Formula Sheet For PH 213 Final Exam

$$F = \frac{kQ_1Q_2}{R^2} \qquad E = \frac{kQ}{R^2} \qquad E = \int \frac{kdQ}{R^2} \qquad k = 9.00x10^9 \frac{Nm^2}{C^2}$$

$$\int \vec{E} \cdot d\vec{A} = \frac{Q_{enclosed}}{\varepsilon_o} \qquad \varepsilon_o = 8.85x10^{-12} \frac{C^2}{Nm^2} \qquad k = \frac{1}{4\pi\varepsilon_o} \qquad Q = \lambda L = \sigma A = \rho V$$

$$U = \frac{kQ_1Q_2}{R} \qquad V = \frac{kQ}{R} \qquad V = \int \frac{kdQ}{R} \qquad \vec{F} = Q\vec{E} \qquad U = QV$$

$$U = -\int \vec{F} \cdot d\vec{R} = -\int (\vec{F}_x \cdot d\vec{x} + \vec{F}_y \cdot d\vec{y} + \vec{F}_z \cdot d\vec{z}) \qquad V = -\int \vec{E} \cdot d\vec{R} = -\int (\vec{E}_x \cdot d\vec{x} + \vec{E}_y \cdot d\vec{y} + \vec{E}_z \cdot d\vec{z})$$

$$\vec{F} = -gradU = -\vec{\nabla}U = -(\frac{\partial U}{\partial x}\hat{i} + \frac{\partial U}{\partial y}\hat{j} + \frac{\partial U}{\partial z}\hat{k}) \qquad \vec{E} = -gradV = -\vec{\nabla}V = -(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k})$$

$Q_e = -1.60 \times 10^{-19}$ C $\quad Q_p = +1.60 \times 10^{-19}$ C $\quad m_e = 9.11 \times 10^{-31}$ kg $\quad m_p = 1.67 \times 10^{-27}$ kg

$V_C = Q/C \quad U_C = (1/2)\,QV \quad I = \Delta Q/\Delta t = dQ/dt \quad V_R = IR \quad P_R = IV$

$V_S = V_1 + V_2 + \ldots \quad V_P = V_1 = V_2 = \ldots \quad I_S = I_1 = I_2 = \ldots \quad I_P = I_1 + I_2 + \ldots$

$R_S = R_1 + R_2 + \ldots \quad R_P = (1/R_1 + 1/R_2 + \ldots)^{-1} \quad C_S = (1/C_1 + 1/C_2 + \ldots)^{-1} \quad C_P = C_1 + C_2 + \ldots$

$V = E \pm IR_{int} \quad Q(t) = Q_o e^{-t/RC} \quad Q(t) = Q_o(1 - e^{-t/RC}) \quad I(t) = I_o e^{-t/RC}$

$$\vec{F}_m = Q(\vec{v}x\vec{B}) \qquad \vec{F}_m = I(\vec{L}x\vec{B}) \qquad R = \frac{mv}{|Q|B} \qquad \vec{B} = \int \frac{\mu_o I}{4\pi} \frac{d\vec{l}x\hat{R}}{R^2} \qquad \oint \vec{B} \cdot d\vec{l} = \mu_o I_{enclosed}$$

$$B = \frac{\mu_o I}{2\pi R} \qquad B = \frac{\mu_o I}{2R} \qquad B = \frac{\mu_o I}{4\pi R}(\sin\theta_1 + \sin\theta_2) \qquad \mu_o = 4\pi \times 10^{-7} \frac{T \cdot m}{A}$$

$$E_{induced} = (-)\frac{d}{dt}\int \vec{B} \cdot d\vec{A} \qquad E_{induced} = NAB\omega\sin(\omega t) \qquad \frac{V_P}{V_S} = \frac{I_S}{I_P} = \frac{N_P}{N_S}$$

$L_S = L_1 + L_2 + \ldots \quad L_P = (1/L_1 + 1/L_2 + \ldots)^{-1} \quad V_L = (-)L\frac{dI}{dt} \quad U = \frac{1}{2}LI^2$

$I(t) = I_o e^{-tR/L} \quad I(t) = I_o(1 - e^{-tR/L}) \quad Q(t) = Q_o\cos(\omega t + \phi) \quad I(t) = I_o\sin(\omega t + \phi) \quad \omega = \frac{1}{\sqrt{LC}}$

$$\oint \vec{B} \cdot d\vec{A} = 0 \qquad I_D = \varepsilon_0 \frac{d}{dt}\int \vec{E} \cdot d\vec{A} \qquad c = \frac{1}{\sqrt{\varepsilon_0\mu_0}} \qquad E = cB \qquad \vec{S} = \frac{\vec{E}x\vec{B}}{\mu_0}$$