\[ \varepsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2 \quad k = \frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2 \quad \mu_0 = 4\pi \times 10^{-7} \text{ T} \cdot \text{m}/\text{A} \]

\[ e = 1.6 \times 10^{-19} \text{ C} \quad m_{\text{electron}} = 9.1 \times 10^{-31} \text{ kg} \quad m_{\text{proton}} = 1.67 \times 10^{-27} \text{ kg} \]

\[ h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s} \quad g = 9.80 \text{ m/s}^2 = 32.0 \text{ ft/s}^2 \quad G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2 \quad c = 3.00 \times 10^8 \text{ m/s} \]

\[ \vec{A} \cdot \vec{B} = AB \cos \theta \quad |\vec{A} \times \vec{B}| = AB \sin \theta \]

\[ F = q \vec{v} \times \vec{B} \quad \vec{F} = \vec{I} \vec{I}' \times \vec{B} \]

\[ \frac{F}{L} = \frac{\mu_0 I'}{2\pi r} \]

\[ \Phi_B = \int \vec{B} \cdot d\vec{A} \quad \vec{B} = \frac{\mu_0 q\vec{v} \times \vec{r}}{4\pi r^2} \]

\[ B = \frac{\mu_0 I}{2\pi r} \quad B = \frac{\mu_0 I \phi}{4\pi a} \]

\[ B = \frac{\mu_0 NI}{2a} \quad B = \mu_0 nI \]

\[ B = \frac{\mu_0 NI}{2\pi r} \]

\[ \vec{E} = -N \frac{d\Phi_B}{dt} = \oint \vec{E} \cdot d\vec{l} \]

\[ \vec{\mu} = MV \quad \vec{B} = \vec{B}_0 + \mu_0 \vec{M} \]

\[ M = \frac{N_2 \Phi_2}{i_1} \quad L = \frac{N \Phi}{i} \]

\[ \tau_L = \frac{L}{R} \]

\[ i = \left( \frac{\vec{E}}{R} \right) (1 - e^{-t/\tau_L}) \]

\[ \vec{E}_x = -\frac{dL}{dt} \quad \vec{E}_y = -\frac{dM}{dt} \]

\[ U_B = \frac{1}{2} Li^2 \quad u_B = \frac{B^2}{2\mu_0} \]

\[ P = \vec{E} \vec{i} = i^2 R = \frac{Li}{dt} \]

\[ E(x,t) = E_{\text{max}} \sin(\omega t - kx) \]

\[ B(x,t) = B_{\text{max}} \sin(\omega t - kx) \]

\[ k = \frac{2\pi}{\lambda} \quad \omega = 2\pi f \]

\[ c = f\lambda \]

\[ \int \frac{E_{\text{max}}}{B_{\text{max}}} = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} \]

\[ \frac{S}{A} = \frac{P}{4\pi^2} \]

\[ S = \frac{P}{A} \]

\[ S = \frac{P}{4\pi^2} \]

\[ S_{\text{av}} = I = \frac{1}{2} \varepsilon_o c E_{\text{max}}^2 \]

\[ I = \frac{P_{\text{av}}}{A} \]

\[ P_{\text{rad}} = \frac{I}{c} \]

\[ I = \frac{1}{2} I_{\text{max}} \]

\[ I = I_{\text{max}} \cos^2 \phi \]

\[ \theta_i = \theta_r \quad n = \frac{c}{v} \]

\[ n_a \sin \theta_a = n_b \sin \theta_b \]

\[ \sin \theta_{\text{crit}} = \frac{n_b}{n_a} \]

\[ \tan \theta_p = \frac{n_b}{n_a} \]

\[ \frac{1 + 1}{s} + \frac{1}{s'} = \frac{1}{f} \quad R = \frac{2}{f} \]

\[ E_{\text{max}} = \frac{1}{(n-1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right)} \]

\[ m = \frac{y'}{y} = -\frac{s'}{s} \quad f = \frac{25 \text{ cm}}{2} \]

\[ M = \frac{\theta'}{\theta} = \frac{25 \text{ cm}}{f} \]

\[ \beta = \frac{2\pi}{\lambda} \sin \theta \]

\[ \sin \theta_{\text{min}} = 1.22 \frac{\lambda}{D} \]

\[ D = \frac{\Delta \theta}{\Delta \lambda} = \frac{m}{d \cos \theta} \]

\[ R = \frac{2\pi a}{\lambda_{\text{min}}} - Nm \]

\[ \Delta t = \gamma \Delta t_0 \quad I = \frac{l_0}{\gamma} \]

\[ \gamma = \frac{1}{\sqrt{1 - (u/c)^2}} \]