Constants

$$e = 1.6 \times 10^{-19}\ \text{C} \qquad m_e = 9.11 \times 10^{-31}\ \text{kg} \qquad m_p = 1.67 \times 10^{-27}\ \text{kg}$$

$$\epsilon_0 = 8.85 \times 10^{-12}\ \text{C}^2/\text{Nm}^2 \qquad k = 1/4\pi\epsilon_0 = 9 \times 10^9\ \text{Nm}^2/\text{C}^2 \qquad \mu_0 = 4\pi \times 10^{-7}\ \text{Tm/A}$$

$$c = 3.00 \times 10^8\ \text{m/s}$$

Formulas

$$A_{\text{sphere}} = 4\pi r^2 \qquad c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} \qquad c = \lambda f \qquad f = \frac{1}{T}$$

$$E(t) = E_{\text{peak}} \sin(2\pi f t) \qquad E_{\text{rms}} = \frac{E_{\text{peak}}}{\sqrt{2}} \qquad B_{\text{rms}} = \frac{B_{\text{peak}}}{\sqrt{2}} \qquad B(t) = B_{\text{peak}} \sin(2\pi f t)$$

$$c = \frac{E(t)}{B(t)} = \frac{E_{\text{rms}}}{B_{\text{rms}}} = \frac{E_{\text{peak}}}{B_{\text{peak}}} \qquad u_E = \frac{1}{2}\epsilon_0 E^2 \qquad u_B = \frac{1}{2\mu_0} B^2 \qquad u = u_E + u_B = \epsilon_0 E^2 = \frac{B^2}{\mu_0}$$

$$S = cu \qquad \bar{u} = \epsilon_0 E_{\text{rms}}^2 = \frac{B_{\text{rms}}^2}{\mu_0} \qquad \bar{S} = c\bar{u} = \frac{\bar{P}}{A} \qquad \bar{S} = \bar{S}_0 \cos^2\theta$$

$$f = \pm\frac{R}{2} \qquad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \qquad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o} \qquad m_{\text{tot}} = m_1 m_2 = \frac{d_{i1} d_{i2}}{d_{o1} d_{o2}}$$

$$v = \frac{c}{n} \qquad n\lambda_n = \lambda_{\text{vacuum}} \qquad n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$d' = d\left(\frac{n_2}{n_1}\right) \qquad \sin\theta_c = \frac{n_2}{n_1} \qquad \tan\theta_B = \frac{n_2}{n_1}$$