

C Physical Constants

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The speed of light in free space (c), which is the phase velocity of any electromagnetic radiation in free space, is $\cong 2.9979 \times 10^8$ m/s. This is commonly rounded up to 3×10^8 m/s. This rounding incurs error of $\cong 0.07\%$, which is usually much less than other errors present in electrical engineering calculations.

The charge of an electron is $\cong -1.602 \times 10^{-19}$ C. The constant $e \triangleq +1.602176634 \times 10^{-19}$ C is known as the “elementary charge,” so the charge of the electron is said to be $-e$.

The permittivity of free space (ϵ_0) is $\cong 8.854 \times 10^{-12}$ F/m.

The permeability of free space (μ_0) is $4\pi \times 10^{-7}$ H/m.

The wave impedance of free space (η_0) is the ratio of the magnitude of the electric field intensity to that of the magnetic field intensity in free space and is $\sqrt{\mu_0/\epsilon_0} \cong 376.7 \Omega$. This is also sometimes referred to as the *intrinsic impedance of free space*.

Boltzmann’s constant is $\cong 1.381 \times 10^{-23}$ J/K, the amount of energy associated with a change of one degree of temperature. This is typically assigned the symbol k (unfortunately, the same symbol often used to represent *wavenumber*).