2. Physical Constants and Conversion Factors

The tables in this chapter supply some of the more commonly needed physical constants and conversion factors.*

The International System of Units (SI) established in 1960 by the General Conference of Weights and Measures under the Treaty of the Meter is based upon: the meter (m) for length, defined as 1 650 763.73 wave-lengths in vacuum corresponding to the transition $2p_{10}-5d_5$ of krypton 86; the kilogram (kg) for mass, defined as the mass of the prototype kilogram at Sevres, France; the second (s) for time, defined as the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of cesium 133; the kelvin (K) for temperature, defined as 1/273.16 of the thermodynamic temperature of the triple point of water; the ampere (A) for electric current, defined as the current which, if flowing in two infinitely long parallel wires *in vacuo* separated by one meter, would produce a force of 2×10^{-7} newtons per meter of length between the wires; and the candela (cd) for luminous intensity, defined as the luminous intensity of 1/600 000 square meter of a perfect radiator at the temperature of freezing platinum.

All other units of SI are derived from these base units by assigning the value unity to the proportionality constants in the defining equations (official symbols for other SI units appear in Tables 2.1 and 2.2). Taking 1/100 of the meter as the unit for length and 1/1000 of the kilogram as the unit for mass gives rise similarly to the cgs system, often used in physics and chemistry.

SI, as it is ordinarily used in electromagnetism, is a rationalized system, i.e., the electromagnetic units of SI relate to the quantities appearing in the so-called rationalized electromagnetic equations. Thus, the force per unit length between two current-carrying parallel wires of infinite length separated by unit distance *in vacuo* is $2f = \mu_0 i_1 i_2 / 4\pi$, where μ_0 has the value $4\pi \times 10^{-7}$H/m. The force between two electric charges *in vacuo* is correspondingly given by $f = q_1 q_2 / 4\pi\epsilon_0 r^2$, ϵ_0 having the value $1/\mu_0 c^2$, where c is the speed of light in meters per second. ($\epsilon_0 \sim 8.854 \times 10^{-12}$F/m)

Setting μ_0 equal to unity and deleting 4π from the denominator in the first equation above defines the cgs-emu system. Setting ϵ_0 equal to unity and deleting 4π from the denominator in the second equation correspondingly defines the cgs-esu system. The cgs-emu and the cgs-esu systems are most frequently used in the unrationalized forms.

Table 2.1. Common Units and Conversion Factors, CGS System and SI

Quantity	SI Name	CGS Name	Factor
Force	newton (N)	dyne	10^5
Energy	joule (J)	erg	10^7
Power	watt (W)	....	10^7

*See also "Preface to Ninth Printing," page IIIa and page II.

Table 2.2. Names and Conversion Factors for Electric and Magnetic Units

Quantity	SI name	emu name	esu name	emu-SI factors	esu-SI factors
Current	ampere (A)	abampere	statampere	10^{-1}	$\sim 3 \times 10^9$
Charge	coulomb (C)	abcoulomb	statcoulomb	10^{-1}	$\sim 3 \times 10^9$
Potential	volt (V)	abvolt	statvolt	10^8	$\sim (1/3) \times 10^{-2}$
Resistance	ohm (Ω)	abohm	statohm	10^9	$\sim (1/9) \times 10^{-11}$
Inductance	henry (H)	centimeter	....	10^9	$\sim (1/9) \times 10^{-11}$
Capacitance	farad (F)	....	centimeter	10^{-9}	$\sim 9 \times 10^{11}$
Magnetizing force	$A \cdot m^{-1}$	oersted	....	$4\pi \times 10^{-3}$	$\sim 3 \times 10^9$
Magnetomotive force	A	gilbert	....	$4\pi \times 10^{-1}$	$\sim 3/10^6$
Magnetic flux	weber (Wb)	maxwell	....	10^8	$\sim (1/3) \times 10^{-2}$
Magnetic flux density	tesla (T)	gauss (G)	....	10^4	$\sim (1/3) \times 10^{-6}$
Electric displacement	....	....	....	10^{-5}	$\sim 3 \times 10^5$

Example: If the value assigned to a current is 100 amperes its value in abamperes is $100 \times 10^{-1} = 10$.