HW-CH29

1. A straight conductor carrying current i=5.0 A splits into identical semicircular arcs as shown in Fig. 29-35. What is the magnetic field at the center C of the resulting circular loop?

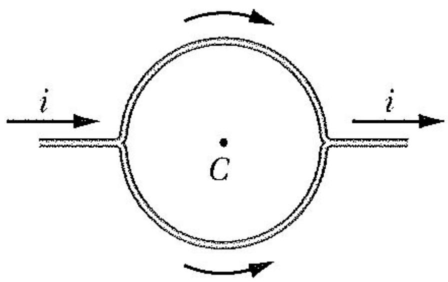


Fig. 29-35 Problem 4.

2. Figure 29-50 shows a snapshot of a proton moving at velocity $\vec{v} = (-200 m/s)\hat{\jmath}$ toward a long straight wire with current $i = 350\ mA$. At the instant shown, the proton's distance from the wire is $d = 2.89 cm$. In unit-vector notation, what is the magnetic force on the proton due to the current?

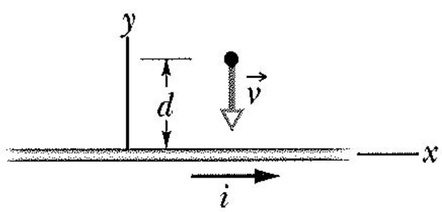
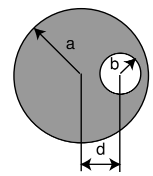


Fig. 29-50 Problem 23.

3. The current density $\vec{J}$ inside a long, cylindrical wire of radius $a = 3.1$ mm is in the direction of the central axis, and its magnitude varies linearly with radial distance r from the axis according to $J = J_0 r/a$, where $J_0 = 310 A/m^2$. Find the magnitude of the magnetic field at (a) $r = 0$, (b) $r = a/2$, and (c) $r = a$.

4. The following figure shows a cross section of a long cylindrical conductor of radius $a = 4.00 cm$ containing a long cylindrical hole of radius $b = 1.50 cm$. The central axes of the cylinder and hole are parallel and are distance $d = 2.00 cm$ apart; current $i = 5.25 A$ is uniformly distributed over the tinted area. (a) What is the magnitude of the magnetic field at the center of the hole? (b) Discuss the two special cases $b = 0$ and $d = 0$.



5. The following figure shows a cross section of an infinite conducting sheet carrying a current per unit x-length of λ; the current emerges perpendicularly out of the page. (a) Use the Biot-Savart law and symmetry to show that for all points P above the sheet and all points P' below it, the magnetic field $\vec{B}$ is parallel to the sheet and directed as shown. (b) Use Ampere's law to prove that $B = \frac{1}{2}\mu_0\lambda$ at all points P and P'.

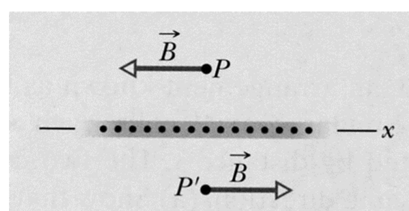


FIG. 29-85 Problem 79.

6. Show that the magnitude of the magnetic field produced at the center of a rectangular loop of wire of length L and width W, carrying a current i, is

$$B = \frac{2\mu_0 i}{\pi}\frac{(L^2 + W^2)^{1/2}}{LW}.$$

7. Show that a uniform magnetic field $\vec{B}$ cannot drop abruptly to zero (as is suggested by the lack

of field lines to the right of point a in Fig. 20-89) as one moves perpendicular to $\vec{B}$, say along the horizontal arrow in the figure. (Hint: Apply Ampere's law to the rectangular path shown by the dashed lines.) In actual magnets, "fringing" of the magnetic field lines always occurs, which means that $\vec{B}$ approaches zero in a gradual manner. Modify the field lines in the figure to indicate a more realistic situation.

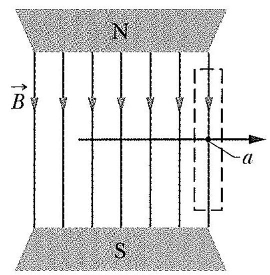


Fig. 29-89 Problem 93.