Fundamental Constants

Quantity	Symbol	Value(s)
Elementary charge	e	1.6022×10^{-19} C
Speed of light in vacuum	c	2.9979×10^{8} m/s
Permeability of vacuum (magnetic constant)	μ_0	$4\pi \times 10^{-7}$ N · A^{-2}
Permittivity of vacuum (electric constant)	ϵ_0	8.8542×10^{-12} F · m^{-1}
Gravitation constant	G	6.6738×10^{-11} N · m^2 · kg^{-2}
Planck constant	h	6.6261×10^{-34} J · s
		4.1357×10^{-15} eV · s
Avogadro constant	N_A	6.0221×10^{23} mol^{-1}
Boltzmann constant	k	1.3807×10^{-23} J · K^{-1}
Stefan-Boltzmann constant	σ	5.6704×10^{-8} W · m^{-2} · K^{-4}
Atomic mass unit	u	$1.66053886 \times 10^{-27}$ kg 931.494061 MeV/c^2

Particle Masses

	Mass in units of		
Particle	**kg**	**MeV/c²**	**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

Conversion Factors

1 y = 3.156×10^{7} s

1 lightyear = 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 T = 10^{4} G

1 Ci = 3.7×10^{10} Bq

1 barn = 10^{-28} m^2

1 u = 1.66054×10^{-27} kg

Useful Combinations of Constants

$\hbar = h/2\pi = 1.0546 \times 10^{-34}\,\text{J}\cdot\text{s} = 6.5821 \times 10^{-16}\,\text{eV}\cdot\text{s}$

$hc = 1.9864 \times 10^{-25}\,\text{J}\cdot\text{m} = 1239.8\,\text{eV}\cdot\text{nm}$

$\hbar c = 3.1615 \times 10^{-26}\,\text{J}\cdot\text{m} = 197.33\,\text{eV}\cdot\text{nm}$

$$\frac{1}{4\pi\epsilon_0} = 8.9876 \times 10^{9}\,\text{N}\cdot\text{m}^2\cdot\text{C}^{-2}$$

Compton wavelength $\lambda_c = \dfrac{h}{m_e c} = 2.4263 \times 10^{-12}\,\text{m}$

$$\frac{e^2}{4\pi\epsilon_0} = 2.3071 \times 10^{-28}\,\text{J}\cdot\text{m} = 1.4400 \times 10^{-9}\,\text{eV}\cdot\text{m}$$

Fine structure constant $\alpha = \dfrac{e^2}{4\pi\epsilon_0\hbar c} = 0.0072974 \approx \dfrac{1}{137}$

Bohr magneton $\mu_\text{B} = \dfrac{e\hbar}{2m_e} = 9.2740 \times 10^{-24}\,\text{J/T} = 5.7884 \times 10^{-5}\,\text{eV/T}$

Nuclear magneton $\mu_\text{N} = \dfrac{e\hbar}{2m_p} = 5.0508 \times 10^{-27}\,\text{J/T}$

$= 3.1525 \times 10^{-8}\,\text{eV/T}$

Bohr radius $a_0 = \dfrac{4\pi\epsilon_0\hbar^2}{m_e e^2} = 5.2918 \times 10^{-11}\,\text{m}$

Hydrogen ground state $E_0 = \dfrac{e^2}{8\pi\epsilon_0 a_0} = 13.606\,\text{eV} = 2.1799 \times 10^{-18}\,\text{J}$

Rydberg constant $R_\infty = \dfrac{\alpha^2 m_e c}{2h} = 1.09737 \times 10^{7}\,\text{m}^{-1}$

Hydrogen Rydberg $R_\text{H} = \dfrac{\mu}{m_e} R_\infty = 1.09678 \times 10^{7}\,\text{m}^{-1}$

Gas constant $R = N_\text{A}k = 8.3145\,\text{J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$

Magnetic flux quantum $\Phi_0 = \dfrac{h}{2e} = 2.0678 \times 10^{-15}\,\text{T}\cdot\text{m}^2$

Classical electron radius $r_e = \alpha^2 a_0 = 2.8179 \times 10^{-15}\,\text{m}$

$kT = 2.5249 \times 10^{-2}\,\text{eV} \approx \dfrac{1}{40}\,\text{eV}$ at $T = 293\,\text{K}$

Note: The latest values of the fundamental constants can be found at the National Institute of Standards and Technology website at http://physics.nist.gov/cuu/Constants