

**Problem Set 9**

---

**Due date:** Tuesday, November 25, 6PM.

Problems will be collected and graded. You may bring your homeworks to class or drop them in my mailbox in front of the Physics Department office. No late homework will be considered.

---

1. Jackson, Problem 5.22.

Consider the result of the previous homework problem 5.19 and the discussion in Sec. 5.14 of Jackson to construct the magnetic field by an image method.

When calculating the force, note that Eq. 5.151 cannot be used, because the medium is nonlinear. Use a simpler equation for the energy of an object of fixed magnetization in an external B-field.

2. An infinitely long cylindrical region with radius  $a$  and constant permeability  $\mu \gg \mu_0$  carries a volume current density

$$\mathbf{j}_z(\rho, \phi) = \hat{\mathbf{z}} j_0 \cos \phi J_1\left(\frac{x_{12}}{a} \rho\right) \quad .$$

( $J_1$  is a Bessel function and  $x_{12}$  one of its roots; notation as usual).

a) Based on the discussion in Sec. 5.14 of the textbook, specify a Poisson-like equation with Dirichlet boundary conditions suitable to find the vector potential in the region  $\rho < a$ .

b) Find an eigenfunction expansion for the corresponding two-dimensional Green's function  $G(\rho, \rho', \phi, \phi')$ .

c) Using the previous result, calculate the vector potential.

d) Find the magnetic field in the region  $\rho < a$ .

3. Jackson, Problem 6.1.

4. Jackson, Problem 6.2 a) and b).