Tear-Off Sheet **8.02 MIT May 2000** **Tear-Off Sheet**

Some (possibly useful) Relations for 8.02 Final Exam

You may use these freely unless the problem specifically prescribes a different approach.

$\mathbf{F} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}\hat{\mathbf{r}}$

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

$\boxed{\oint\!\!\oint \mathbf{E}\cdot d\mathbf{A} = \frac{q_{in}}{\varepsilon_0}}$

$\boxed{\oint\!\!\oint \mathbf{B}\cdot d\mathbf{A} = 0}$

$\boxed{\oint \mathbf{E}\cdot d\mathbf{s} = -\frac{d\Phi_B}{dt}}$

$C \equiv \frac{Q}{\Delta V}$

$V(b) - V(a) \equiv -\int_a^b \mathbf{E}\cdot d\mathbf{s}$

$\boxed{\oint \mathbf{B}\cdot d\mathbf{s} = \mu_0\left(i_{encl} + \varepsilon_0 \frac{d\Phi_E}{dt}\right)}$

$U_E = \frac{C(\Delta V)^2}{2} = \frac{Q^2}{2C}$

$u_E = \frac{1}{2}\varepsilon_0 \mathbf{E}\cdot\mathbf{E} = \frac{1}{2}\varepsilon_0 |\mathbf{E}|^2$

$\varepsilon_0 \cong 9\times 10^{-12}\ \mathrm{C^2\,N^{-1}\,m^{-2}}$

$\mathbf{F} = q\,(\mathbf{v}\times\mathbf{B})$

$d\mathbf{F} = i\,(d\mathbf{s}\times\mathbf{B})$; $i = dq/dt$

$\frac{1}{4\pi\varepsilon_0} \cong 9 \times 10^9\ \mathrm{N\,m^2\,C^{-2}}$

$P = iV = i^2 R = V^2/R$

$|\boldsymbol{\mu}| = N\,i\,A$

$\mu_0 = 4\pi\times 10^{-7}\ \frac{\mathrm{T\cdot m}}{\mathrm{A}}$

$|\mathrm{B}| = \mu_0\, n\, i$

$\mathbf{E} = \rho\,\mathbf{j}$

$R = \rho\, l/A$

$V = iR$

$\boldsymbol{\tau} = \boldsymbol{\mu}\times\mathbf{B}$

$d\mathbf{B} = \frac{\mu_0\, i}{4\pi}\frac{d\mathbf{s}\times\mathbf{r}}{r^3}$

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

$L = \frac{N\phi}{i}$; $M_{2,1} = \frac{N_2\,\phi_{2,1}}{i_1}$

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

$U_L = \frac{1}{2}L\,i^2$

$u_B = \frac{\mathbf{B}\cdot\mathbf{B}}{2\mu_0} = \frac{|\mathbf{B}|^2}{2\mu_0}$

$\tau = RC$

$\tau = L/R$

$X_L = \omega L$

$\omega_0 = (LC)^{-1/2}$

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

$\mathrm{v} = \frac{\omega}{k} = \frac{2\pi\nu}{2\pi/\lambda} = \lambda\nu$

$i_m = \frac{\mathcal{E}_m}{Z} = \frac{\mathcal{E}_m}{\left[R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right]^{1/2}}$

$\tan\phi = \frac{\omega L - \frac{1}{\omega C}}{R}$

$\mathcal{E} = \mathcal{E}_m \sin \omega t;$

$i = i_m \sin(\omega t - \phi)$

$\Delta p = \Delta U/c$

$\mathbf{S} = \frac{\mathbf{E}\times\mathbf{B}}{\mu_0}$

$P = \frac{|\mathbf{S}|}{c}$

$\nabla\bullet\mathbf{E} = \frac{\rho}{\varepsilon_0}$; $\nabla\bullet\mathbf{B} = 0$

$\nabla\times\mathbf{E} = -\frac{\partial\mathbf{B}}{\partial t}$

$\nabla\times\mathbf{B} = \mu_0\,\mathbf{j} + \mu_0\varepsilon_0\frac{\partial\mathbf{E}}{\partial t}$

$\frac{\omega}{k} = (\mu_0\varepsilon_0)^{-1/2} = 3\times 10^8\ \mathrm{m/s} \equiv c$

$\frac{\partial^2 E_z}{\partial x^2} = \mu_0\varepsilon_0\frac{\partial^2 E_z}{\partial t^2}$

$\frac{E_m}{B_m} = c$