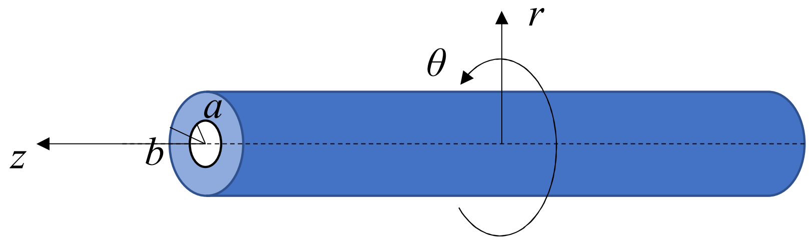
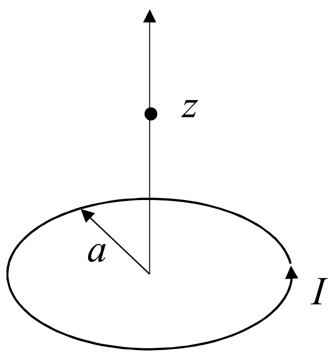
Q28.20 A cylinder of iron is placed so that it is free to rotate around its axis. Initially the cylinder is at rest, and a magnetic field is applied to the cylinder so that it is magnetized in a direction parallel to its axis. If the direction of the *external* field is suddenly reversed, the direction of magnetization will also reverse and the cylinder will begin rotating around its axis. (This is called the *Einstein–de Haas effect*.) Explain why the cylinder begins to rotate.

Home work: hand in required

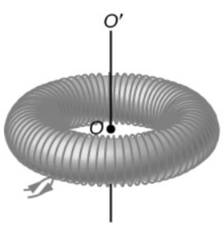
1. Current I is flowing in the long tube (in the axial direction), which has inner diameter of a and outer diameter of b. Please give the field at point (r, θ, $z=0$), with $r<a$, $a<r<b$, and $r>b$ respectively.



2. Please calculate the magnetic field of an circular current loop, at one point on the axis (0, 0, z).



3. As shown in Fig. (a), a 400 turn toroid is wound around an iron core, the mean radius of which is 6.0 cm, carrying 4.0 A. The relative permeability of the core is 80. (a) What is the magnetic flux density in the core? (b) What is the part of the magnetic flux density that is due to the atomic currents?



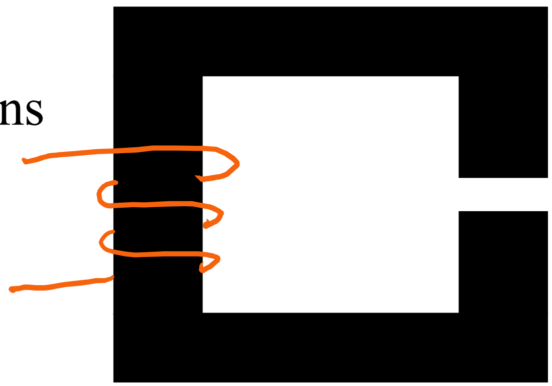
(a)

4. A wide, long, insulating belt has a uniform positive charge per unit area σ on its upper surface. Rollers at each end move the belt to the $+x$ direction at a constant speed v. Calculate the magnitude and direction of the magnetic field produced by the moving belt at a point just above its surface. (the belt can be considered a infinitely large plane xoy for this point at $(0,0,z=z_0)$)

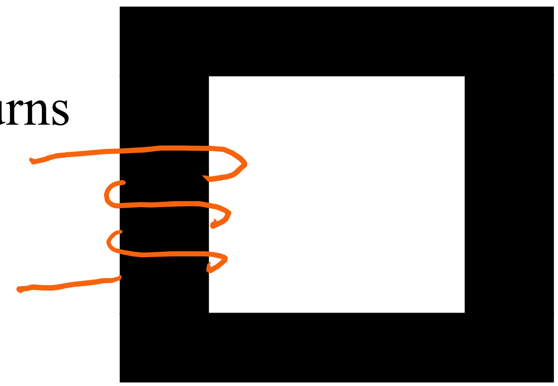
Home work: hand in required

5. Can you explain why the magnetic flux density in the two following cases are different?

3 A*3 turns



3 A*3 turns



6. In the former case, how do you respond to the following statement: ***H*** is almost the same for both cases since ***H*** is determined by the applied current. $\boldsymbol{M}=\chi \boldsymbol{H}$, so ***M*** should also be the almost the same. ***M*** contributes to most of ***B***, so ***B*** should also be similar in the two cases.