

Appendix B: Conversion of Physical Units

Physical quantity	Gaussian units [cgs]	Rationalized metric units [mks]
Length	1 cm	$= 10^{-2}$ m
Mass	1 g	$= 10^{-3}$ kg
Time	1 s	$= 1$ s
Force	1 dyne	$= 10^{-5}$ N (Newton)
Energy	1 erg	$= 10^{-7}$ J (Joule)
Power	1 erg s ⁻¹	$= 10^{-7}$ W (Watt)
Charge	1 statcoulomb	$= \frac{1}{3} \cdot 10^{-9}$ C (Coulomb)
Electric field	1 statvolt cm ⁻¹	$= 3 \cdot 10^4$ V m ⁻¹
Current	1 statampere	$= \frac{1}{3} \cdot 10^{-9}$ A (Ampère)
Current density	1 statampere cm ⁻²	$= \frac{1}{3} \cdot 10^{-5}$ A m ⁻²
Electrical conductivity	1 s ⁻¹	$= \frac{1}{9} \cdot 10^{-9}$ Siemens m ⁻¹
Magnetic induction	1 G (Gauss)	$= 10^{-4}$ T (Tesla)
Magnetic field	1 Oersted	$= \frac{1}{4\pi} \cdot 10^3$ A m ⁻¹

Appendix C: Maxwell's Equations in Different Physical Unit Systems

Gaussian units [cgs] (current in <i>emu</i> units)	Gaussian units [cgs] (current in <i>esu</i> units)	Rationalized metric units [mks]
$\nabla \cdot \mathbf{E} = 4\pi\rho_E$	$\nabla \cdot \mathbf{E} = 4\pi\rho_E$	$\nabla \cdot \mathbf{D} = \rho_E$
$\nabla \cdot \mathbf{B} = 0$	$\nabla \cdot \mathbf{B} = 0$	$\nabla \cdot \mathbf{B} = 0$
$\nabla \times \mathbf{E} = -\frac{1}{c} \frac{d\mathbf{B}}{dt}$	$\nabla \times \mathbf{E} = -\frac{1}{c} \frac{d\mathbf{B}}{dt}$	$\nabla \times \mathbf{E} = -\frac{d\mathbf{B}}{dt}$
$\nabla \times \mathbf{H} = \frac{1}{c} \frac{d\mathbf{D}}{dt} + 4\pi\mathbf{j}$	$\nabla \times \mathbf{H} = \frac{1}{c} \frac{d\mathbf{D}}{dt} + \left(\frac{4\pi}{c}\right)\mathbf{j}$	$\nabla \times \mathbf{H} = \frac{d\mathbf{D}}{dt} + \mathbf{j}$

- *emu* units: The current \mathbf{j} is measured in *electromagnetic units*.
- *esu* units: The current \mathbf{j} is measured in *electrostatic units*, the ratio of the values of \mathbf{j} is $\mathbf{j}(esu)/\mathbf{j}(emu) = c \approx 3 \times 10^{10}$ cm s⁻¹.
- *Rationalized mks units* are SI units with the factor 4π removed from the equations.
- The electric displacement is $\mathbf{D} = \varepsilon\mathbf{E}$, with $\varepsilon \approx 1$ in cgs units.
- The magnetic field is $\mathbf{H} = \mathbf{B}/\mu$, with $\mu \approx 1$ in cgs units.