

PHY 712 – Problem Set # 15

Complete reading of Chapter 5 of **Jackson**.

You may choose one of the following problems. (Extra credit for working both problems.)

1. Work Problem #5.13 in **Jackson**.
2. Consider a uniform cylindrical current expressed in cylindrical equations in the form:

$$\mathbf{J}(\rho) \equiv j_0 \Theta(a - \rho) \hat{\mathbf{z}}, \quad (1)$$

where j_0 is a constant current density, a is the radius of the cylinder, and $\Theta(a - \rho)$ denotes the Heaviside function.

- (a) Find the vector potential \mathbf{A} in the Coulomb gauge ($\nabla \cdot \mathbf{A} = 0$). Assuming the appropriate boundary conditions at $\rho = a$, find the form of \mathbf{A} for both $\rho < a$ and for $\rho > a$ up to an arbitrary constant.
- (b) Find the magnetic field \mathbf{B} for both $\rho < a$ and for $\rho > a$.
- (c) Sketch $\mathbf{A}(\rho)$ and $\mathbf{B}(\rho)$ as a function of ρ .