## 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 $\rho$ !):

$$
\mathrm{B}_{1}(\rho)=8 \mu_{0} \rho \hat{a}_{\phi} \quad\left[W / m^{2}\right]
$$

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 $\rho$ !):

$$
\mathrm{B}_{2}(\rho)=\frac{\alpha \mu_{0}}{\rho} \hat{a}_{\phi} \quad\left[W / m^{2}\right]
$$

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


$$
\mu_{2}=4 \mu_{0}
$$

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.

