Physics 7312 — Professor Scalise

Homework Assignment #3

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8. In lecture we found that for an infinitely long solenoid of radius R carrying current I in n turns per unit length and oriented along the z axis, the vector poential in cylindrical polar coordinates (s, ϕ, z) and MKS units is:

$$\vec{A}(s,\phi,z) = \begin{cases} \frac{\mu_0 n I s}{2}\hat{\phi} & ,(s < R) \\ \frac{\mu_0 n I R^2}{2s}\hat{\phi} & ,(s > R) \end{cases}$$

   For cgs units, replace μ_0 by $\frac{4\pi}{c}$.

   (a) Find the magnetic field $\vec{B}(\vec{r}) = \vec{\nabla} \times \vec{A}(\vec{r})$ everywhere (inside and outside the solenoid).

   (b) Find the divergence of $\vec{A}(\vec{r})$ everywhere.

9. A spherical shell of radius R carrying uniform surface charge density σ rotates about an axis through its center with angular velocity $\vec{\omega}$.

   (a) Find the magnetic vector potential $\vec{A}(\vec{r})$ everywhere (inside and outside the sphere). Hint: The integration is easier if you align the polar (z) axis along the field point rather than along the angular velocity vector.

   (b) Find the magnetic field $\vec{B}(\vec{r}) = \vec{\nabla} \times \vec{A}(\vec{r})$ everywhere. Is there anything noteworthy about the magnetic field inside the sphere?