

Figure 1: Problem 1.

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Problems set # 9

Physics 167

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1. Consider the hemispherical closed surface in Fig. 1. The hemisphere is in a uniform magnetic field that makes an angle θ with the vertical. Calculate the magnetic flux through (i) the flat surface S_1 and (ii) the hemispherical surface S_2 .

2. A cube of edge length $\ell = 2.50$ cm is positioned as shown in Fig. 2. A uniform magnetic field given by $\vec{B} = (5\hat{i} + 4\hat{j} + 3\hat{k})$ T exists throughout the region. (i) Calculate the flux through the shaded face. (ii) What is the total flux through the six faces?

3. A solenoid 2.50 cm in diameter and 30.0 cm long has 300 turns and carries 12.0 A. (i) Calculate the flux through the surface of a disk of radius 5.00 cm that is positioned perpendicular to and centered on the axis of the solenoid, as shown in Fig. 3 (a). (ii) Figure 3 (b) shows an enlarged end view of the same solenoid. Calculate the flux through the blue area, which is defined by an annulus that has an inner radius of 0.400 cm and outer radius of 0.800 cm.

4. Two parallel rails with negligible resistance are 10.0 cm apart and are connected by a 5.00- Ω resistor. The circuit also contains two metal rods having resistances of 10.0 Ω and 15.0 Ω sliding along the rails (Fig. 4). The rods are pulled away from the resistor at constant speeds of 4.00 m/s and 2.00 m/s, respectively. A uniform magnetic field of magnitude 0.01 T is applied perpendicular to the plane of the rails. Determine the current in the 5.00- Ω resistor.

5. Two infinitely long solenoids (seen in cross section) pass through a circuit as shown in Fig. 5. The magnitude of B inside each is the same and is increasing at the rate of 100 T/s. What is the current in each resistor?

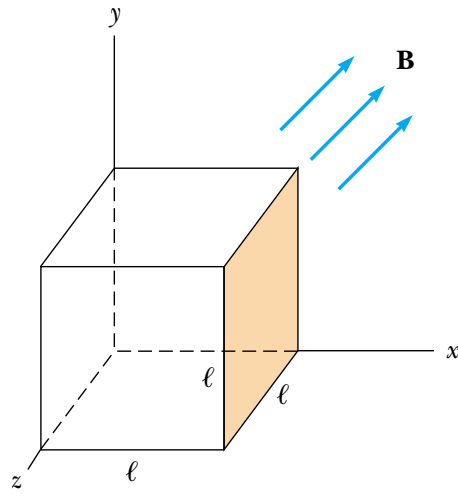
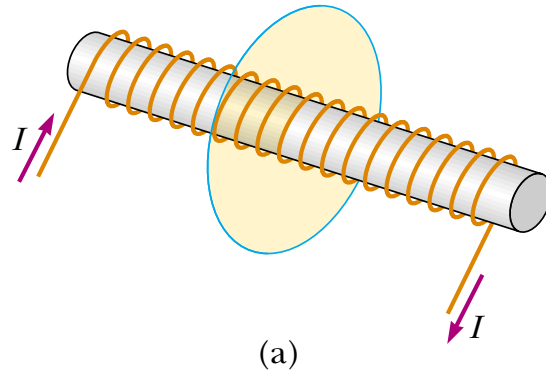
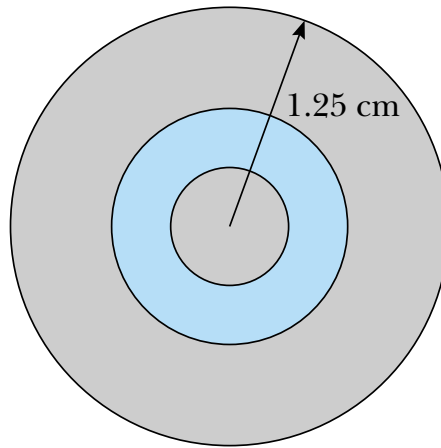


Figure 2: Problem 2.



(a)



(b)

Figure 3: Problem 3.

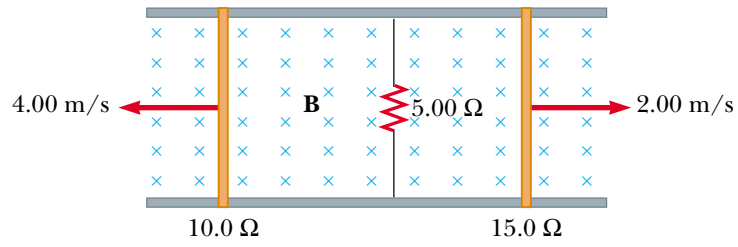


Figure 4: Problem 4.

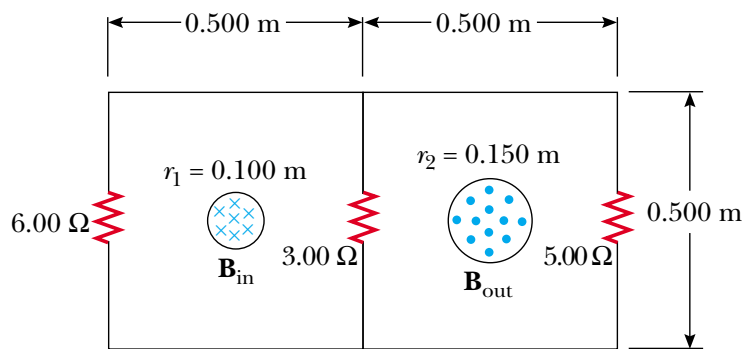


Figure 5: Problem 5.