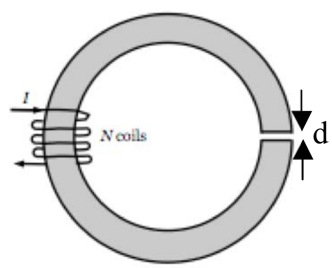
Q0. SURVEY: http://www.colorado.edu/sei/surveys/Sp09/Clicker_Phys3310_sp09-post.html
You will get full credit (5 pts) on this homework problem just for filling out this survey (URL above) about the course. We won't grade you in any way on your specific responses. Your opinions matter and will help us improve this course in the future. The course instructors will only see anonymous results; they will not see names associated with responses.

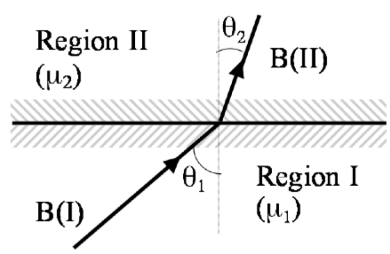
Q1. B AND H IN A CAVITY
Find **B** and **H** at the center of a hollow spherical cavity carved out of a *large* chunk of uniform, linear, magnetic material (susceptibility χ_m) which had (before you carved the hole) a total uniform field **B** = $B_0\hat{\mathbf{z}}$ through its volume. Before the cavity is carved, the material has a uniform $\mathbf{H}_0 = (1/\mu_0)B_0\hat{\mathbf{z}} - M_0\hat{\mathbf{z}}$. (Express your final answers in terms of B_0 and χ_m only)
Hint: Think of the problem as the superposition of a large totally uniform magnetized system with a sphere of uniform but opposite magnetization. Because a uniformly magnetized sphere cannot exist in a linear material without additional external magnetic fields, you should assume that the oppositely magnetized sphere has permanent magnetization M_0. This problem could help you to "model" magnetic materials - knowing B in a cavity would tell you how an atom there would magnetize.

Q2. CONTINUITY B AND H FIELDS
A toroidal piece of "soft iron" (iron that is roughly linear, but has a very large permeability μ characteristic of ferromagnetic materials) has a very thin gap in it, of width *d*. A wire carries current *I*, and is wrapped *N* times around a section of the toroid. The toroid has a constant cross-sectional area *A*. Find the **B** and **H** fields in the gap.



You may assume: that B (and H and M) inside the soft iron are quite uniform, smooth, and continuous all the way around, except of course in the gap; consider the boundary conditions there for H and B. Also, assume that fringe fields are negligible, and that μ/μ_0>>1. Also, assume that μ/μ_0>>($2\pi R/d$), in other words that although the gap may be reasonably small, μ/μ_0(iron) is quite huge, typically of order 1000.

Q3. BOUNDARY CONDITIONS FOR B AND H FIELDS
A) Consider the situation of a static B field spanning a boundary between two different materials (with different permeabilities, μ), in the configuration shown in the figure, assuming medium one has relative magnetic permeability μ_1, and medium two has permeability μ_2. Find the ratio $\tan\theta_2/\tan\theta_1$. Please show/explain your work clearly. *(Find the ratio in terms of μ_1 and μ_2, that should be simplest. Assume there is no free current anywhere in the figure).*



B) In the figure as shown, if one of the regions is vacuum, and the other one is paramagnetic, which is which? (I.e. which region is vacuum, region I or region II?) How about if one is vacuum, and one is diamagnetic, then which is which? Briefly explain.