

57. (a) We denote the large loop and small coil with subscripts 1 and 2, respectively.

$$B_1 = \frac{\mu_0 i_1}{2R_1} = \frac{(4\pi \times 10^{-7} \text{ T} \cdot \text{m/A})(15 \text{ A})}{2(0.12 \text{ m})} = 7.9 \times 10^{-5} \text{ T} .$$

- (b) The torque has magnitude equal to

$$\begin{aligned} \tau &= \left| \vec{\mu}_2 \times \vec{B}_1 \right| = \mu_2 B_1 \sin 90^\circ \\ &= N_2 i_2 A_2 B_1 = \pi N_2 i_2 r_2^2 B_1 \\ &= \pi(50)(1.3 \text{ A})(0.82 \times 10^{-2} \text{ m})^2(7.9 \times 10^{-5} \text{ T}) = 1.1 \times 10^{-6} \text{ N} \cdot \text{m} . \end{aligned}$$