In SI units

$c = 2.99792458 \times 10^8$ m/s (exact)

$\hbar = 1.0545717 \times 10^{-34}$ J-s

$\varepsilon_0 = 8.854187817 \times 10^{-12}$ F m^{-1} $= \frac{1}{\mu_0 c^2}$ with $\mu_0 = 4\pi \times 10^{-7}$ NA^{-2}

$1\,GeV = 1.6021765 \times 10^{-10}$ J

a) Dimensionally $L = \frac{L}{T} \times \frac{T \times E}{E} = \frac{\hbar c}{E}$

∴ Natural unit of length is GeV^{-1}

$1\,\hbar c/GeV = \frac{1.0545\ldots \times 10^{-34}\,J\text{-}s \times 2.99792\ldots\,m/s}{1.60217\ldots\,J} = 1.97327 \times 10^{-16}$ m

b) Area is length squared, unit is GeV^{-2}

$1\,(\hbar c/GeV)^2 = 3.89379 \times 10^{-32}$ m^2

c) $T = \frac{T \times E}{E} = \frac{\hbar}{E}$

∴ time is in GeV^{-1}

$1\,\hbar/GeV = 6.58212 \times 10^{-25}$ sec

d) Energy $[E] = \left[\frac{Q^2}{\varepsilon_0 L}\right]$ so $[\varepsilon_0] = \left[\frac{Q^2}{EL}\right]$ & $Q = \sqrt{\varepsilon_0 E L}$

Potential $[V] = \frac{E}{Q} = \sqrt{\frac{E}{\varepsilon_0 L}} = \sqrt{\frac{E^2}{\varepsilon_0 \hbar c}} = \left[\frac{E}{\sqrt{\varepsilon_0 \hbar c}}\right]$,

∴ V is in GeV

$\therefore$ $1\ GeV/\sqrt{\varepsilon_0 \hbar c} = 3.02822 \times 10^8\ V.$

c) Charge $[Q] = [\sqrt{\varepsilon_0}\, EL] = \sqrt{[\varepsilon_0 \hbar c]}$.

$\therefore$ charge is dimensionless in natural units

$1\sqrt{\varepsilon_0 \hbar c} = 5.29082 \times 10^{-19}\ C$

f) $1\ m^2 = 10^4\ cm^2 = 10^{28}\ b = 10^{31}\ mb$

$\therefore$ $1\ (\hbar c)^2\ GeV^{-2} = 3.89379 \times 10^{-32} \times 10^{31}\ mb$

$= 0.389379\ mb$

g) $e = 1.602177 \times 10^{-19}\ C$

$= \dfrac{1.602177 \times 10^{-19}}{5.29082 \times 10^{-19}}$ natural units

$= 0.302822$.

Inverse conversion factors: $1\ m = \dfrac{1}{1.97327 \times 10^{-16}} \dfrac{\hbar c}{GeV} = 5.0677 \times 10^{15}\ \dfrac{\hbar c}{GeV}$

$1\ m^2 = \dfrac{1}{3.89379 \times 10^{-32}} = 2.5682 \times 10^{31}\ \dfrac{\hbar c^2}{GeV^2}$

$1\ s = \dfrac{1}{6.58212 \times 10^{-25}} = 1.51927 \times 10^{24}\ \hbar/GeV$

$1\ volt = 3.30227 \times 10^{-9}\ GeV/\sqrt{\varepsilon_0 \hbar c}$

$1\ C = 1.890066 \times 10^{18}\ \sqrt{\varepsilon_0 \hbar c}$

$1\ mb = 2.5682\ \hbar c^2/GeV^2$