USEFUL INFORMATION

Electric and magnetic fields:

$$\vec{dE} = \frac{1}{4\pi\epsilon_0}\frac{dq}{r^2}\hat{r}, \qquad d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{s}\times\vec{r}}{r^3}$$

Useful integral laws:

$$\oint \vec{B}\cdot d\vec{r} = \mu_0\left(I_{\text{enclosed}} + I_{\text{displ.}}\right)$$

$$\oint \vec{E}\cdot d\vec{r} = -\frac{d}{dt}\Phi_B = -\frac{d}{dt}\int \vec{B}\cdot d\vec{S}$$

Forces:

$$\vec{F} = q\left(\vec{v}\times\vec{B} + \vec{E}\right), \qquad d\vec{F} = I\left(d\vec{s}\times\vec{B}\right)$$

Potential for conservative field:

$$V(\vec{r}) = -\int_{\vec{r}_0}^{\vec{r}} \vec{E}\cdot d\vec{r}$$

Kinematics:

$$\frac{d\vec{r}}{dt} = \frac{dx}{dt}\,\vec{i}_x + \frac{dy}{dt}\,\vec{i}_y = \frac{dr}{dt}\,\vec{i}_r + r\frac{d\theta}{dt}\,\vec{i}_\theta$$

Energy and Power:

$$U_C = \frac{1}{2}CV^2, \qquad U_L = \frac{1}{2}LI^2, \qquad P = VI$$

Circuit Elements:

$$C = \frac{Q}{V}, \qquad \text{For parallel plates } C = \frac{\epsilon_0 A}{d}$$

$$\vec{j} = \sigma\vec{E}, \qquad R = \rho\frac{\ell}{A}$$

$$\left|\int \vec{B}_{\text{self}}\cdot d\vec{S}\right| = LI$$