

Quantity	symbol or definition	cgs	SI	numerical value
speed of light	$c$			299792458 m/s
Planck's constant	$h = 2\pi\hbar$			$6.62606896(33) \times 10^{-34}$ J s
elementary charge	$e$			$1.602176487(40) \times 10^{-19}$ C
electron mass	$m$			$9.10938215(45) \times 10^{-31}$ kg
proton mass	$M_p$			$1.672621637(83) \times 10^{-27}$ kg
neutron mass	$M_n$			$1.674927211(84) \times 10^{-27}$ kg
permittivity of vacuum	$\epsilon_0 = \frac{1}{\mu_0 c^2}$			$8.854187817 \times 10^{-12}$ F/m
permeability of vacuum	$\mu_0$			$4\pi \times 10^{-7}$ H/m
fine structure constant	$\alpha$	$\frac{e^2}{\hbar c}$	$\frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c}$	$7.2973525376(50) \times 10^{-3} \simeq \frac{1}{137.036}$
Rydberg constant	$R_\infty$	$\frac{me^4}{4\pi\hbar^3 c}$	$\left(\frac{1}{4\pi\epsilon_0}\right)^2 \frac{me^4}{4\pi\hbar^3 c}$	$109737.31568527(73)$ cm <sup>-1</sup>
Bohr radius	$a_0$	$\frac{\hbar^2}{me^2}$	$4\pi\epsilon_0 \frac{\hbar^2}{me^2}$	$5.2917720859(36) \times 10^{-11}$ m
velocity	$v_0 = \alpha c$	$\frac{e^2}{\hbar}$	$\frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar}$	$2.1876912541(15) \times 10^6$ m/s
time	$\tau_0 = \frac{a_0}{v_0} = \frac{a_0}{\alpha c}$	$\frac{\hbar^3}{me^4}$	$(4\pi\epsilon_0)^2 \frac{\hbar^3}{me^4}$	$2.418884326505(16) \times 10^{-17}$ s
Hartree energy	$E_h = 2hcR_\infty = \frac{1}{4\pi\epsilon_0} \frac{e^2}{a_0}$	$\frac{me^4}{\hbar^2}$	$\left(\frac{1}{4\pi\epsilon_0}\right)^2 \frac{me^4}{\hbar^2}$	27.21138386(68) eV
electric field	$\frac{1}{4\pi\epsilon_0} \frac{e}{a_0^2}$	$\frac{m^2 e^5}{\hbar^4}$	$\left(\frac{1}{4\pi\epsilon_0}\right)^3 \frac{m^2 e^5}{\hbar^4}$	$5.14220632(13) \times 10^{11}$ V/m
Bohr magneton	$\mu_B$	$\frac{e\hbar}{2mc}$	$\frac{e\hbar}{2m}$	$9.27400915(23) \times 10^{-24}$ J/T
magnetic field*	$\frac{\mu_0 \hbar e}{4\pi m a_0^3}$	$\frac{m^2 e^7}{\hbar^5}$	$\left(\frac{1}{4\pi\epsilon_0}\right)^4 \frac{m^2 e^7}{c^2 \hbar^5}$	12.5168 T

Table 1.1: Characteristic atomic quantities. Numerical values of fundamental constants taken from CODATA (2006). Numbers in parentheses indicate uncertainty of last digits. The speed of light, permittivity, and permeability are exact definitions. \*Note the atomic unit of magnetic field is defined as  $\hbar/(ea_0^2) = 2.350517382(59) \times 10^5$  T which is much larger than the characteristic magnetic field seen by the orbiting electron.

	J	eV	cm <sup>-1</sup>	Hz	K
1 J =	1	$6.24 \times 10^{18}$	$5.03 \times 10^{22}$	$1.51 \times 10^{33}$	$7.24 \times 10^{22}$
1 eV =	$1.60 \times 10^{-19}$	1	8065	$2.42 \times 10^{14}$	11600
1 cm <sup>-1</sup> =	$1.99 \times 10^{-23}$	$1.24 \times 10^{-4}$	1	$3.00 \times 10^{10}$	1.44
1 Hz =	$6.63 \times 10^{-34}$	$4.14 \times 10^{-15}$	$3.34 \times 10^{-11}$	1	$4.80 \times 10^{-11}$
1 K =	$1.38 \times 10^{-23}$	$8.62 \times 10^{-5}$	0.695	$2.08 \times 10^{10}$	1

Table 1.2: Conversion factors between energy units.