



上海科技大学

ShanghaiTech University

Homework-4

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1. Consider a hard ferromagnet in a cylindrical shape, the height of the ferromagnetic cylinder is L , and the radius is a . The magnetization is M_0 along z direction.
 - (a) Please calculate the magnetic field H and magnetic induction B at all points on the z axis, both outside and inside the cylinder.
 - (b) Plot the ratios $\frac{B}{\mu_0 M_0}$ and $\frac{H}{M_0}$ on the z axis as functions of z for $L = 5a$.

2. Consider a free space with some localized permanent magnetization distribution $\mathbf{M}(\mathbf{r})$, and the free current density in the space is zero everywhere.
 - (a) Please prove that for such a situation, $\int d\mathbf{r}^3 \mathbf{B} \cdot \mathbf{H} = 0$. (Note that the system is no longer a linear medium.)
 - (b) Consider a spherical hard ferromagnet with magnetization $\mathbf{M} = M_0 \hat{z}$, with radius a . Please calculate the magnetic fields (H and B) both outside and inside the sphere. Please verify that the conclusion from the previous question is correct.
