Jim Wiss
Spring 2014

Mid 3 Review

Consider the case of an infinitely long cylinder of radius R with a current density $\vec{J}\left(s<R\right)=J_0\hat{z}$. We add a cancelling surface current $\vec{K}(s=R)=-K_0\hat{z}$ with K_0 adjusted so that $\vec{B}\left(s>R\right)=0$. Write all answers to this problem in terms of K_0, R, cylindrical coordinates and unit vectors, and physical and mathematical constants as needed.

a) Find J_0 in terms of K_0.

b) Find the outward, magnetic pressure on the $s=R$ surface using $\mathcal{P}_{\text{out}}=\hat{s}\cdot\vec{K}\times\vec{B}_{\text{other}}$ where $\vec{B}_{\text{other}}$ excludes the field due to $\vec{K}=-K_0\hat{z}$ itself. Hint I would compute $\vec{B}_{\text{other}}$ using the region just outside of cylinder where $\vec{B}=0$. Recall a current plane produces a field of $\vec{B}_{>}=+\frac{\mu_0\vec{K}\times\hat{\eta}}{2}$, $\vec{B}_{<}=-\frac{\mu_0\vec{K}\times\hat{\eta}}{2}$.