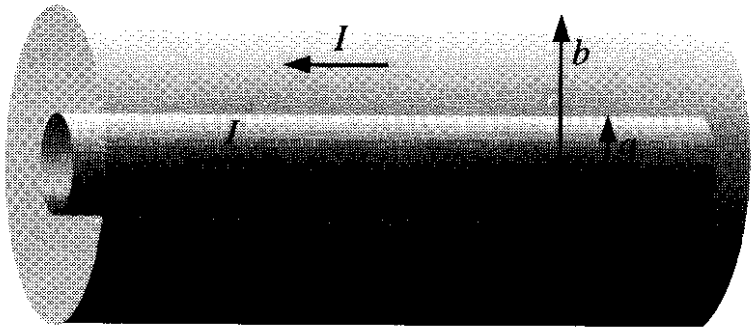
P3323 quiz9-3
October 21, 2016

A coaxial cable consists of two very long cylindrical tubes, separated by linear insulating material with magnetic susceptibility χ_m. A current I flows along the inner conductor in the $+\hat{\mathbf{z}}$ direction and returns along the outer one; in each case the current distributes itself uniformly over the surface.



1. What is $\mathbf{H}$ in the region between the tubes?

   A)

   $$\mathbf{H} = \frac{I}{2\pi r}\hat{\phi}$$

   B)

   $$\mathbf{H} = \frac{\mu_0 \chi_m I}{2\pi r}\hat{\phi}$$

   C)

   $$\mathbf{H} = 0$$

   D)

   $$\mathbf{H} = \frac{1}{\mu_0}\mathbf{B}$$

2. What is the magnetic field $\mathbf{B}$ in the region between the tubes?

A)

$$\mathbf{B} = \frac{1}{\mu}\mathbf{H}$$

B)

$$\mathbf{B} = 0$$

C)

$$\mathbf{B} = \mu_0 \frac{I}{2\pi r}\hat{\phi}$$

D)

$$\mathbf{B} = \mu_0(1 + \chi_m)\frac{I}{2\pi r}\hat{\phi}$$

3. What is the magnetization $\mathbf{M}$ in the region between the tubes?

A)

$$\mathbf{M} = 0$$

B)

$$\mathbf{M} = \chi_m \frac{I}{2\pi r}\hat{\phi}$$

C)

$$\mathbf{M} = \mu_0(1 + \chi_m)\frac{I}{2\pi r}\hat{\phi}$$

D)

$$\mathbf{M} = \chi_m \frac{I}{2\pi r}\hat{\mathbf{r}}$$

4. What is the bound current $\mathbf{J_b}$ in the region between the tubes?

A)

$$\mathbf{J_b} = 0$$

B)

$$\mathbf{J_b} = \chi_m \frac{I}{\pi r^2} \hat{\mathbf{z}}$$

C)

$$\mathbf{J_b} = \frac{I}{\pi r^2} \hat{\mathbf{z}}$$

5. What is the bound surface current $\mathbf{K_b}$ on the boundary with the inner tube?

A)

$$\mathbf{K_b} = 0$$

B)

$$\mathbf{K_b} = \chi_m \frac{I}{\pi a} \hat{\mathbf{z}}$$

C)

$$\mathbf{K_b} = \frac{I}{\pi a} \hat{\mathbf{r}}$$