Problem 6.8. A very long circular cylinder of radius R carries a magnetization $\mathbf{M} = ks^2\hat{\boldsymbol{\phi}}$, where k is a constant (Fig. 6.13). Find the magnetic field due to $\mathbf{M}$, for points inside and outside the cylinder (and far from the ends).

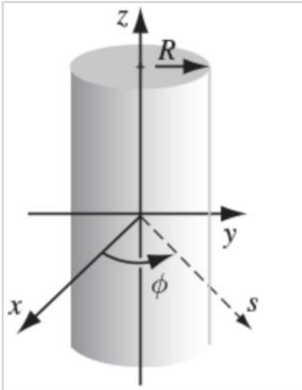

Fig. 6.13

Fig. 6.13

Problem 6.10. An iron rod of length L and square cross section (side length a) is given a uniform longitudinal magnetization $\mathbf{M}$, and then bent around into a circle with a narrow gap (width w), as shown in Fig. 6.14. Find the magnetic field at the center of the gap, assuming $w \ll a \ll L$. [*Hint:* Treat it as the superposition of a *complete* torus plus a square loop with reversed current.]

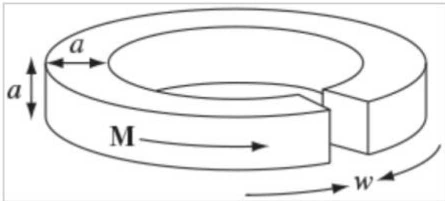

Fig. 6.14

Fig. 6.14

Problem 6.12. An infinitely long cylinder, of radius R, carries a "frozen-in" magnetization, parallel to the axis,

$$\mathbf{M} = ks\hat{\mathbf{z}},$$

where k is a constant and s is the distance from the axis; there is no free current anywhere. Find the magnetic field inside and outside the cylinder by two different methods:

(a) As in Section 6.2, locate all the bound currents, and calculate the field they produce.

(b) Use Ampère's law (in the form of Eq. 6.20) to find $\mathbf{H}$, and then get $\mathbf{B}$ from Eq. 6.18. (Notice that the second method is much faster, and avoids any explicit reference to the bound currents.)

Problem 6.16. A coaxial cable consists of two very long cylindrical tubes, separated by linear insulating material of magnetic susceptibility χ_m. A current I flows down the inner conductor and returns along the outer one; in each case, the current distributes itself uniformly over the surface (Fig. 6.24). Find the magnetic field in the region between the tubes. As a check, calculate the magnetization and the bound currents, and confirm that (together, of course, with the free currents) they generate the correct field.

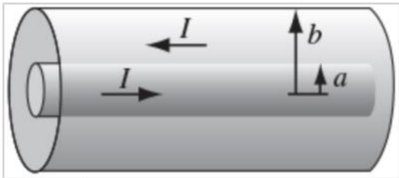

Fig. 6.24

Fig. 6.24