EMFall02A

An isolated, uniformly magnetized sphere of radius a has constant magnetization $\boldsymbol{M}_1 = M_o\boldsymbol{z}$ inside the sphere($r \le a$).

a.) State clearly the mathematical boundary conditions on the $\boldsymbol{B}$ and $\boldsymbol{H}$ fields on the surface of the uniformly magnetized sphere.

b.) Determine the functional form of the $\boldsymbol{B}$ and $\boldsymbol{H}$ fields inside the sphere (region 1, $r \le a$) and outside the sphere (region 2, $r > a$).

c.) Draw pictures of $\boldsymbol{B}$, $\boldsymbol{H}$ and $\boldsymbol{M}$ in the neighborhood of the sphere – interior and exterior to the sphere.

d.) The uniformly magnetized sphere with constant magnetization $\boldsymbol{M}_1 = M_o\boldsymbol{z}$ inside the sphere($r \le a$) is now placed in a uniform magnetic field, $\boldsymbol{B}_o = B_o\boldsymbol{z}$. Show that

$$M_o = \frac{3}{4\pi}\left(\frac{\mu - 1}{\mu + 2}\right)B_o$$

where μ is the magnetic permeability of the sphere.