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 \( \rho \) !):

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

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 \( \rho \) !):

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

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**.