PHYSICAL CONSTANTS & CONVERSION FACTORS

Named Constants

Atomic mass unit: $1\ \text{u} = \frac{1}{12}\text{m}(^{12}\text{C atom})$
$= 1.66\times10^{-27}\ \text{kg}$
$= 931.5\ \text{MeV}/c^2$

Avogadro's constant: $N_\text{A} = 6.02\times10^{23}\ \text{particles/mole}$

Bohr radius: $a_\text{B} = \hbar^2/(ke^2m_\text{e})$
$= 5.29\times10^{-11}\ \text{m}$

Boltzmann's constant: $k_\text{B} = 8.62\times10^{-5}\ \text{eV/K}$
$= 1.38\times10^{-23}\ \text{J/K}$

Coulomb force constant: $k = 1/(4\pi\varepsilon_0) = \mu_0c^2/(4\pi)$
$= 8.99\times10^{9}\ \text{N}\cdot\text{m}^2/\text{C}^2$

Electron Compton wavelength: $\lambda_\text{c} = h/(m_\text{e}c)$
$= 2.43\times10^{-12}\ \text{m}$

Electron volt: $1\ \text{eV} = 1.60\times10^{-19}\ \text{J}$

Elementary charge: $e = 1.60\times10^{-19}\ \text{C}$

Fine-structure constant: $\alpha = ke^2/(\hbar c)$
$= 7.30\times10^{-3} \approx 1/137$

Gas constant: $R = 8.31\ \text{J}/(\text{mole}\cdot\text{K})$
$= 0.0821\ \text{liter}\cdot\text{atm}/(\text{mole}\cdot\text{K})$

Gravitational constant: $G = 6.67\times10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2$

Mass of electron: $m_\text{e} = 5.485799110\times10^{-4}\ \text{u}$
$\approx 9.11\times10^{-31}\ \text{kg}$
$= 0.511\ \text{MeV}/c^2$

Mass of proton: $m_\text{p} = 1.00727646688\ \text{u}$
$\approx 1.673\times10^{-27}\ \text{kg}$
$= 938.3\ \text{MeV}/c^2$

Mass of neutron: $m_\text{n} = 1.00866491578\ \text{u}$
$\approx 1.675\times10^{-27}\ \text{kg}$
$= 939.6\ \text{MeV}/c^2$

Bohr magneton: $\mu_\text{B} = e\hbar/(2m_\text{e})$
$= 5.79\times10^{-5}\ \text{eV/T}$
$= 9.27\times10^{-24}\ \text{J/T}(\text{or A}\cdot\text{m}^2)$

Nuclear magneton: $\mu_\text{N} = e\hbar/(2m_\text{p})$
$= 3.15\times10^{-8}\ \text{eV/T}$
$= 5.05\times10^{-27}\ \text{J/T}$

Radioactive source activity: $1\ \text{Ci} = 3.7\times10^{10}\ \text{Bq}$

Permeability of vacuum: $\mu_0 = 4\pi\times10^{-7}\ \text{N/A}^2$
$= 1.26\times10^{-6}\ \text{N/A}^2$

Permittivity of vacuum: $\varepsilon_0 = 1/(\mu_0\text{c}^2)$
$= 8.85\times10^{-12}\ \text{C}^2/(\text{N}\cdot\text{m}^2)$

Planck's constant: $h = 6.63\times10^{-34}\ \text{J}\cdot\text{s}$
$= 4.14\times10^{-15}\ \text{eV}\cdot\text{s}$
$\hbar = h/2\pi$
$= 1.05\times10^{-34}\ \text{J}\cdot\text{s}$
$= 6.58\times10^{-16}\ \text{eV}\cdot\text{s}$

Rydberg constant: $R = m_\text{e}k^2e^4/(4\pi c\hbar^3)$
$= 1.10\times10^{-2}\ \text{nm}^{-1}$

Rydberg energy: $E_\text{R} = hcR = m_\text{e}k^2e^4/(2\hbar^2)$
$= 13.6\ \text{eV}$

Speed of light in vacuum: $c = 3.00\times10^{8}\ \text{m/s}$

Useful Combinations

$hc = 1240\ \text{eV}\cdot\text{nm} = 1240\ \text{MeV}\cdot\text{fm}$

$\hbar c = 197\ \text{eV}\cdot\text{nm} = 197\ \text{MeV}\cdot\text{fm}$

$ke^2 = 1.44\ \text{eV}\cdot\text{nm} = 1.44\ \text{MeV}\cdot\text{fm}\,, \quad k = \frac{1}{4\pi\varepsilon_0}$

$N_\text{A}\times(1\ \text{u}) = 1\ \text{gram}$

$k_\text{B}T = 0.026\ \text{eV}$ at room temperature (300K)

Conversion Factors

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

Energy: 1 cal = 4.184 J
1 eV = 1.60 × 10^{-19} J

Length: 1Å = 1 angstrom
= 10^{-10} m
1 ft = 30.48 cm
1 in = 2.54 cm
1 mi = 1609 m

Mass: 1 kg = 2.20 lb
1 MeV/c^2 = 1.07 × 10^{-3} u
= 1.78 × 10^{-30} kg

Momentum: $1\ \text{MeV}/c = 5.34\times10^{-22}\ \text{kg}\cdot\text{m/s}$

(More accurate numbers can be found in Taylor, Zafiratos & Dubson, Modern Physics, 2/e, Appendix A (2004).)