

FINAL EXAM

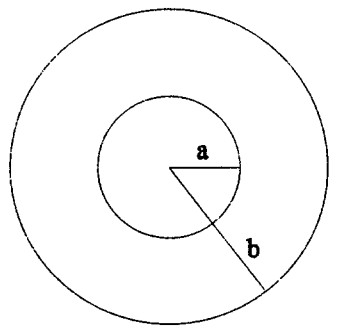
Name (print) Prabasa Paul Name (signed) _____

Discussion Instructor (circle): Condella Godfrey-Smith Guilkey Leong Nott Paul

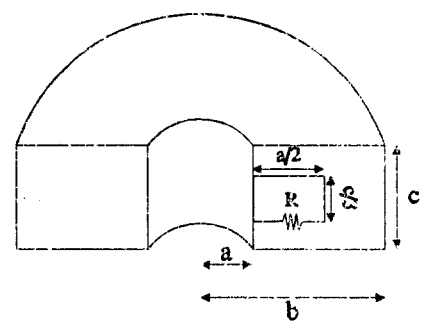
Discussion Section # _____

SHOW ALL WORK!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

The toroidal coil shown has a rectangular cross section and is wound with 953 turns of wire. The distances a and b are measured from the center of the doughnut.



TOP VIEW



SIDE VIEW
(cross section)

- (a) Calculate the value of the magnetic field inside the coil for any r between a and b ($a < r < b$) and for any value of the current I.
- (b) If $I = I_0 e^{-kt}$ where k is a constant, calculate the current at any time t in the single rectangular loop of wire inside the toroid. The loop has dimension a/2 and c/3 as shown, and its left edge, as in the picture, is at r = a.

(a) $N = 953$
 $B = \frac{\mu_0 N I}{2\pi r}$ (10 pts.)

(b) $I_{loop} = \frac{\mathcal{E}}{R} = - \frac{d\phi}{dt} / R$
 $\phi = \int \vec{B} \cdot d\vec{A} = \int_a^{3a/2} \frac{\mu_0 N I}{2\pi r} \frac{c}{3} dr = \frac{\mu_0 N I c}{6\pi} \ln(3/2) e^{-kt}$

$\Rightarrow I_{loop} = \frac{\mu_0 N c \ln(3/2)}{6\pi R} k I_0 e^{-kt}$

(20 pts.)