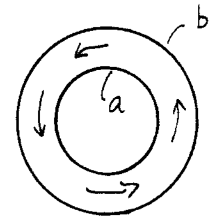
PHYSICS 322 | HOUR EXAM 2 | APRIL 20, 2005

1) An infinitely long cylinder (inner radius a, outer radius b) is magnetized in the $\hat{\phi}$ direction as shown. Assume $\vec{M}$ is constant in magnitude



(a) Find all of the bound currents.

(b) Find $\vec{B}$ for i) $s<a$; ii) $a<s<b$; iii) $s>b$.

2) This is a problem to find $\vec{B}$ at a point a distance z above an infinite sheet of current. The current $\vec{K}$ is in the x-y plane and moves in the $+\hat{x}$ direction. You are to use the following method:

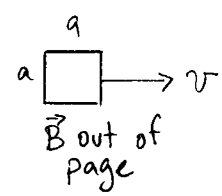
(a) First find the vector potential. If you work the problem directly $\vec{A}$ will be infinite, so keep your answer finite by calculating for a finite sheet. The math is easiest for a disc of radius R

(b) Find $\vec{B}$ from $\vec{A}$.

(c) Take the limit $R \to \infty$.

If you can't do the problem as described, you can get partial credit finding $\vec{B}$ some other way.

3) A square coil, dimensions a by a and total resistance R is pulled at constant velocity $\vec{v} = v\hat{x}$ through a field that increases linearly with x, $\vec{B} = (B_0 + \alpha x)\hat{z}$.



(a) Find the direction of the induced current in the loop.

(b) Find the magnitude of I.

(c) How much power is being dissipated in the coil ($P = \mathcal{E} \cdot I$)?

(d) Find the force necessary to pull the coil along.

(e) Show that the work done in time t is equal to the energy dissipated in the coil.