

# FIFTH MIDTERM

# 4

Name: \_\_\_\_\_

Discussion Instructor (circle): Billeter      Blake      Herring      Young

Discussion Section # \_\_\_\_\_

Student ID #: \_\_\_\_\_

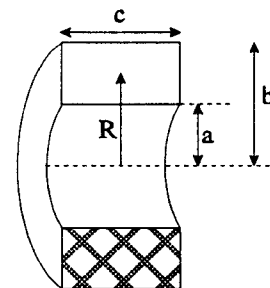
**SHOW ALL WORK!!!!**

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

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

A toroid has a rectangular cross section as shown. It has 375 turns.

- (a) [20 pts.] Calculate the total magnetic flux through the toroid (through the cross hatched area), if the current in each turn is  $I_0$ .  
 (b) [5 pts.] Calculate the self-inductance of the toroid.



(a)  $\Phi = \int_A \vec{B} \cdot d\vec{A}$  (5 points)

$B = \frac{\mu_0 N I_0}{2\pi R}$  (5 points)

$dA = c \cdot dR$  (5 points)

$\Rightarrow \Phi = \int_a^b \frac{\mu_0 N I_0}{2\pi R} c \cdot dR$

$\Phi = \frac{\mu_0 N I_0 c}{2\pi} \int_a^b \frac{dR}{R}$

$\Phi = \frac{\mu_0 N I_0 c}{2\pi} \ln\left(\frac{b}{a}\right), N=375$  (5 points)

(b)  $L = \frac{N\Phi}{I_0} = \frac{\mu_0 N^2 c}{2\pi} \ln\left(\frac{b}{a}\right)$  (5 points)