Revised Assignment #9: Due Friday April 24, 2015 at 2:30 pm

Problems

There are only three problems in this problem set. Each one is worth 20 points.

Problem 9-1: Jackson 8.14 page 402.
Note: There is no need to do the integral from scratch that you need do to get to the equation in part (a). It is sufficient to show that the equation given satisfies the appropriate differential equation and the boundary conditions.

Problem 9-2: Two problems with azimuthal symmetry

(a) Consider a charge distribution given by

$$\rho(\mathbf{X}) = \sigma_o \delta\left(r - R\right)\cos\theta$$

Since this charge distribution is azimuthal symmetric, the electrostatic potential can be written in the form given in equation (3.33) of Jackson p 101. Determine the coefficients A_l and B_l for this distribution of charge, using the appropriate boundary conditions on **E.**

(b) Consider a current distribution given by

$$\mathbf{J}(\mathbf{X}) = \kappa_o \delta\left(r - R\right)\sin\theta\,\hat{\phi}$$

Since $\nabla \times \mathbf{B} = 0$ almost everywhere (except at $r = R$), we can in this situation write the magnetic field as the negative gradient of a scalar function $\Phi_{magnetic}\left(r,\theta\right)$, where equation (3.33) holds for this scalar function as well. Determine the coefficients A_l and B_l for $\Phi_{magnetic}\left(r,\theta\right)$ for this distribution of current using the appropriate boundary conditions on **B**.

Problem 9-3: Jackson 3.3 page 136 part (a) ONLY

You may find the following relations useful.

$$\int_0^{\pi/2} \sin^{2l+1}x\; dx = \frac{2*4*6*....*2l}{1*3*5*...*(2l+1)} \quad l = 1,2,3... \qquad \int_0^{\pi/2} \sin x\; dx = 1$$

$$P_{2l}(0) = \left(-1\right)^l \frac{1*3*5*...*(2l-1)}{2*4*6*....*2l} \quad l = 1,2,3... \qquad P_{2l}(0) = 1 \quad l = 0$$

$$1 + \sum_{l=1}^{\infty} \frac{1*3*5*...*(2l-1)}{2*4*6*....*2l*\left(2l+1\right)} = \frac{\pi}{2}$$