Special Problem 8-4.1

A cylinder of **infinite** length is centered along the *z*-axis. This cylinder has a radius of 2 m.

Outside the cylinder (i.e., $\rho > 2$) is a **magnetic material** with relative permeability $\mu_r = 3$.

The magnetic field **inside** the cylinder is zero, i.e.,

$$\mathbf{H}(\bar{r}) = 0 \text{ for } \rho < 2$$

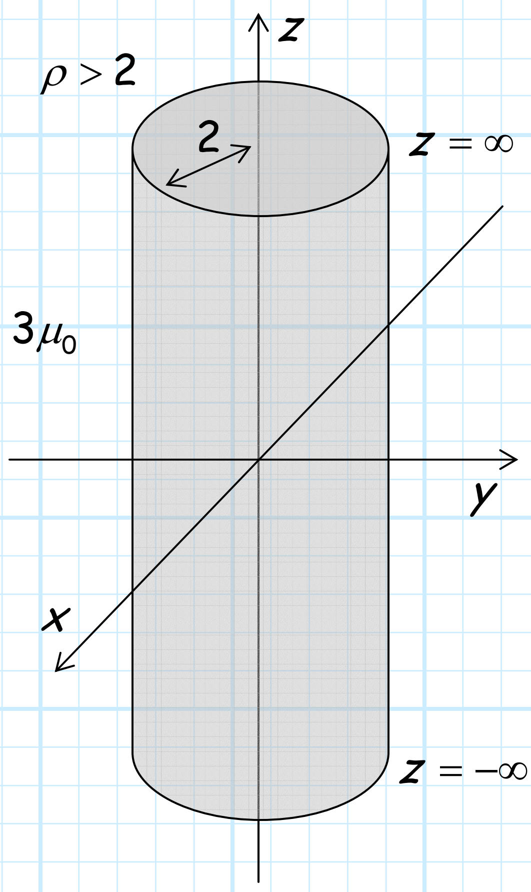
Flowing on the **surface** of this cylinder is conduction current:

$$\mathbf{J}_s(\bar{r}) = 4\hat{\mathbf{a}}_\phi + 3\hat{\mathbf{a}}_z \quad A/m$$

It is known that the magnetic field **outside** the cylinder (where $\mu_r = 3$) has the form:

$$\mathbf{H}(\bar{r}) = \frac{\alpha}{\rho}\hat{a}_\phi + \frac{\beta}{\rho}\hat{a}_z \quad \text{for} \quad \rho > 2$$

where α and β are **unknown constants**.



1. Find the magnetic field $\mathbf{H}(\bar{r})$ outside the cylinder (i.e. the **numeric** values of constants α and β).

2. Determine an expression for the **dipole density** outside the cylinder (i.e., in the magnetic material).