^{-1}	1.7×10^{-7}
Faraday constant $N_A e$	F	96 485.3383(83)	C mol^{-1}	8.6×10^{-8}
molar gas constant	R	8.314 472(15)	J mol^{-1} K^{-1}	1.7×10^{-6}
Boltzmann constant R/N_A	k	$1.380\,6505(24) \times 10^{-23}$	J K^{-1}	1.8×10^{-6}
Stefan-Boltzmann constant $(\pi^2/60)k^4/\hbar^3 c^2$	σ	$5.670\,400(40) \times 10^{-8}$	W m^{-2} K^{-4}	7.0×10^{-6}
Non-SI units accepted for use with the SI				
electron volt: (e/C) J	eV	$1.602\,176\,53(14) \times 10^{-19}$	J	8.5×10^{-8}
(unified) atomic mass unit 1 u $= m_u = \frac{1}{12} m(^{12}\text{C})$ $= 10^{-3}$ kg mol$^{-1}/N_A$	u	$1.660\,538\,86(28) \times 10^{-27}$	kg	1.7×10^{-7}
Bohr magneton $e\hbar/2m_e$	μ_B	$927.400\,949(80) \times 10^{-26}$	J T^{-1}	8.6×10^{-8}
in eV T^{-1}		$5.788\,381\,804(39) \times 10^{-5}$	eV T^{-1}	6.7×10^{-9}
	μ_B/h	$13.996\,2458(12) \times 10^9$	Hz T^{-1}	8.6×10^{-8}
	μ_B/hc	46.686 4507(40)	m^{-1} T^{-1}	8.6×10^{-8}
	μ_B/k	0.671 7131(12)	K T^{-1}	1.8×10^{-6}
nuclear magneton $e\hbar/2m_p$	μ_N	$5.050\,783\,43(43) \times 10^{-27}$	J T^{-1}	8.6×10^{-8}
in eV T^{-1}		$3.152\,451\,259(21) \times 10^{-8}$	eV T^{-1}	6.7×10^{-9}
fine-structure constant $e^2/4\pi\epsilon_0\hbar c$	α	$7.297\,352\,568(24) \times 10^{-3}$		3.3×10^{-9}
inverse fine-structure constant	α^{-1}	137.035 999 11(46)		3.3×10^{-9}
Rydberg constant $\alpha^2 m_e c/2h$	R_∞	10 973 731.568 525(73)	m^{-1}	6.6×10^{-12}
	$R_\infty c$	$3.289\,841\,960\,360(22) \times 10^{15}$	Hz	6.6×10^{-12}
	$R_\infty hc$	$2.179\,872\,09(37) \times 10^{-18}$	J	1.7×10^{-7}
$R_\infty hc$ in eV		13.605 6923(12)	eV	8.5×10^{-8}
Bohr radius $\alpha/4\pi R_\infty = 4\pi\epsilon_0\hbar^2/m_e e^2$	a_0	$0.529\,177\,2108(18) \times 10^{-10}$	m	3.3×10^{-9}
Hartree energy $e^2/4\pi\epsilon_0 a_0 = 2R_\infty hc$ $= \alpha^2 m_e c^2$	E_h	$4.359\,744\,17(75) \times 10^{-18}$	J	1.7×10^{-7}
in eV		27.211 3845(23)	eV	8.5×10^{-8}
quantum of circulation	$h/2m_e$	$3.636\,947\,550(24) \times 10^{-4}$	m^2 s^{-1}	6.7×10^{-9}
	h/m_e	$7.273\,895\,101(48) \times 10^{-4}$	m^2 s^{-1}	6.7×10^{-9}

Some Physical Constants

(See Appendix D for a complete list of fundamental constants.)

Avogadro's number	N_A	6.022142×10^{23} particles/mol
Boltzmann's constant	k	1.380650×10^{-23} J/K
Bohr magneton	$m_B = e\hbar/2m_e$	$9.2740095 \times 10^{-24}$ J/T
Coulomb constant	$k = 1/4\pi\varepsilon_0$	8.987551788×10^9 N·m^2/C^2
Compton wavelength	$\lambda_c = h/m_e c$	$2.42631024 \times 10^{-12}$ m
Fundamental charge	e	1.602176×10^{-19} C
Gas constant	$R = N_A k$	8.31447 J/mol·K = 1.987 22 cal/mol·K $= 8.20578 \times 10^{-2}$ L·atm/mol·K
Gravitational constant	G	6.6742×10^{-11} N·m^2/kg^2
Mass, of electron	m_e	9.109382×10^{-31} kg $= 510.9989$ keV/c^2
of proton	m_p	1.672622×10^{-27} kg $= 938.2722$ MeV/c^2
of neutron	m_n	1.674927×10^{-27} kg $= 939.5653$ MeV/c^2
Permeability of free space	μ_0	$4\pi \times 10^{-7}$ N/A^2
Planck's constant	h	6.626069×10^{-34} J·s $=4.135667 \times 10^{-15}$ eV·s
	$\hbar$	1.054572×10^{-34} J·s $=6.582119 \times 10^{-16}$ eV·s
Speed of light	c	2.99792458×10^8 m/s
Unified mass unit	u	1.660539×10^{-27} kg $= 931.49401$ MeV/c^2

Some Conversion Factors

1 yr = 3.156×10^7 s
1 light-year = 9.461×10^{15} m
1 cal = 4.186 J
1 MeV/c = 5.344×10^{-22} kg·m/s
1 eV = 1.6022×10^{-19} J
1 kW·h = 3.6 MJ
1 T = 10^4 G
1 Ci = 3.7×10^{10} Bq
1 barn = 10^{-28} m^2
1 u = 1.66054×10^{-27} kg
1 parsec = 3.26 light-years
1 rad = 57.30°

Some Particle Masses and Rest Energies

	kg	MeV/c^2	u
Electron	9.1094×10^{-31}	0.51100	5.4858×10^{-4}
Muon	1.8835×10^{-28}	105.66	0.11343
Proton	1.6726×10^{-27}	938.27	1.00728
Neutron	1.6749×10^{-27}	939.57	1.00866
Deuteron	3.3436×10^{-27}	1875.61	2.01355
α particle	6.6447×10^{-27}	3727.38	4.00151
W	1.43×10^{-25}	80×10^3	85.9
Z°	1.63×10^{-25}	91.2×10^3	97.9