

APPENDIX C

Useful Information

This appendix is broken into several tables.

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Symbol	Meaning	Best Value	Approximate Value
c	Speed of light in vacuum	$2.99792458 \times 10^8 \text{ m/s}$	$3.00 \times 10^8 \text{ m/s}$
G	Gravitational constant	$6.67408(31) \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$	$6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$
N_A	Avogadro's number	$6.02214076 \times 10^{23}$	6.02×10^{23}
k	Boltzmann's constant	$1.380649 \times 10^{-23} \text{ J/K}$	$1.38 \times 10^{-23} \text{ J/K}$
R	Gas constant	$8.3144621(75) \text{ J/mol} \cdot \text{K}$	$8.31 \text{ J/mol} \cdot \text{K} = 1.99 \text{ cal/mol} \cdot \text{K}$ $= 0.0821 \text{ atm} \cdot \text{L/mol} \cdot \text{K}$
σ	Stefan-Boltzmann constant	$5.670373(21) \times 10^{-8} \text{ W/m}^2 \cdot \text{K}$	$5.67 \times 10^{-8} \text{ W/m}^2 \cdot \text{K}$
k	Coulomb force constant	$8.987551788... \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$	$8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$
q_e	Charge on electron	$-1.602176634 \times 10^{-19} \text{ C}$	$-1.60 \times 10^{-19} \text{ C}$
ϵ_0	Permittivity of free space	$8.854187817... \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2$	$8.85 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2$
μ_0	Permeability of free space	$4\pi \times 10^{-7} \text{ T} \cdot \text{m/A}$	$1.26 \times 10^{-6} \text{ T} \cdot \text{m/A}$
h	Planck's constant	$6.62607015 \times 10^{-34} \text{ J} \cdot \text{s}$	$6.63 \times 10^{-34} \text{ J} \cdot \text{s}$

Table C1 Important Constants¹

¹ Stated values are according to the National Institute of Standards and Technology Reference on Constants, Units, and Uncertainty, www.physics.nist.gov/cuu (<http://www.physics.nist.gov/cuu>) (accessed May 18, 2012). Values in parentheses are the uncertainties in the last digits. Numbers without uncertainties are exact as defined.

Symbol	Meaning	Best Value	Approximate Value
m_e	Electron mass	$9.10938291(40) \times 10^{-31} \text{ kg}$	$9.11 \times 10^{-31} \text{ kg}$
m_p	Proton mass	$1.672621777(74) \times 10^{-27} \text{ kg}$	$1.6726 \times 10^{-27} \text{ kg}$
m_n	Neutron mass	$1.674927351(74) \times 10^{-27} \text{ kg}$	$1.6749 \times 10^{-27} \text{ kg}$
u	Atomic mass unit	$1.660538921(73) \times 10^{-27} \text{ kg}$	$1.6605 \times 10^{-27} \text{ kg}$

Table C2 Submicroscopic Masses²

Sun	mass	$1.99 \times 10^{30} \text{ kg}$
	average radius	$6.96 \times 10^8 \text{ m}$
	Earth-sun distance (average)	$1.496 \times 10^{11} \text{ m}$
Earth	mass	$5.9736 \times 10^{24} \text{ kg}$
	average radius	$6.376 \times 10^6 \text{ m}$
	orbital period	$3.16 \times 10^7 \text{ s}$
Moon	mass	$7.35 \times 10^{22} \text{ kg}$
	average radius	$1.74 \times 10^6 \text{ m}$
	orbital period (average)	$2.36 \times 10^6 \text{ s}$
	Earth-moon distance (average)	$3.84 \times 10^8 \text{ m}$

Table C3 Solar System Data

Prefix	Symbol	Value	Prefix	Symbol	Value
tera	T	10^{12}	deci	d	10^{-1}
giga	G	10^9	centi	c	10^{-2}
mega	M	10^6	milli	m	10^{-3}
kilo	k	10^3	micro	μ	10^{-6}

Table C4 Metric Prefixes for Powers of Ten and Their Symbols

² Stated values are according to the National Institute of Standards and Technology Reference on Constants, Units, and Uncertainty, www.physics.nist.gov/cuu (<http://www.physics.nist.gov/cuu>) (accessed May 18, 2012). Values in parentheses are the uncertainties in the last digits. Numbers without uncertainties are exact as defined.

Prefix	Symbol	Value	Prefix	Symbol	Value
hecto	h	10^2	nano	n	10^{-9}
deka	da	10^1	pico	p	10^{-12}
—	—	$10^0 (= 1)$	femto	f	10^{-15}

Table C4 Metric Prefixes for Powers of Ten and Their Symbols

Alpha	A	α	Eta	H	η	Nu	N	ν	Tau	T	τ
Beta	B	β	Theta	Θ	θ	Xi	Ξ	ξ	Upsilon	Y	υ
Gamma	Γ	γ	Iota	I	ι	Omicron	O	o	Phi	Φ	ϕ
Delta	Δ	δ	Kappa	K	κ	Pi	Π	π	Chi	X	χ
Epsilon	E	ϵ	Lambda	Λ	λ	Rho	P	ρ	Psi	Ψ	ψ
Zeta	Z	ζ	Mu	M	μ	Sigma	Σ	σ	Omega	Ω	ω

Table C5 The Greek Alphabet

	Entity	Abbreviation	Name
Fundamental units	Length	m	meter
	Mass	kg	kilogram
	Time	s	second
	Current	A	ampere
Supplementary unit	Angle	rad	radian
Derived units	Force	$N = kg \cdot m/s^2$	newton
	Energy	$J = kg \cdot m^2/s^2$	joule
	Power	$W = J/s$	watt
	Pressure	$Pa = N/m^2$	pascal
	Frequency	$Hz = 1/s$	hertz
	Electronic potential	$V = J/C$	volt
	Capacitance	$F = C/V$	farad

Table C6 SI Units

	Entity	Abbreviation	Name
	Charge	$C = s \cdot A$	coulomb
	Resistance	$\Omega = V/A$	ohm
	Magnetic field	$T = N/(A \cdot m)$	tesla
	Nuclear decay rate	$Bq = 1/s$	becquerel

Table C6 SI Units

Length	1 inch (in.)= 2.54 cm (exactly)
	1 foot (ft)= 0.3048 m
	1 mile (mi)= 1.609 km
Force	1 pound (lb)= 4.448 N
Energy	1 British thermal unit (Btu)= 1.055×10^3 J
Power	1 horsepower (hp)= 746 W
Pressure	$1 \text{ lb/in}^2 = 6.895 \times 10^3$ Pa

Table C7 Selected British Units

Length	1 light year (ly) = 9.46×10^{15} m
	1 astronomical unit (au) = 1.50×10^{11} m
	1 nautical mile = 1.852 km
	1 angstrom($\text{\AA}$) = 10^{-10} m
Area	1 acre (ac) = 4.05×10^3 m ²
	1 square foot (ft ²) = 9.29×10^{-2} m ²
	1 barn (<i>b</i>) = 10^{-28} m ²
Volume	1 liter (<i>L</i>) = 10^{-3} m ³
	1 U.S. gallon (gal) = 3.785×10^{-3} m ³
Mass	1 solar mass = 1.99×10^{30} kg
	1 metric ton = 10^3 kg
	1 atomic mass unit (<i>u</i>) = 1.6605×10^{-27} kg
Time	1 year (<i>y</i>) = 3.16×10^7 s
	1 day (<i>d</i>) = 86,400 s
Speed	1 mile per hour (mph) = 1.609 km/h
	1 nautical mile per hour (naut) = 1.852 km/h
Angle	1 degree ($^\circ$) = 1.745×10^{-2} rad

Table C8 Other Units

	1 minute of arc ($'$) = $1/60$ degree
	1 second of arc ($''$) = $1/60$ minute of arc
	1 grad = 1.571×10^{-2} rad
Energy	1 kiloton TNT (kT) = 4.2×10^{12} J
	1 kilowatt hour (kW $\cdot$ h) = 3.60×10^6 J
	1 food calorie (kcal) = 4186 J
	1 calorie (cal) = 4.186 J
	1 electron volt (eV) = 1.60×10^{-19} J
Pressure	1 atmosphere (atm) = 1.013×10^5 Pa
	1 millimeter of mercury (mm Hg) = 133.3 Pa
	1 torricelli (torr) = 1 mm Hg = 133.3 Pa
Nuclear decay rate	1 curie (Ci) = 3.70×10^{10} Bq

Table C8 Other Units

Circumference of a circle with radius r or diameter d	$C = 2\pi r = \pi d$
Area of a circle with radius r or diameter d	$A = \pi r^2 = \pi d^2/4$
Area of a sphere with radius r	$A = 4\pi r^2$
Volume of a sphere with radius r	$V = (4/3) (\pi r^3)$

Table C9 Useful Formulae

