Physics 7312 Professor Scalise
Homework Assignment #6 Spring 2023

1. Solve the problem that you did not solve on the midterm exam.

2. A parallel-plate capacitor with circular plates of radius R is being charged by a steady current I. Find the magnetic field magnitude and direction between the plates as a function of distance s from the center of the plates for all s.

3. In this problem, we are going to determine the force required to remove a permanent magnet from a thick refrigerator door, the so-called "lifting strength". Consider a long cylindrical permanent magnet with area A of the circular ends, length $L \gg \sqrt{A}$, and magnetization $\vec{M}$ along the symmetry axis of the cylinder.

   (a) Find the magnetic surface charge density σ_m on the cylinder. What is its magnitude in terms of the givens and where is it located?

   (b) Now we will reason in analogy with a capacitor. If two capacitor plates have area A, separation d, and surface charge densities $\pm\sigma_e$, what is the force on one plate caused by the other plate? Answer in terms of the givens (no q's, for example).

   (c) The bar magnet will create an image bar magnet in the ferromagnetic material of the refrigerator door. What should be the magnetic force on one end of the permanent real bar magnet caused by the end of the image bar magnet? Assume that the door is thick enough so that we don't saturate the atomic magnetic dipoles.

   (d) A large but attainable magnetization is 10^6 amp/m. For a 1 inch diameter permanent magnet, what is the lifting strength? Does it seem reasonable based on your experience?

4. Derive the field angular momentum on the bottom of page 4 of lecture 27 for an electric monopole q and a magnetic monopole g.