

Massachusetts Institute of Technology
Department of Physics
Physics 8.022 - Fall 2002

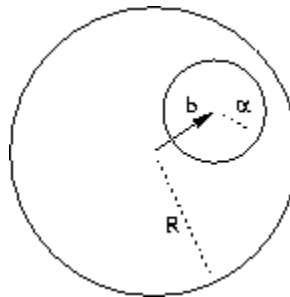
Assignment #9
Biot-Savart and Ampere's Laws
Faraday's Law of Induction
Mutual and Self Inductance

Reading *Purcell*: Chapters 6 and 7.

Problem Set #9

Work on **all** problems. Not all problems receive equal points. Total points for this set is 100.

- (15 points) [1] Hollow wire.



A straight wire (along the z axis) of radius R carries current density $\vec{J} = J_0 \hat{k}$. A cylindrical hole of radius α parallel to the axis of the wire is drilled at distance b from it as shown in figure (viewed from the top). Show that the field anywhere inside the hole is uniform and given by $\vec{B} = \frac{2\pi J_0}{c} \hat{k} \times \vec{b}$. If I is the total current flowing through the hollow wire, express B in terms of I, b, R and α .

(15 points) [2] *Emf* in a loop.

A pair of parallel wires carries equal and opposite currents I . A closed rectangular wire loop of dimensions h and w is placed in the plane of them and as shown in the figure.

- Find the magnetic flux through the loop.
- Now allow I to vary with time at a slow enough rate dI/dt . Find the induced *Emf* in the loop.

