PHY3323 Formula sheet

The final will be comprehensive, covering chapter 1 through chapter 5.

50% comes from materials covered on page 167 to page 265. The other 50% comes from the two midterm tests.

$\vec{E} = \frac{1}{4\pi\epsilon_o}\int_V \frac{\rho(\vec{r'})}{\mathscr{r}^2}\hat{\mathscr{r}}\,d\tau'$ $\quad\nabla\cdot\vec{E} = \frac{\rho}{\epsilon_o}$ $\quad-\nabla\cdot\vec{P} = \rho_b$

V(b) – V(a) = $-\int_a^b \vec{E}\cdot\vec{d\ell}$ $\quad\nabla^2 V = -\frac{\rho}{\epsilon_o}$ $\quad\nabla^2 V = 0$

$V(\vec{r}) = \frac{1}{4\pi\epsilon_o}\int\frac{\rho(\vec{r'})}{\mathscr{r}}d\tau'$ $\quad W = \frac{1}{2}\int\rho V d\tau$ $\quad W = \frac{\epsilon_o}{2}\int E^2 d\tau$

$q' = -\frac{R}{a}q,\ \ b = \frac{R^2}{a}$ $\quad\frac{1}{\mathscr{r}} = \frac{1}{r}\sum_{n=0}^{\infty}\left(\frac{r'}{r}\right)^n P_n(\cos\theta')$

$V(r,\theta) = \sum_{l=0}^{\infty}\left(A_l r^l + B_l r^{-(l+1)}\right)P_l(\cos\theta),$ $\quad V(P) = \frac{1}{4\pi\epsilon_o}\frac{\vec{P}\cdot\hat{r}}{r^2}$

$\vec{E}_{dip}(\mathbf{r}) = \frac{1}{4\pi\epsilon_o}\frac{1}{r^3}[3(\vec{p}\cdot\hat{r})\hat{r} - \vec{p}],$ $\quad\vec{N} = \vec{p}\times\vec{E},$ $\quad\vec{F} = (\vec{p}\cdot\nabla)\vec{E},$ $\quad\vec{N} = \vec{m}\times\vec{B}$

$V = \frac{1}{4\pi\epsilon_o}\int\frac{\sigma_b}{\mathscr{r}}da' + \frac{1}{4\pi\epsilon_o}\int\frac{\rho_b}{\mathscr{r}}d\tau'$ $\quad\vec{D} = \epsilon_o\vec{E} + \vec{P} = \epsilon_o(1+\chi_e)\vec{E}$ $\quad\sigma_b \equiv \vec{P}\cdot\hat{n},\ \ \rho_b \equiv -\nabla\cdot\vec{P}$

$W = \frac{\epsilon_o}{2}\int E^2 d\tau$ $\quad\nabla\cdot\vec{D} = \rho_f$ $\quad W = \frac{1}{2}\int\vec{D}\cdot\vec{E}d\tau$ $\quad\vec{E} = -\nabla V$

$\vec{F} = q[\vec{E} + (\vec{V}\times\vec{B})]$ $\quad\nabla\cdot\vec{J} = -\frac{\partial\rho}{\partial t}$ $\quad\vec{m} = I\vec{a}$

$\vec{B}(P) = \frac{\mu_o}{4\pi}\int\frac{\vec{I}\times\hat{\mathscr{r}}}{\mathscr{r}^2}dl' = \frac{\mu_o I}{4\pi}\int\frac{\vec{dl'}\times\hat{\mathscr{r}}}{\mathscr{r}^2}$ $\quad\nabla\times\vec{B} = \mu_o\vec{J}$ $\quad\oint\vec{B}\cdot\vec{dl} = \mu_o I_{enc}$

$B_{above}^{\perp} = B_{below}^{\perp}$ $\quad B_{above}^{\parallel} - B_{below}^{\parallel} = \mu_o K$ $\quad\vec{B} = \nabla\times\vec{A}$

$\vec{B}_{dip}(r) = \nabla\times\vec{A}_{dip} = \frac{\mu_o m}{4\pi r^3}(2\cos\hat{r} + \sin\theta\hat{\theta}),$ $\quad\vec{A}(\vec{r}) = \frac{\mu_o}{4\pi}\int_V\frac{\vec{J}_b(r')}{\mathscr{r}}d\tau' + \frac{\mu_o}{4\pi}\oint_S\frac{\vec{K}_b(r')}{\mathscr{r}}da'$

Boundary conditions

$D_{above}^{\perp} - D_{below}^{\perp} = \sigma_f,$ $\quad E_{above}^{\parallel} - E_{below}^{\parallel} = 0,$ $\quad P_0(x) = 1, P_1(x) = x, P_2 = \frac{3x^2-1}{2}$

Table of integrals

$\int\sqrt{x-a}\,dx = \frac{2}{3}(x-a)^{1.5},$ $\quad\int\frac{1}{\sqrt{x+a}}dx = 2\sqrt{(x+a)},$ $\int\frac{1}{\sqrt{(x+a)}^3}dx = -\frac{2}{\sqrt{x+a}}$