

NAME \_\_\_\_\_  
Date \_\_\_\_\_

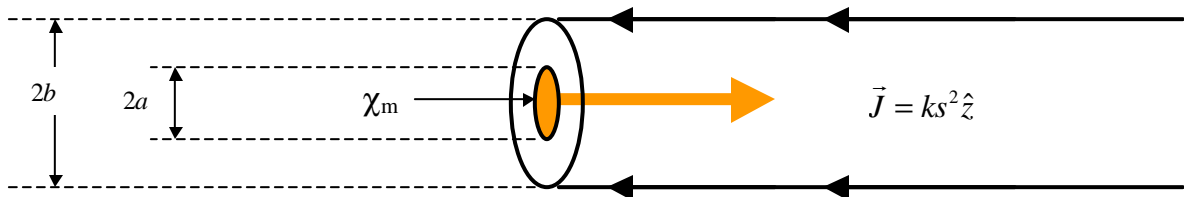
PHY 424/ELE 324  
Fall 2005 – EXAM 2

Info: There are 3 problems. Point values are indicated. Work expeditiously. Don't spend too much time on any one problem. If you have questions, please ask.

Rules:

- (A) You must show your work or explain your answer to receive full credit.
- (B) Your final answer MUST be put in a BOX to ensure you receive full credit.

#1) Consider an infinitely long cylindrical coaxial cable which has a solid inner conductor of radius  $a$ , and outer conductor of radius  $b$ . The inner conductor carries a current density,  $\vec{J} = ks^2\hat{z}$  which returns on the outer conductor at  $s=b$  and has magnetic susceptibility  $\chi_m$ . The region in between the two conductors is filled with vacuum (40 pts).



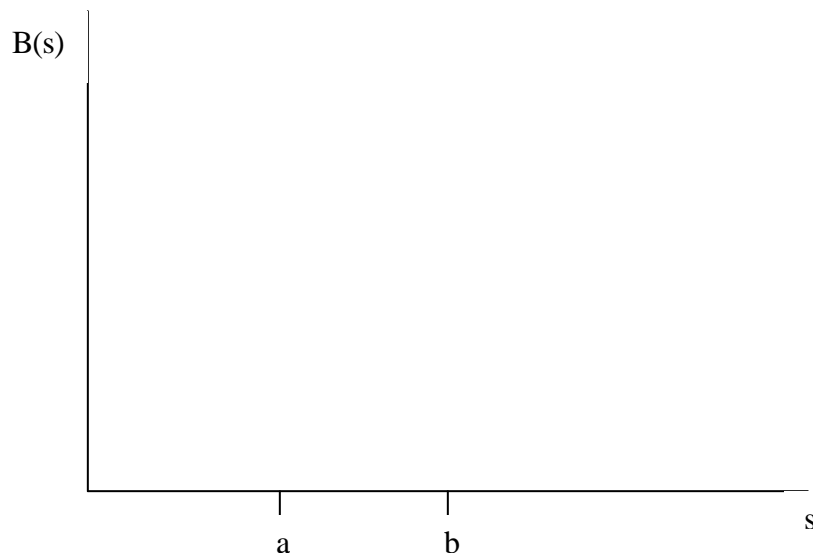
a) Find the magnetic field in the region  $s \leq a$  (8 pts).

b) Find the magnetic field in the region  $a \leq s \leq b$  (8 pts).

c) Determine the magnetization of the inner conductor (4 pts).

d) Using what you found in (c), determine the bound volume current density and surface current densities for the inner conductor (10 pts).

e) Sketch  $\mathbf{B}$  as a function of  $s$  for the region from  $s=0$  to  $s \gg b$ . Show 2 curves on the same figure, one where the inner conductor is diamagnetic and one where it is paramagnetic. In a sentence or two compare/contrast the two curves (10 pts). Indicate their dependence on the variable  $s$ .





- d) Sketch the electric field as a function of the distance  $r$  from the center of the sphere. Make sure your sketch goes from  $r = 0$  and shows the asymptotic behavior of  $\mathbf{E}$  for  $r \gg b$ . Also, indicate the values of  $\mathbf{E}$  at  $r = a$  and  $b$  (10 pts).

3) A circular hoop of radius  $R$  and charge density  $\lambda$  is centered on  $z=0$  and spinning with an angular velocity,  $\omega$ . Determine the magnetic field,  $\mathbf{B}$  at a height  $z=z_0$  on the  $z$ -axis. (22 points)  
(Note:  $v = \omega r$ )