Possibly Useful Information

Constants & Conversions:

$g = 9.81$ m/s^2 $\quad e = 1.60 \times 10^{-19}$ C $\quad \varepsilon_0 = 8.85 \times 10^{-12} \ \frac{\text{C}^2}{\text{Nm}^2}$

$k = \frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^9 \ \frac{\text{Nm}^2}{\text{C}^2}$ $\quad \mu_0 = 4\pi \times 10^{-7} \ \frac{\text{T} \cdot \text{m}}{\text{A}}$ $\quad c = 3.0 \times 10^8 \ \frac{\text{m}}{\text{s}}$

1 eV = 1.602×10^{-19} J $\quad$ 1 V = 1 J/C= 1N·m/C $\quad$ 1 H = 1 T·m^2/A $\quad$ 1 W = 1 J/s

1 A = 1 $\frac{\text{C}}{\text{s}}$ $\quad$ 1 T = 1 $\frac{\text{N}}{\text{A} \cdot \text{m}}$ $\quad$ 1 H = $\frac{\text{T} \cdot \text{m}^2}{\text{A}}$ = 1 Ω·s $\quad$ 1 F = 1 $\frac{\text{C}}{\text{V}}$ = 1 $\frac{\text{s}}{\Omega}$

$m_p = 1.67 \times 10^{-27}$ kg $\quad m_e = 9.11 \times 10^{-31}$ kg

$C = 2\pi r$ $\quad A = \pi r^2$ $\quad A = 4\pi r^2$ $\quad V = (4/3)\pi r^3$ $\quad$ 180° in Δ

Current, Resistance & Circuits:

$I = \frac{dq}{dt}$ $\quad I = \int \vec{J} \cdot d\vec{A}$ $\quad I = JA$ $\quad \vec{J} = ne\vec{v}_d$ $\quad \vec{E} = \rho\vec{J}$

$R = \frac{V}{I}$ $\quad \sigma = \frac{1}{\rho}$ $\quad R = \frac{\rho L}{A}$ $\quad \rho - \rho_0 = \rho_0 \alpha (T - T_0)$

$P = IV = I^2 R = \frac{V^2}{R}$ $\quad P = \frac{\Delta E}{\Delta t}$ $\quad \mathcal{E} = \frac{dW}{dq}$ $\quad U = q\Delta V$

$R_{eq} = \sum_{j=1}^{n} R_j$ $\quad \frac{1}{R_{eq}} = \sum_{j=1}^{n} \frac{1}{R_j}$ $\quad \Delta V_{loop} = 0$ $\quad \sum I_{junc} = 0$

$I = \left(\frac{\mathcal{E}}{R}\right) e^{-t/RC}$ $\quad V_C = \mathcal{E}\left(1 - e^{-t/RC}\right)$ $\quad q = q_0 e^{-t/RC}$ $\quad I = -\left(\frac{q_0}{RC}\right) e^{-t/RC}$ $\quad \tau_C = RC$

Magnetic Fields:

$\vec{F}_B = q\vec{v} \times \vec{B}$ $\quad F_B = \frac{mv^2}{r}$ $\quad \vec{F}_B = I\vec{L} \times \vec{B}$

$\mu = NIA$ $\quad \vec{\tau} = \vec{\mu} \times \vec{B}$ $\quad U(\theta) = -\vec{\mu} \cdot \vec{B}$

$d\vec{B} = \frac{\mu_0}{4\pi} \frac{Id\vec{s} \times \hat{r}}{r^2}$ $\quad \oint \vec{B} \cdot d\vec{s} = \mu_0 I_{enc}$ $\quad \Phi_B = \int \vec{B} \cdot d\vec{A}$

$B = \frac{\mu_0 I}{2\pi r}$ $\quad B = \frac{\mu_0 I \phi}{4\pi R}$ $\quad B = \mu_0 n I$ $\quad B = \frac{\mu_0 I N}{2\pi r}$ $\quad B = \frac{\mu_0 I R^2}{2\left(R^2 + x^2\right)^{3/2}}$

Magnetic Induction:

$\varepsilon = -\frac{d\Phi_B}{dt}$ $\quad \oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt}$ $\quad L = \frac{N\Phi_B}{I}$ $\quad \varepsilon_L = -L\frac{dI}{dt}$

$L = \mu_0 n^2 A\ell$ $\quad L = \frac{\mu_0 N^2 h}{2\pi} \ln\frac{b}{a}$ $\quad I = \frac{\varepsilon}{R}\left(1 - e^{-t/\tau_L}\right)$ $\quad I = I_0 e^{-t/\tau_L}$ $\quad \tau_L = \frac{L}{R}$

$U_B = \frac{1}{2} L I^2$ $\quad u_B = \frac{B^2}{2\mu_0}$ $\quad \oint \vec{B} \cdot d\vec{A} = 0$

Possibly Useful Information

LC Oscillations:

$$\omega^2 = \frac{1}{LC} \qquad V = V_{\max} \sin(\omega t + \phi_V) \qquad I = I_{\max} \sin(\omega t + \phi_I)$$

$$q = q_{\max} \cos(\omega t + \phi) \qquad q = q_{\max} e^{-Rt/2L} \cos(\omega' t + \phi) \qquad \omega' = \sqrt{\omega^2 - (R/2L)^2}$$

Equations from Exam 1:

Electric Force and Electric Fields:

$$\vec{F}_{12} = \frac{kq_1 q_2}{r^2}\hat{r} \qquad q = Ne \qquad \vec{F} = q\vec{E} \qquad \vec{E} = \frac{kq}{r^2}\hat{r}$$

$$\vec{E} = \sum_i \vec{E}_i = \sum_i \frac{kq_i}{r_i^2}\hat{r}_i \qquad \vec{E} = \int d\vec{E} = \int \frac{kdq}{r^2}\hat{r}$$

$$\vec{p} = q\vec{d} \qquad \vec{\tau} = \vec{p} \times \vec{E} \qquad U = -\vec{p} \cdot \vec{E}$$

$$\Phi = \int \vec{E} \cdot d\vec{A} \qquad \oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$$

$$E = \frac{q}{4\pi\varepsilon_0 r^2} \qquad E = \frac{\lambda}{2\pi\varepsilon_0 r} \qquad E = \frac{\sigma}{2\varepsilon_0} \qquad E_{cond} = \frac{\sigma}{\varepsilon_0}$$

$$\lambda = \frac{Q}{L} = \frac{dq}{d\ell} \qquad \sigma = \frac{Q}{A} = \frac{dq}{dA} \qquad \rho = \frac{Q}{V} = \frac{dq}{dV}$$

Electric Fields and Potentials:

$$\Delta U = U_f - U_i = -W_{field} \qquad U = \frac{kq_1 q_2}{r} \qquad V = \frac{kq}{r}$$

$$V = \sum_i V_i = \sum_i \frac{kq_i}{r_i} \qquad V = \int dV = \int \frac{kdq}{r}$$

$$\Delta V = V_f - V_i = -\frac{W_{firld}}{q} = -\int_i^f \vec{E} \cdot d\vec{s} \qquad \vec{E} = -\nabla V = -\left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right)$$

Capacitance:

$$q = C\Delta V \qquad C = \frac{\varepsilon_0 A}{d} \qquad C = 2\pi\varepsilon_0 \frac{L}{\ln(b/a)} \qquad C = 4\pi\varepsilon_0 \frac{ab}{b-a}$$

$$C = 4\pi\varepsilon_0 R \qquad C_{eq} = \sum_{j=1}^{n} C_j \qquad \frac{1}{C_{eq}} = \sum_{j=1}^{n} \frac{1}{C_j}$$

$$U = \frac{q^2}{2C} = \frac{1}{2}C(\Delta V)^2 \qquad u = \frac{1}{2}\varepsilon_0 E^2 \qquad C = \kappa C_0 \qquad \varepsilon_0 \oint \kappa\vec{E} \cdot d\vec{A} = q$$