Home Work 9

9-1 A square loop of wire of edge length a carries current i. Show that, at the center of the loop, the magnitude of the magnetic field produced by the current is

$$B = \frac{2\sqrt{2}\mu_0 i}{\pi a}$$

9-2 In Figure 1, a long circular pipe with outside radius R = 2.6 cm carries a (uniformly distributed) current i = 8.00 mA into the page. A wire runs parallel to the pipe at a distance of 3.00R from center to center. Find the (a) magnitude and (b) direction (into or out of the page) of the current in the wire such that the net magnetic field at point P has the same magnitude as the net magnetic field at the center of the pipe but is in the opposite direction.

9-3 An electron is shot into one end of a solenoid. As it enters the uniform magnetic field within the solenoid, its speed is 800 m/s and its velocity vector makes an angle of 30° with the central axis of the solenoid. The solenoid carries 4.0 A and has 8000 turns along its length. How many revolutions does the electron make along its helical path within the solenoid by the time it emerges from the solenoid's opposite end? (In a real solenoid, where the field is not uniform at the two ends, the number of revolutions would be slightly less than the answer here.)

9-4 Figure 2 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.

9-5 In Fig. 3, an arrangement known as Helmholtz coils consists of two circular coaxial coils, each of N turns and radius R, separated by distance s. The two coils carry equal currents i in the same direction. Show that the first derivative of the magnitude of the net magnetic field of the coils (dB/dx) vanishes at the midpoint P regardless of the value of s. Why would you expect this to be true from symmetry? This accounts for the uniformity of B near P for this particular coil separation.

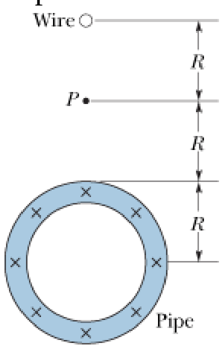

Fig.1

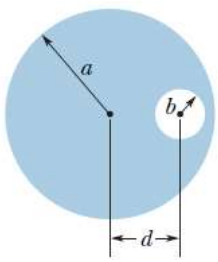

Fig.2

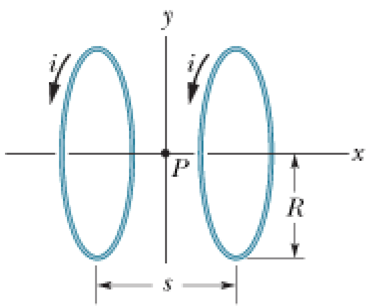

Fig.3