

# FIFTH MIDTERM

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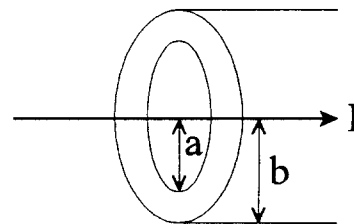
**SHOW ALL WORK!!!!**

**REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!**

**Use the conversion constants and data given on the front page.**

A long straight wire carries a current of 4.75 A.

- (a) Find the magnitude of the magnetic field at a distance  $r = 1.75 \times 10^{-2}$  m from the wire.
- (b) Calculate the magnetic energy stored in a region of space that is a tube parallel to the wire of inner radius  $a = 3.20$  cm and outer radius  $b = 7.70$  cm with a length of 2.75 m.



$$(a) \quad B = \frac{\mu_0 I}{2\pi r} = 5.43 \times 10^{-5} \text{ T}$$

$$(b) \quad E = \int_a^b \frac{B(r)^2}{2\mu_0} 2\pi r l dr = \frac{\mu_0 I^2 l}{4\pi} \ln \frac{b}{a}$$
$$= 5.45 \times 10^{-6} \text{ J}$$