

EM7all96B

- (a) Consider a semi-infinite solenoid of radius b situated along the z axis from $-\infty$ to 0 . It has n turns per unit length and a current I_1 , running through the coil. Find the magnetic field B_z on the symmetry axis at any point z on the positive z axis.
- (b) In cylindrical coordinates, derive an expression for the radial component of the magnetic field, B_ρ , a height z above the top of the coil and a distance a away from the z axis. Work in the limit $a \ll b$.
- (c) Now consider a ring of current I_2 and radius a positioned at height $+z$, shown as a dotted circle in the figure. The direction of I_2 is the same as I_1 . Calculate the magnitude of the force on this ring in terms of a , I_2 , and B_ρ . What is the direction of this force?
- (d) Consider a diamagnetic substance suspended by a spring just above the solenoid along the z axis. With *no* current in the solenoid, the sample is at rest. Next, the current is turned on in the solenoid. What happens to the sample on the spring? Justify your answer.

