

APPENDIX

18. ADDITIONAL ELECTRICAL UNITS

Since one rarely encounters calculations in the emu system involving electric dipole moment p , polarization P , electric susceptibility η , and electric displacement D , we shall not define units for these quantities in the emu system.

A-3 Table of conversion factors

The mks electrical units belong to the rationalized mksa system. In this system, permittivity of empty space has the value

$$\epsilon_0 = \frac{1}{4\pi \times 8.98776 \times 10^9} \frac{\text{coulomb}^2}{\text{newton m}^2} \quad \left(\text{or } \frac{\text{farad}}{\text{meter}}\right)$$

and permeability of empty space has the value

$$\mu_0 = 4\pi \times 10^{-7} \frac{\text{weber}}{\text{amp meter}} \quad \left(\text{or } \frac{\text{henry}}{\text{meter}}\right)$$

Both esu and emu are unrationalized systems.*

See page 728 for instructions for use of the following table.

Quantity	Conversion Factor		
	Conversion Number	Numerator	Unit of Denominator
Angle, plane	1.745 × 10 ⁻² 57.30 2.778 × 10 ⁻¹ 2π 360	radian degree revolution radian degree	degree radian degree revolution revolution
Area, A	1 × 10 ⁻⁴ 9.290 × 10 ⁻⁴ 6.452 × 10 ⁻⁴	meter ² meter ² meter ²	cm ² foot ² inch ²
Capacitance, C	1.113 × 10 ⁻¹² 1 × 10 ⁹ 1 × 10 ⁻⁴ 1 × 10 ⁻¹⁸	farad farad farad farad	statfarad (esu) abfarad (emu) microfarad, μf micromicrofarad, μμf
Charge, electric (or quantity of electricity) Q, q	3.336 × 10 ⁻¹⁰ 10	coulomb coulomb	statcoulomb (esu) abcoulomb (emu)

* For conversion of a formula in one system of units to the same formula in another system of units, see W. R. Smythe, *Static and Dynamic Electricity*, 2d ed., New York, McGraw-Hill Book Co., Inc., 1950, pp. 585-589.

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Quantity	Conversion Factor		
	Conversion Number	Unit of Numerator	Unit of Denominator
Current, i, I	3.336×10^{-10} 10	amp amp	statamp (esu) abamp (emu)
Density	1×10^3 16.02 515.4	kg/meter ³ kg/meter ³ kg/meter ³	g/cm ³ pound/foot ³ slug/foot ³
Distance (or length) l, L	1×10^{-3} 2.540×10^{-2} 0.3048 1×10^3 1609	meter meter meter meter meter	cm inch foot kilometer mile
Electric displacement (or induction), D	$1/(12\pi \times 10^3)$ $10^4/4\pi$	coulomb/meter ² coulomb/meter ²	esu of displacement (no name assigned) emu of displacement (no name assigned)
Electric field intensity, E	1×10^3 2.998×10^4 2.998×10^{18}	volt/meter or newton/coulomb volt/meter volt/meter	volt/cm dyne/statcoulomb (esu) dyne/abcoulomb (emu)
Energy (or work), W	1×10^{-7} 3.6×10^6 4.186 1.356 1055	joule joule joule joule joule	erg kwhr calorie ft lb Btu
Force (or weight), F	10^{-4} 0.1383 4.448 9.807×10^{-3}	newton newton newton newton	dyne poundal pound (force) gram (force)
Inductance, L or M	1×10^{-9} 8.987×10^{11} 1×10^{-6} 1×10^{-3}	henry henry henry henry	abhenry (emu) stathenry (esu) microhenry millihenry

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Quantity	Conversion Factor		
	Conversion number	Numerator	Unit of Denominator
Magnetic field intensity, H	$10^3/4\pi$	amp turn/meter	oersted (emu)
	1×10^3	amp turn/meter	abamp turn/cm (emu)
	39.37	amp turn/meter	amp turn/inch
Magnetic flux, Φ	1×10^{-8}	weber	maxwell, or line (emu)
	1×10^{-8}	weber	kiloline (emu)
	2.998×10^9	weber	esu of Φ (no name assigned)
Magnetic flux density, B	1×10^{-4}	weber/meter ²	gauss, or line/cm ² (emu)
	1.550×10^{-4}	weber/meter ²	kilolines/inch ²
	2.998×10^9	weber/meter ²	esu of B (no name assigned)
Magnetomotive force, mmf	10	amp turn	abamp turn (emu)
	$10/4\pi$	amp turn	gilbert (emu)
Mass	1×10^{-3}	kilogram	g
	14.59	kilogram	slug
	0.4536	kilogram	pound (mass)
	2.205	pound (mass)	kilogram
Pole strength, m	$4\pi \times 10^{-9}$	weber (mks Kennelly) [†]	unit pole (emu)
	0.1	amp meter (mks Sommerfeld) [‡]	unit pole (emu)
	$4\pi \times 10^{-7}$	weber (mks Kennelly)	amp meter (mks Sommerfeld)
Potential difference and emf, V, \mathcal{E}	299.8	volt	statvolt (esu)
	1×10^{-9}	volt	abvolt (emu)
Power, p, P	1×10^{-7}	watt	erg/sec
	745.7	watt	horsepower
	1.356	watt	footpound/sec
	4.186	watt	calorie/sec

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	Conversion number	Unit of Numerator	Unit of Denominator
Resistance	8.987×10^{11}	ohm	statohm (esu)
	1×10^{-9}	ohm	abohm (emu)
Resistivity	1×10^{-8}	ohm meter	ohm cm
	1×10^{-11}	ohm meter	abohm cm (emu)
	8.987×10^9	ohm meter	statohm cm (esu)
Speed	0.3048	meter/sec	foot/sec
	0.4470	meter/sec	mile/hr
	0.2778	meter/sec	kilometer/hr
Volume	1×10^{-4}	meter ³	cm ³
	2.832×10^{-2}	meter ³	foot ³
	1.639×10^{-6}	meter ³	inch ³
	1×10^{-3}	meter ³	liter

† Not used in this text, see footnote 6, Par. 17-6.

‡ Used in this text.

INSTRUCTIONS FOR USE OF TABLE OF CONVERSION FACTORS. In making a conversion of a quantity from one system to another, be sure that the proper units are on the number to be converted (e. g., 1.52 radian, 6.15 statcoulomb, 5×10^7 maxwell). Next secure the appropriate conversion factor from the table. The second column gives the conversion number and the third and fourth columns give the units which belong to the conversion number; the third column is the unit of the numerator of the conversion number and the fourth column that of the denominator (e. g., the conversion factors 57.30 degree/radian, 3.336×10^{-10} coulomb/statcoulomb, 1×10^{-8} weber/maxwell). Then perform the operation (multiplication or division) with the conversion factor which will cancel the units which you wish to eliminate and retain the units which you wish to retain. For example, suppose you know that the magnetic flux density of a certain magnetic field is $B = 5.5 \times 10^3$ gauss and you wish to know the magnetic flux density of this same field expressed in weber/m². From the table, the conversion factor is

$$1 \times 10^{-4} \frac{\text{weber/m}^2}{\text{gauss}}$$

The unit to be canceled is the gauss and the unit to be retained is weber/m².