

51. (a) The magnitude of the magnetic dipole moment is given by $\mu = NiA$, where N is the number of turns, i is the current, and A is the area. We use $A = \pi R^2$, where R is the radius. Thus,

$$\mu = Ni\pi R^2 = (300)(4.0 \text{ A})\pi(0.025 \text{ m})^2 = 2.4 \text{ A}\cdot\text{m}^2 .$$

- (b) The magnetic field on the axis of a magnetic dipole, a distance z away, is given by Eq. 30-29:

$$B = \frac{\mu_0}{2\pi} \frac{\mu}{z^3} .$$

We solve for z :

$$z = \left(\frac{\mu_0}{2\pi} \frac{\mu}{B} \right)^{1/3} = \left(\frac{(4\pi \times 10^{-7} \text{ T}\cdot\text{m/A})(2.36 \text{ A}\cdot\text{m}^2)}{2\pi(5.0 \times 10^{-6} \text{ T})} \right)^{1/3} = 46 \text{ cm} .$$