

$$\vec{F} = k \frac{q_1 q_2}{r^2} \hat{r}$$

$$\vec{p} = q \vec{L}$$

$$E_{n2} - E_{n1} = \frac{\sigma}{\epsilon_0}$$

$$V = \frac{kq}{r}$$

$$E_r = -\frac{dV}{dr}$$

$$C = \frac{2\pi\epsilon_0 L}{\ln(b/a)}$$

$$U = \frac{1}{2} CV^2 = \frac{Q^2}{2C}$$

$$V = IR$$

$$P = I^2 R$$

$$\text{Junction: } \sum I_i = 0$$

$$d\vec{F} = I d\vec{l} \times \vec{B}$$

$$\vec{m} = NIA\hat{n}$$

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{r}}{r^2}$$

$$B = \frac{\mu_0}{4\pi} \frac{I}{R} (\sin \theta_1 + \sin \theta_2)$$

$$\phi_m = N \int \vec{B} \cdot d\vec{A}$$

$$\varepsilon = -L \frac{dI}{dt}$$

$$P_{av} = \varepsilon_{rms} I_{rms} \cos \delta$$

$$V_{Crms} = I_{rms} X_C$$

$$X_L = \omega L$$

$$\tan \delta = \frac{X_L - X_C}{R}$$

$$\theta_r = \theta_i$$

$$\sin \theta_C = \frac{n_2}{n_1}$$

$$\frac{1}{f} = (n - 1) \left( \frac{1}{r_1} - \frac{1}{r_2} \right)$$

$$M = \frac{x_{np}}{f}$$

$$\delta = \frac{2\pi \Delta r}{\lambda}$$

$$y_m = m \frac{\lambda L}{d}$$

$$\phi = \frac{2\pi}{\lambda} a \sin \theta$$

$$\vec{F} = q \vec{E}$$

$$\vec{E} = \int \frac{k dq}{r^2} \hat{r}$$

$$\Delta V = V_b - V_a = - \int_a^b \vec{E} \cdot d\vec{l}$$

$$V = \sum_i \frac{k q_i}{r_i}$$

$$C = \frac{Q}{V}$$

$$E = \frac{E_0}{\kappa}$$

$$C_{eq} = C_1 + C_2 + \dots$$

$$R = \rho \frac{L}{A}$$

$$R_{eq} = R_1 + R_2 + \dots$$

$$\text{Loop: } \sum \Delta V = 0$$

$$F = \frac{\mu_0}{2\pi} \frac{I_1 I_2 L}{R}$$

$$\vec{\tau} = \vec{m} \times \vec{B}$$

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{2m}{x^3}$$

$$B = \frac{\mu_0}{4\pi} \frac{2I}{r}$$

$$\varepsilon = \oint_C \vec{E} \cdot d\vec{l} = -\frac{d\phi_m}{dt}$$

$$U_m = \frac{1}{2} LI^2$$

$$\varepsilon_{rms} = I_{rms} Z$$

$$X_C = \frac{1}{\omega C}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\omega_{res} = \frac{1}{\sqrt{LC}}$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$I = I_0 \cos^2 \theta$$

$$m = \frac{y'}{y} = -\frac{s'}{s}$$

$$M = -\frac{L}{f_o} \frac{x_{np}}{f_e}$$

$$\lambda' = \frac{\lambda}{n}$$

$$a \sin \theta = m \lambda$$

$$\delta = \frac{2\pi}{\lambda} d \sin \theta$$

$$\vec{E} = \sum_i \frac{k q_i}{r_i^2} \hat{r}_i$$

$$\phi_{net} = \oint_S \vec{E} \cdot \hat{n} dA = 4\pi k Q_{in} = \frac{Q_{in}}{\epsilon_0}$$

$$U = qV$$

$$V = \int \frac{k dq}{r}$$

$$C = \frac{\epsilon_0 A}{d}$$

$$C = \kappa C_0$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$$

$$P = IV$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

$$\vec{F} = q\vec{v} \times \vec{B}$$

$$f_c = \frac{qB}{2\pi m}$$

$$r_c = \frac{mv}{qB}$$

$$B = \mu_0 n I$$

$$\oint_C \vec{B} \cdot d\vec{l} = \mu_0 I_C$$

$$\phi_m = LI$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$V_{Rrms} = I_{rms} R$$

$$V_{Lrms} = I_{rms} X_L$$

$$\varepsilon(t) = \varepsilon_{max} \cos(\omega t)$$

$$I(t) = \frac{\varepsilon_{max}}{Z} \cos(\omega t - \delta)$$

$$n = \frac{c}{v}$$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$$

$$P = \frac{1}{f}$$

$$M = -\frac{f_o}{f_e}$$

$$d \sin \theta = m \lambda$$

$$I = 4I_0 \left( \frac{\sin \frac{1}{2}\phi}{\frac{1}{2}\phi} \right)^2 \cos^2 \frac{1}{2}\delta$$

$$L = \mu_0 n^2 A l$$

$$G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2 \quad k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2 \quad 1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\frac{\mu_0}{4\pi} = 10^{-7} \text{ N/A}^2$$

$$x_{np} = 25 \text{ cm}$$

$$m_e = 9.11 \times 10^{-31} \text{ kg}$$

$$m_p = 1.67 \times 10^{-27} \text{ kg}$$