

### Special Problem 9-3.1

A **solenoid** with  $N=1000$  turns and length  $d=1.0$  m and is filled with a magnetic material with permeability:

$$\mu(\rho) = \mu_0 (8 - 60\rho)$$

Note this permeability is **not** a constant, but instead is a **function** of coordinate  $\rho$ .

The **magnetic field** within the solenoid is:

$$\mathbf{H}(\vec{r}) = \frac{i N}{d} \hat{a}_z \quad \left[ \frac{A}{m} \right]$$

where  $i$  is the current within the wire.

Each loop forms a **circle** with radius  $a=0.1$  m .

Determine the **inductance** of this solenoid in terms of  $\mu_0$  (Hint: the answer is **not** a function of  $\rho$ !).

