Physics II Formula Sheet

$$\vec{F}_{12} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\vec{u}_r$$

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{Q}{r^2}\vec{u}_r$$

$$\vec{E} = \sum_{i=1}^{n}\vec{E}_i = \sum_{i=1}^{n}\frac{1}{4\pi\epsilon_0}\frac{q_i}{{r_i}^2}\vec{u}_{r_i}$$

$$\vec{E} = \int d\vec{E} = \int \frac{1}{4\pi\epsilon_0}\frac{dq}{r^2}\vec{u}_r$$

$$U = -\vec{p}\cdot\vec{E}$$

$$\vec{\tau} = \vec{p}\times\vec{E}$$

$$\Phi_E = \int \vec{E}\cdot d\vec{A}$$

$$\oint \vec{E}\cdot d\vec{A} = \frac{Q_{\text{encl}}}{\epsilon_0}$$

$$E = \frac{\sigma}{2\epsilon_0}$$

$$E = \frac{\sigma}{\epsilon_0}$$

$$\Delta U = -q_0\int_A^B \vec{E}\cdot d\vec{l}$$

$$U = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r_{12}}$$

$$\Delta V_{A\to B} = \frac{\Delta U}{q_0} = -\int_A^B \vec{E}\cdot d\vec{l}$$

$$V = \frac{1}{4\pi\epsilon_0}\frac{Q}{r}$$

$$V = \sum_{i=1}^{n}\frac{1}{4\pi\epsilon_0}\frac{q_i}{r_i}$$

$$V = \int \frac{1}{4\pi\epsilon_0}\frac{dq}{r}$$

$$\vec{E} = -\left(\frac{\partial V}{\partial x}\vec{\imath} + \frac{\partial V}{\partial y}\vec{\jmath} + \frac{\partial V}{\partial z}\vec{k}\right)$$

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

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

$$C = 4\pi\epsilon_0\frac{r_a r_b}{r_b - r_a}$$

$$C = \frac{2\pi\epsilon_0 L}{\ln(r_b/r_a)}$$

$$C_{\text{eq}} = C_1 + C_2 + C_3 + \cdots$$

$$\frac{1}{C_{\text{eq}}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots$$

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

$$u_E = \frac{1}{2}\epsilon_0 E^2$$

$$C = \kappa_e C_0$$

$$u_E = \frac{1}{2}\kappa_e\epsilon_0 E^2 = \frac{1}{2}\epsilon E^2$$

$$I = \frac{dQ}{dt}$$

$$\vec{J} = nq\vec{v}_d$$

$$\vec{E} = \rho\vec{J}$$

$$\rho = \rho_0[1 + \alpha(T - T_0)]$$

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

$$V = RI$$

$$I = \frac{\mathcal{E}}{R + r}$$

$$P = VI$$

$$P = I^2 R = \frac{V^2}{R}$$

$$R_{\text{eq}} = R_1 + R_2 + R_3 + \cdots$$

$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

$$\sum_{\textit{closed loop}} \Delta V = 0$$

$$\sum I_{\text{in}} = \sum I_{\text{out}}$$

$$Q(t) = C\mathcal{E}(1 - e^{-\frac{t}{RC}})$$

$$I(t) = \frac{\mathcal{E}}{R}e^{-\frac{t}{RC}}$$

$$Q(t) = Q_0 e^{-\frac{t}{RC}}$$

$$I(t) = -\frac{Q_0}{RC}e^{-\frac{t}{RC}}$$

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

$$\vec{F}_B = I\,\vec{L} \times \vec{B}$$

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

$$\Phi_B = \int \vec{B} \cdot d\vec{A}$$

$$\oint \vec{B} \cdot d\vec{A} = 0$$

$$\vec{\mu} = NI\vec{A}$$

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

$$U_B = -\vec{\mu} \cdot \vec{B}$$

$$\vec{F} = q\,\vec{E} + q\,\vec{v} \times \vec{B}$$

$$r = \frac{mv}{|q|B}$$

$$\omega = 2\pi f = \frac{|q|B}{m}$$

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

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

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

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{\text{encl}}$$

$$B = \mu_0 n I$$

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

$$\mathcal{E} = -N\frac{d\Phi_B}{dt}$$

$$\mathcal{E} = \oint \left(\vec{v} \times \vec{B}\right) \cdot d\vec{l}$$

$$\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 \left(i_C + \epsilon_0 \frac{d\Phi_E}{dt}\right)_{\text{encl}}$$

$$M = \frac{N_2 \Phi_{B_2}}{i_1} = \frac{N_1 \Phi_{B_1}}{i_2}$$

$$\mathcal{E}_2 = -M\frac{di_1}{dt}$$

$$\mathcal{E}_1 = -M\frac{di_2}{dt}$$

$$L = \frac{N\Phi_B}{i}$$

$$\mathcal{E} = -L\frac{di}{dt}$$

$$L = \frac{\mu_0 N^2 A}{\ell}$$

$$L = \frac{\mu_0 N^2 A}{2\pi r}$$

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

$$u_B = \frac{1}{2\mu_0}B^2$$

$$i = \frac{\mathcal{E}}{R}\left(1 - e^{-\frac{R}{L}t}\right)$$

$$i = \frac{\mathcal{E}}{R}e^{-\frac{R}{L}t}$$

$$q = Q\cos(\omega t + \phi)$$

$$i = -\omega Q \sin(\omega t + \phi)$$

$$\omega = \sqrt{\frac{1}{LC}}$$

$$\omega' = \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

$$q = Ae^{-\frac{R}{2L}t}\cos\left(\omega' t + \phi\right)$$

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

$$X_L = \omega L$$

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

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

$$V_{\text{rms}} = \frac{V}{\sqrt{2}}$$

$$I_{\text{rms}} = \frac{I}{\sqrt{2}}$$

$$V_{\text{rms}} = ZI_{\text{rms}}$$

$$P_{\mathrm{av}} = \frac{1}{2} V I \cos\Phi = V_{\mathrm{rms}} I_{\mathrm{rms}} \cos\phi$$

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$\frac{V_2}{V_1} = \frac{N_2}{N_1}$$

$$V_1 I_1 = V_2 I_2$$

$$\frac{E}{B} = \frac{E_{\mathrm{max}}}{B_{\mathrm{max}}} = c$$

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$$

$$v = \frac{1}{\sqrt{\epsilon\mu}} = \frac{c}{\sqrt{\kappa_e \kappa_m}} = \frac{c}{n}$$

$$u = u_E + u_B = \epsilon_0 E^2 = \frac{B^2}{\mu_0}$$

$$\vec{S} = \frac{1}{\mu_0} \vec{E} \times \vec{B}$$

$$I = S_{\mathrm{av}} = \frac{E_{\mathrm{max}} B_{\mathrm{max}}}{2\mu_0}$$

$$I = \frac{1}{2} \epsilon_0 c (E_{\mathrm{max}})^2 = \frac{c}{2\mu_0} (B_{\mathrm{max}})^2$$

$$p_{\mathrm{rad}} = \frac{S_{\mathrm{av}}}{c} = \frac{I}{c}$$

$$p_{\mathrm{rad}} = \frac{2S_{\mathrm{av}}}{c} = \frac{2I}{c}$$

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

$$\lambda_n = \frac{\lambda_0}{n}$$

$$\theta_r = \theta_a$$

$$n_a \sin\theta_a = n_b \sin\theta_b$$

$$\sin\theta_{\mathrm{crit}} = \frac{n_b}{n_a}$$

$$\frac{1}{s} + \frac{1}{s'} = \frac{2}{R} = \frac{1}{f}$$

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

$$\frac{n_a}{s} + \frac{n_b}{s'} = \frac{n_b - n_a}{R}$$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$d \sin\theta = m\lambda \; (m = 0, \pm 1, \pm 2, \ldots)$$

$$d \sin\theta = \left(m + \frac{1}{2}\right) \lambda \; (m = 0, \pm 1, \pm 2, \ldots)$$

$$E_p = 2E |\cos\frac{\Phi}{2}|$$

$$I_0 = 2\epsilon_0 c E^2$$

$$I = I_0 \cos^2 \frac{\Phi}{2}$$

$$\Phi = \frac{2\pi}{\lambda}(r_2 - r_1)$$

$$2t = m\lambda \; (m = 0, 1, 2, \ldots)$$

$$2t = \left(m + \frac{1}{2}\right) \lambda \; (m = 0, 1, 2, \ldots)$$

$$\sin\theta = \frac{m\lambda}{a} \; (m = \pm 1, \pm 2, \pm 3, \ldots)$$

$$I = I_0 \left(\frac{\sin\left(\frac{\pi a}{\lambda}\sin\theta\right)}{\frac{\pi a}{\lambda}\sin\theta}\right)^2$$

Circle	Circumference	$2\pi r$
	Area	πr^2
Sphere	Area	$4\pi r^2$
	Volume	$\frac{4}{3}\pi r^3$
Cylinder	Lateral Area	$2\pi r\ell$
	Volume	$\pi r^2 \ell$