

Equations

$$I = \frac{dq}{dt}, \quad I = \int \vec{J} \cdot d\vec{A}, \quad V = IR, \quad P = IV, \quad \vec{F} = m\vec{a}$$

$$\phi_B = \int \vec{B} \cdot d\vec{A}, \quad \varepsilon = -\frac{d\phi_B}{dt}, \quad \phi_B = BA \text{ (sometimes)}, \quad \varepsilon = -L\frac{dI}{dt}$$

$$(\text{Increasing}) \quad I = I_0(1 - e^{-t/\tau}), \quad \tau = L/R, \quad (\text{decreasing}) \quad I = I_0 e^{-t/\tau}$$

$$\vec{F} = I\vec{l} \times \vec{B}, \quad d\vec{F} = I d\vec{l} \times \vec{B}, \quad \phi_E = \int \vec{E} \cdot d\vec{A}$$

$$\oint \vec{E} \cdot d\vec{s} = -\frac{d\phi_B}{dt}, \quad \oint \vec{B} \cdot d\vec{s} = \mu_0 \epsilon_0 \frac{d\phi_E}{dt} + \mu_0 I_{\text{enclosed}}, \quad I_{\text{Displacement}} = \epsilon_0 \frac{d\phi_E}{dt}$$

$$B = \mu_0 n I \quad (\text{solenoid}), \quad L = \mu_0 n^2 A l \quad (\text{solenoid})$$

$$U_L = (1/2) LI^2, \quad U_C = (1/2) CV^2, \quad u_B = B^2/(2\mu_0), \quad u_E = \epsilon_0 E^2/2$$

$$c = E/B, \quad \text{Pressure} = S/c, \quad \vec{S} = (1/\mu_0) \vec{E} \times \vec{B}, \quad S_{av} = E_{max} B_{max}/(2\mu_0)$$

$$\vec{E} = \vec{E}_0 \sin(kx - \omega t), \quad k = 2\pi/\lambda, \quad \omega = 2\pi f, \quad c_{\text{vacuum}} = \lambda f = 1/\sqrt{\epsilon_0 \mu_0}$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad (\text{Snell's Law}), \quad \sin \theta_c = n_2/n_1, \quad n = c/v, \quad n_1 \lambda_1 = n_2 \lambda_2$$

$$E = E_0 \cos \theta_{\text{polarizer}}, \quad I = I_0 \cos^2 \theta_{\text{polarizer}}, \quad \theta_{\text{polarizer}} = \theta_E - \theta_{\text{axis}}^{\text{transmission}}$$

$$I_{\text{unpolarized}} \rightarrow I_{\text{unpolarized}}/2, \quad \text{Work} = \int \vec{F} \cdot d\vec{l} = Fl, \quad \text{Power} = \frac{dW}{dt} = Fv$$

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}, \quad M = -\frac{q}{p} = \frac{h'}{h}, \quad M_{\text{overall}} = M_1 \cdot M_2 \cdot M_3 \dots$$

$$|f| = |R/2| \text{ (mirror)}, \quad \frac{n_1}{p} + \frac{n_2}{q} = \frac{n_2 - n_1}{R}, \quad \frac{1}{f} = (n - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Constants

$$\begin{aligned} \mu_0 &= 4\pi \times 10^{-7} \frac{Tm}{A} \\ \epsilon_0 &= 8.85 \times 10^{-12} \frac{C^2}{Nm^2} \\ c &= 3.0 \times 10^8 \text{ m/s} \\ g &= 9.8 \text{ m/s}^2 \end{aligned}$$