Home Work Set # 10, Physics 217, Due: December 5, 2001

Problem 1

Find the force of attraction between two magnetic dipoles, $\overline{m}_1$ and $\overline{m}_2$, oriented as shown in Figure 1, a distance *d* apart, using
(a) equation (6.2) of Griffiths.
(b) equation (6.3) of Griffiths.

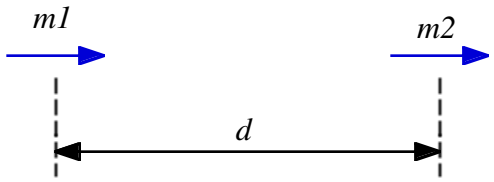

Figure 1. Problem 1.

Problem 2

A uniform current density $\overline{J} = \overline{J}_0 \hat{k}$ fills a slab straddling the *yz* plane, from *x* = -*a* to *x* = +*a*. A magnetic dipole $\overline{m} = m_0 \hat{i}$ is situated at the origin.

a) Find the force on the dipole using equation (6.3) of Griffiths.
b) Do the same for a dipole pointing in the *y*-direction: $\overline{m} = m_0 \hat{j}$.

Problem 3

A long circular cylinder of radius *R* carries a magnetization $\overline{M} = kr^2 \hat{\phi}$, where *k* is a constant, *r* is the distance from the axis, and $\hat{\phi}$ is the azimuthal unit vector. Find the magnetic field due to $\overline{M}$ for points inside and outside the cylinder.

Problem 4

A short circular cylinder of radius *R* and length *L* carries a "frozen-in" uniform magnetization $\overline{M}$ parallel to its axis. Find the bound current, and sketch the magnetic field of the cylinder. (Make two sketches: one for $L >> R$, and one for $L << R$.)

Problem 5

Of the following materials, which would you expect to be paramagnetic and which diamagnetic? Aluminum, copper, copper chloride ($CuCl_2$), carbon, lead, nitrogen (N_2), salt (NaCl), sodium, water.