Units

Quantity	Symbol	SI	CGS
distance	s	m	cm
mass	m	kg	g
time	t	s	s
velocity	v	$\frac{\text{m}}{\text{s}}$	$\frac{\text{cm}}{\text{s}}$
momentum	p	$\frac{\text{kg}\cdot\text{m}}{\text{s}}$	$\frac{\text{gm}\cdot\text{cm}}{\text{s}}$
force	F	Newton(N) $= \frac{\text{kg}\cdot\text{m}}{\text{s}^2}$	dyne $= \frac{\text{gm}\cdot\text{cm}}{\text{s}^2}$
energy, work	W, U	Joule(J) $=$ N $\cdot$ m $= \frac{\text{kg}\cdot\text{m}^2}{\text{s}^2}$	erg $=$ dyne $\cdot$ cm $= \frac{\text{gm}\cdot\text{cm}^2}{\text{s}^2}$
power	P	Watt(W) $= \frac{\text{J}}{\text{s}} = \frac{\text{kg}\cdot\text{m}^2}{\text{s}^3}$	$\frac{\text{erg}}{\text{s}} = \frac{\text{gm}\cdot\text{cm}^2}{\text{s}^3}$
electric charge	q	Coulomb(C)	esu
electric potential	φ	Volt(V) $= \frac{\text{J}}{\text{C}} = \frac{\text{kg}\cdot\text{m}^2}{\text{C}\cdot\text{s}^2}$	statvolt $= \frac{\text{erg}}{\text{esu}} = \frac{\text{gm}\cdot\text{cm}^2}{\text{esu}\cdot\text{s}^2}$
electric field	E	$\frac{\text{V}}{\text{m}} = \frac{\text{N}}{\text{C}} = \frac{\text{kg}\cdot\text{m}}{\text{C}\cdot\text{s}^2}$	$\frac{\text{statvolt}}{\text{cm}} = \frac{\text{dyne}}{\text{esu}} = \frac{\text{gm}\cdot\text{cm}}{\text{esu}\cdot\text{s}^2}$
electric current	I	A $= \frac{\text{C}}{\text{s}}$	$\frac{\text{esu}}{\text{s}}$
current density	J	$\frac{\text{A}}{\text{m}^2} = \frac{\text{C}}{\text{m}^2\cdot\text{s}}$	$\frac{\text{esu}}{\text{cm}^2\cdot\text{s}}$
resistance	R	Ohm(Ω) $= \frac{\text{V}}{\text{A}} = \frac{\text{kg}\cdot\text{m}^2}{\text{C}^2\cdot\text{s}}$	$\frac{\text{s}}{\text{cm}}$
resistivity	ρ	$\Omega \cdot$ m $= \frac{\text{kg}\cdot\text{m}^3}{\text{C}^2\cdot\text{s}}$	s
conductance	G	Siemens $=$ mho $= \frac{1}{\Omega} = \frac{\text{C}^2\cdot\text{s}}{\text{kg}\cdot\text{m}^2}$	$\frac{\text{cm}}{\text{s}}$
conductivity	σ	$\frac{1}{\Omega\cdot\text{m}} = \frac{\text{Siemens}}{\text{m}} = \frac{\text{C}^2\cdot\text{s}}{\text{kg}\cdot\text{m}^3}$	$\frac{1}{\text{s}}$
magnetic flux density	B	Tesla(T) $= \frac{\text{N}}{\text{A}\cdot\text{m}} = \frac{\text{kg}}{\text{C}\cdot\text{s}}$	gauss $= \frac{\text{dyne}}{\text{esu}} = \frac{\text{gm}\cdot\text{cm}}{\text{esu}\cdot\text{s}^2}$
magnetic field	H	$\frac{\text{A}}{\text{m}} = \frac{\text{C}}{\text{m}\cdot\text{s}}$	Oersted $= \frac{\text{dyne}}{\text{esu}} = \frac{\text{gm}\cdot\text{cm}}{\text{esu}\cdot\text{s}^2}$
magnetic flux	Φ	Weber $=$ T $\cdot$ m^2 $= \frac{\text{N}\cdot\text{m}}{\text{A}} = \frac{\text{kg}\cdot\text{m}^2}{\text{C}\cdot\text{s}}$	Gauss $\cdot$ cm^2 $= \frac{\text{dyne}\cdot\text{cm}^2}{\text{esu}} = \frac{\text{gm}\cdot\text{cm}^3}{\text{esu}\cdot\text{s}^2}$
capacitance	C	Farad(F) $= \frac{\text{sec}}{\Omega} = \frac{\text{C}^2\cdot\text{s}^2}{\text{kg}\cdot\text{m}^2}$	cm
inductance	L, M	Henry(H) $= \Omega \cdot$ s $= \frac{\text{kg}\cdot\text{m}^2}{\text{C}^2}$	$\frac{\text{s}^2}{\text{cm}}$

$\epsilon_0 = 8.854 \times 10^{-12}\ \frac{\text{F}}{\text{m}}$
$\mu_0 = 4\pi \times 10^{-7}\ \frac{\text{H}}{\text{m}}$
$c^2\mu_0\epsilon_0 = 1$

Unities

Quantity	Detail	Unity
mass		$\frac{1\ \mathrm{kg}}{1000\ \mathrm{g}}$
distance		$\frac{1\ \mathrm{m}}{100\ \mathrm{cm}}$
velocity		$\frac{1\ {}^{\mathrm{m}}/_{\mathrm{s}}}{100\ {}^{\mathrm{cm}}/_{\mathrm{s}}}$
momentum		$\frac{1\ {}^{\mathrm{kg \cdot m}}/_{\mathrm{s}}}{100{,}000\ {}^{\mathrm{g \cdot cm}}/_{\mathrm{s}}}$
force		$\frac{1\ \mathrm{N}}{100{,}000\ \mathrm{dyne}}$
energy		$\frac{1\ \mathrm{J}}{10{,}000{,}000\ \mathrm{erg}}$
power		$\frac{1\ \mathrm{W}}{10{,}000{,}000\ {}^{\mathrm{erg}}/_{\mathrm{s}}}$
electric charge	$\frac{\mathrm{C}}{\mathrm{esu}} \rightarrow \sqrt{\frac{4\pi\epsilon_0}{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}} 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} = \frac{1}{10\ \mathrm{c}}$	$\frac{1\ \mathrm{C}}{3.00\times 10^9\ \mathrm{esu}}$
electric potential	$\frac{\mathrm{V}}{\mathrm{statvolt}} \rightarrow \sqrt{\frac{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}}{4\pi\epsilon_0 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} = \frac{\mathrm{c}}{10^6}$	$\frac{300\ \mathrm{V}}{1\ \mathrm{statvolt}}$
electric field	$\frac{{}^{\mathrm{V}}/_{\mathrm{m}}}{{}^{\mathrm{statvolt}}/_{\mathrm{cm}}} \rightarrow \sqrt{\frac{\left(10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}\right)^3}{4\pi\epsilon_0 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}}$	$\frac{\mathrm{c}}{10^4} = \frac{30{,}000\ {}^{\mathrm{V}}/_{\mathrm{m}}}{1\ {}^{\mathrm{statvolt}}/_{\mathrm{cm}}}$
electric current	$\frac{\mathrm{A}}{{}^{\mathrm{esu}}/_{\mathrm{s}}} \rightarrow \sqrt{\frac{4\pi\epsilon_0}{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}} 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} = \frac{1}{10\ \mathrm{c}}$	$\frac{1\ \mathrm{A}}{3.00\times 10^9\ {}^{\mathrm{esu}}/_{\mathrm{s}}}$
current density	$\frac{{}^{\mathrm{A}}/_{\mathrm{m^2}}}{{}^{\mathrm{esu}}/_{\mathrm{cm^2 \cdot s}}} \rightarrow \sqrt{\frac{4\pi\epsilon_0 \left(10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}\right)^3}{10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} = \frac{10^3}{\mathrm{c}}$	$\frac{1\ {}^{\mathrm{A}}/_{\mathrm{m^2}}}{3\times 10^5\ {}^{\mathrm{esu}}/_{\mathrm{cm^2 \cdot s}}}$
resistance	$\frac{\Omega}{{}^{\mathrm{s}}/_{\mathrm{cm}}} = \frac{\frac{\mathrm{V}}{\mathrm{statvolt}}}{\frac{\mathrm{A}}{{}^{\mathrm{esu}}/_{\mathrm{s}}}} \rightarrow \sqrt{\frac{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}}{4\pi\epsilon_0 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} \cdot \sqrt{\frac{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}} 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}{4\pi\epsilon_0}} = \frac{\mathrm{c}^2}{10^5}$	$\frac{1\ \Omega}{1.113\times 10^{-12}\ {}^{\mathrm{s}}/_{\mathrm{cm}}}$
resistivity	$\frac{\Omega \cdot \mathrm{m}}{\mathrm{s}} = \frac{\Omega}{{}^{\mathrm{s}}/_{\mathrm{cm}}} \cdot \frac{\mathrm{m}}{\mathrm{cm}} \rightarrow \sqrt{\frac{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}}{4\pi\epsilon_0 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} \cdot \frac{1\ \mathrm{m}}{100\ \mathrm{cm}} = \frac{\mathrm{c}}{10^8}$	$\frac{3\ \Omega \cdot \mathrm{m}}{1\ \mathrm{s}}$
conductance	$\frac{\mathrm{mho}}{{}^{\mathrm{cm}}/_{\mathrm{s}}} = \frac{1}{\frac{\Omega}{{}^{\mathrm{s}}/_{\mathrm{cm}}}} \rightarrow \frac{\mathrm{c}^2}{10^5}$	$\frac{1.113\times 10^{-12}\ \mathrm{mho}}{1\ {}^{\mathrm{cm}}/_{\mathrm{s}}}$
conductivity	$\frac{{}^{1}/_{\mathrm{s}}}{{}^{1}/_{\Omega \cdot \mathrm{m}}} = \frac{1}{\frac{\Omega \cdot \mathrm{m}}{\mathrm{s}}} \rightarrow \frac{10^8}{\mathrm{c}}$	$\frac{1\ {}^{1}/_{\Omega \cdot \mathrm{m}}}{3\ {}^{1}/_{\mathrm{s}}}$
magnetic flux density	$\frac{\mathrm{Tesla}}{\mathrm{Gauss}} \rightarrow \sqrt{\frac{\left(10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}\right)^3 \mu_0}{4\pi 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}}$	$\frac{1\ \mathrm{T}}{10{,}000\ \mathrm{G}}$
magnetic field	$\frac{{}^{\mathrm{A}}/_{\mathrm{m}}}{\mathrm{Oersted}} = \frac{\mathrm{c}\frac{{}^{\mathrm{cm}}/_{\mathrm{s}}}{{}^{\mathrm{m}}/_{\mathrm{s}}}}{4\pi\frac{\mathrm{cm}}{\mathrm{s}}} \cdot \frac{{}^{\mathrm{A}}/_{\mathrm{m^2}}}{{}^{\mathrm{esu}}/_{\mathrm{cm^2 \cdot s}}} \rightarrow \frac{\mathrm{c}}{4\pi} \cdot \sqrt{\frac{4\pi\epsilon_0 \left(10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}\right)^3}{10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} = \frac{10^3}{4\pi}$	$\frac{79.577\ {}^{\mathrm{A}}/_{\mathrm{m}}}{1\mathrm{Oersted}}$
magnetic flux	$\frac{\mathrm{Tesla \cdot m^2}}{\mathrm{Gauss \cdot cm^2}} \rightarrow \frac{1}{10^4}\sqrt{\frac{\left(10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}\right)^3 \mu_0}{4\pi 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}}$	$\frac{1\ \mathrm{T \cdot m^2}}{10^8\ \mathrm{G \cdot m^2}}$
capacitance	$\frac{\mathrm{F}}{\mathrm{cm}} = \frac{\frac{\mathrm{C}}{\mathrm{esu}}}{\frac{\mathrm{V}}{\mathrm{statvolt}}} \rightarrow \sqrt{\frac{4\pi\epsilon_0}{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}} 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} \cdot \sqrt{\frac{4\pi\epsilon_0 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}}} = \frac{10^5}{\mathrm{c}^2}$	$\frac{1.113\times 10^{-12}\ \mathrm{F}}{1\mathrm{cm}}$
inductance	$\frac{\mathrm{H}}{{}^{\mathrm{s^2}}/_{\mathrm{cm}}} = \frac{\Omega}{{}^{\mathrm{s}}/_{\mathrm{cm}}} \rightarrow \sqrt{\frac{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}}}{4\pi\epsilon_0 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}} \cdot \sqrt{\frac{10^2\ {}^{\mathrm{cm}}/_{\mathrm{m}} 10^7\ {}^{\mathrm{erg}}/_{\mathrm{J}}}{4\pi\epsilon_0}} = \frac{\mathrm{c}^2}{10^5}$	$\frac{1\ \mathrm{H}}{1.113\times 10^{-12}\ {}^{\mathrm{s^2}}/_{\mathrm{cm}}}$

Symbolic conversions

The units of time, length, and mass in both systems are simply related by orders of magnitude; there are no symbolic constants in equations between the two systems involving these three fundamental units. Therefore, equations of velocity, force, momentum, energy, etc. remain the same in either unit system. However, because the unit of charge is defined differently (the presence of ϵ_0 and μ_0), the only symbolic differences lie when dealing with units related to electromagnetism.

Quantity	Derivation equations	Factors
electric charge	$\mathrm{F_{SI}} = \frac{1}{4\pi\epsilon_0}\frac{\mathrm{q_{SI}^2}}{\mathrm{r^2}} \equiv \frac{\mathrm{q_{CGS}^2}}{\mathrm{r^2}} = \mathrm{F_{CGS}}$	$\mathrm{q_{CGS}} = \frac{1}{\sqrt{4\pi\epsilon_0}}\mathrm{q_{SI}}$
electric potential	$\mathrm{V_{SI}} = \frac{1}{4\pi\epsilon_0}\frac{\mathrm{q_{SI}}}{\mathrm{r}} \equiv \frac{\mathrm{q_{CGS}}}{\mathrm{r}} = \mathrm{V_{CGS}}$	$\mathrm{V_{CGS}} = \sqrt{4\pi\epsilon_0}\mathrm{V_{SI}}$
electric field	$\mathrm{E_{SI}} = \frac{1}{4\pi\epsilon_0}\frac{\mathrm{q_{SI}}}{\mathrm{r^2}} \equiv \frac{\mathrm{q_{CGS}}}{\mathrm{r^2}} = \mathrm{E_{CGS}} \rightarrow \mathrm{E} \equiv \mathrm{V}$	$\mathrm{E_{CGS}} = \sqrt{4\pi\epsilon_0}\mathrm{E_{SI}}$
electric current	$\mathrm{I} = \frac{\mathrm{dq}}{\mathrm{dt}} \rightarrow \mathrm{I} \equiv \mathrm{q}$	$\mathrm{I_{CGS}} = \frac{1}{\sqrt{4\pi\epsilon_0}}\mathrm{I_{SI}}$
current density	$\mathrm{J} = \frac{\mathrm{I}}{\mathrm{area}} \rightarrow \mathrm{J} \equiv \mathrm{I}$	$\mathrm{J_{CGS}} = \frac{1}{\sqrt{4\pi\epsilon_0}}\mathrm{J_{SI}}$
resistance	$\mathrm{R_{CGS}} = \frac{\mathrm{V_{CGS}}}{\mathrm{I_{CGS}}} = \frac{\sqrt{4\pi\epsilon_0}\mathrm{V_{SI}}}{\frac{1}{\sqrt{4\pi\epsilon_0}}\mathrm{I_{SI}}}$	$\mathrm{R_{CGS}} = (4\pi\epsilon_0)\,\mathrm{R_{SI}}$
resistivity	$\rho = \frac{\mathrm{R \cdot area}}{\mathrm{length}} \rightarrow \rho \equiv \mathrm{R}$	$\rho_{\mathrm{CGS}} = (4\pi\epsilon_0)\,\rho_{\mathrm{SI}}$
conductance	$\mathrm{G_{CGS}} = \frac{1}{\mathrm{R_{CGS}}} \equiv \frac{1}{\mathrm{R_{SI}}} = \mathrm{G_{SI}}$	$\mathrm{G_{CGS}} = \frac{1}{4\pi\epsilon_0}\mathrm{G_{SI}}$
conductivity	$\sigma = \frac{1}{\rho}$	$\sigma_{\mathrm{CGS}} = \frac{1}{4\pi\epsilon_0}\sigma_{\mathrm{SI}}$
magnetic flux density	$\mathrm{B_{CGS}} = \frac{2\mathrm{I_{CGS}}}{\mathrm{rc}} \equiv \frac{\mu_0\mathrm{I_{SI}}}{2\pi\mathrm{r}} = \mathrm{B_{SI}}$	$\mathrm{B_{CGS}} = \frac{4\pi}{\mathrm{c}\mu_0\sqrt{4\pi\epsilon_0}}\mathrm{B_{SI}}$
magnetic field	$\mathrm{H_{CGS}} = \mathrm{B_{CGS}} \equiv \frac{\mathrm{B_{SI}}}{\mu_0} = \mathrm{H_{SI}}$	$\mathrm{H_{CGS}} = \frac{4\pi\sqrt{4\pi\epsilon_0}}{\mathrm{c}}\mathrm{H_{SI}}$
magnetic flux	$\Phi = \mathrm{B} \cdot \mathrm{area} \rightarrow \Phi \equiv \mathrm{B}$	$\Phi_{\mathrm{CGS}} = \frac{4\pi}{\mathrm{c}\mu_0\sqrt{4\pi\epsilon_0}}\Phi_{\mathrm{SI}}$
capacitance	$\mathrm{C_{CGS}} = \frac{\mathrm{A}}{4\pi\mathrm{d}} \equiv \frac{\epsilon_0\mathrm{A}}{\mathrm{d}} = \mathrm{C_{SI}}$	$\mathrm{C_{CGS}} = \frac{1}{4\pi\epsilon_0}\mathrm{C_{SI}}$
inductance	$\mathrm{L_{CGS}} = \frac{\Phi_{\mathrm{CGS}}}{\mathrm{I_{CGS}c}} = \frac{\frac{4\pi}{\mathrm{c}\mu_0\sqrt{4\pi\epsilon_0}}\Phi_{\mathrm{SI}}}{\frac{1}{\sqrt{4\pi\epsilon_0}}\mathrm{I_{SI}c}} \equiv \frac{\Phi_{\mathrm{SI}}}{\mathrm{I_{SI}}} = \mathrm{L_{SI}}$	$\mathrm{L_{CGS}} = \frac{4\pi}{\mathrm{c}^2\mu_0}\mathrm{L_{SI}}$

To use these conversions, substitute each variable (symbol) in the CGS equation with the expression to the right of the equal sign in the right-most column. For example, when applied to equation 3.16 in Purcell: $C_{\mathrm{CGS}} = \frac{A}{4\pi s}$ only the C on the left hand side needs to be substituted: $\frac{1}{4\pi\epsilon_0}C_{\mathrm{SI}} = \frac{A}{4\pi s} \quad \rightarrow \quad C_{\mathrm{SI}} = \frac{\epsilon_0 A}{s}$.