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 $\rho$):

$$B_1(\rho) = 8 \mu_0 \rho \hat{a}_\phi \left[ \frac{W}{m^2} \right]$$

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 $\rho$):

$$B_2(\rho) = \frac{\alpha \mu_0}{\rho} \hat{a}_\phi \left[ \frac{W}{m^2} \right]$$

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**.