

### Special Problem 8-3.4

Shown below is the **cross-section** of a cylindrical structure that is centered along the z-axis (the z-axis is pointing out of the page).

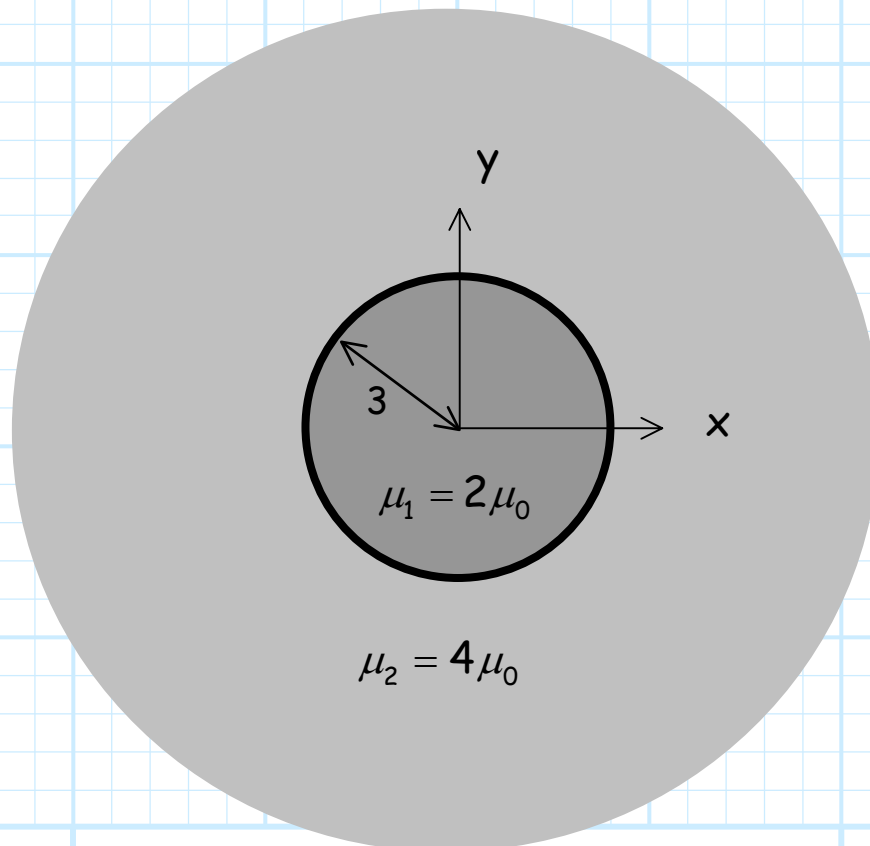
The center region (region 1) is a **cylinder** of material with  $\mu_r = 2$  and a **radius of 3 meters**. The magnetic flux density in region 1 is known to be (note it's a function of  $\rho$  !):

$$\mathbf{B}_1(\rho) = 8\mu_0 \rho \hat{a}_\phi \quad \left[ \frac{W}{m^2} \right]$$

Surrounding the cylinder of region 1 is material with  $\mu_r = 4$ . The magnetic flux density within this region is known to have the form (note it's also a function of  $\rho$  !):

$$\mathbf{B}_2(\rho) = \frac{\alpha \mu_0}{\rho} \hat{a}_\phi \quad \left[ \frac{W}{m^2} \right]$$

where the value  $\alpha$  is an unknown **constant**.



In **region 1**, determine:

1) the **magnetization** currents flowing on the cylinder surface and within the cylinder volume.

In **region 2**, apply the magnetic **boundary conditions** to the material interface (i.e.,  $\rho=3$ ) to determine:

2) the **magnetic flux density** (i.e., find constant  $\alpha$ ).

3) the **magnetic field**.