ÇANKAYA UNIVERSITY

PHYS 132 – PHYSICS II

CHAPTER 29

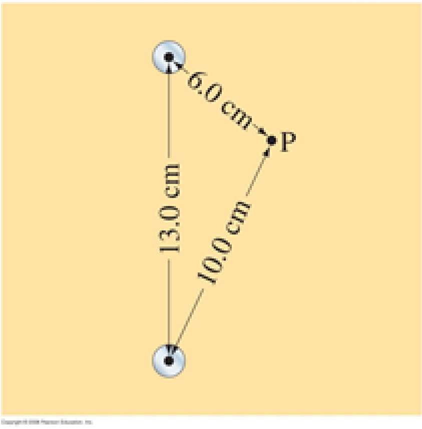
MAGNETIC FIELDS DUE TO CURRENTS

PROBLEM SET

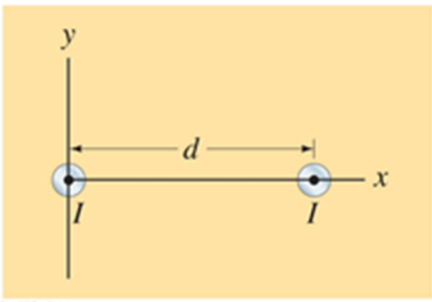
1) Determine the magnitude and direction of the force between two parallel wires 25 m long and 4.0 cm apart, each carrying 35 A in the same direction.
[Answer: 0.15 N, attractive]

2) An experiment on the Earth's magnetic field is being carried out 1.00 m from an electric cable. What is the maximum allowable current in the cable if the experiment is to be accurate to ∓ 2.0 %? [Earth magnetic field = $0.5 \times 10^{-4}\ T$] **[Answer: 5.0 A]**

3) *** Two long thin parallel wires 13.0 cm apart carry 35-A currents in the same direction. Determine the magnetic field vector at a point 10.0 cm from one wire and 6.0 cm from the other (Fig. 28–34). **[Answer: $\mathbf{1.2 \times 10^{-4}}$ T, $\mathbf{82^0}$]**

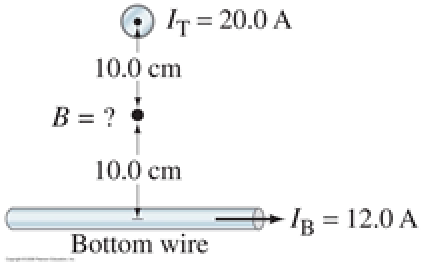


4) Let two long parallel wires, a distance d apart, carry equal currents I in the same direction. One wire is at $x=0$, the other at $x=d$, Fig. 28–38. Determine $\vec{\mathbf{B}}$ along the x axis between the wires as a function of x.



[Answer: $\frac{\mu_0 I}{2\pi}\left(\frac{d-2x}{x(d-x)}\right)\hat{\mathbf{j}}$ **]**

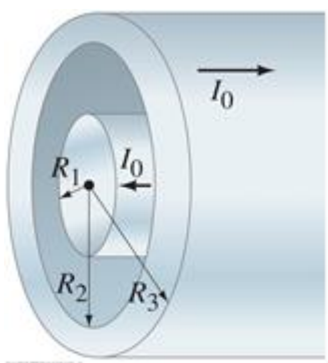
5) Two long wires are oriented so that they are perpendicular to each other. At their closest, they are 20.0 cm apart (Fig. 28–39). What is the magnitude of the magnetic field at a point midway between them if the top one carries a current of 20.0 A and the bottom one carries 12.0 A? **[Answer: $\mathbf{4.66 \times 10^{-5}}$ T]**

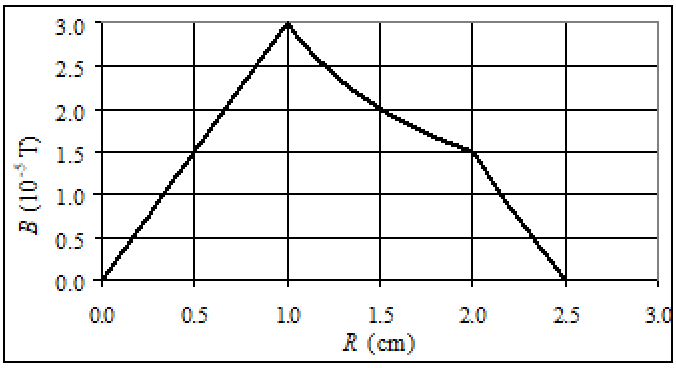


6) A 40.0-cm-long solenoid 1.35 cm in diameter is to produce a field of 0.385 mT at its center. How much current should the solenoid carry if it has 765 turns of wire? **[Answer: 0.160 A]**

7) *** A coaxial cable consists of a solid inner conductor of radius R_1, surrounded by a concentric cylindrical tube of inner radius R_2 and outer radius R_3 (Fig. 28–42). The conductors carry equal and opposite currents I_0 distributed uniformly across their cross sections. Determine the magnetic field at a distance R from the axis for: (*a*) $R < R_1$; (*b*) $R_1 < R < R_2$; (*c*) $R_2 < R < R_3$; (*d*) $R > R_3$. (*e*) Let $I_0 = 1.50$ A, $R_1 = 1.00$ cm, $R_2 = 2.00$ cm, and $R_3 = 2.50$ cm. Graph B from $R = 0$ to $R = 3.00$ cm.

[Answer: a) $B = \dfrac{\mu_0 I_0 R}{2\pi R_1^2}$ **b)** $B = \dfrac{\mu_0 I_0}{2\pi R}$ **c)** $B = \dfrac{\mu_0 I_0}{2\pi R}\dfrac{\left(R_3^2 - R^2\right)}{\left(R_3^2 - R_2^2\right)}$ **d)** Zero**]**

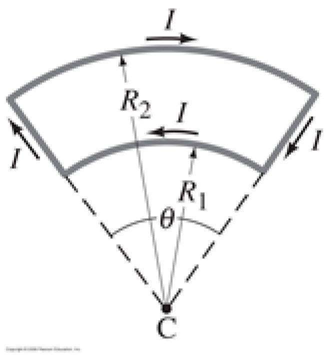




8) *** A wire, in a plane, has the shape shown in Fig. 28–43, two arcs of a circle connected by radial lengths of wire. Determine $\vec{\mathbf{B}}$ at point C in terms of R_1,R_2,θ and the current I.

[Answer:

$$\frac{\mu_0 I\theta}{4\pi}\left(\frac{R_2 - R_1}{R_1 R_2}\right)\hat{\mathbf{k}}$$ **]**



9) A circular conducting ring of radius R is connected to two exterior straight wires at two ends of a diameter (Fig. 28–44). The current I splits into unequal portions (as shown) while passing through the ring. What is $\vec{\mathbf{B}}$ at the center of the ring?

[Answer:

$$-\frac{3\mu_0 I}{40R}$$ **]**

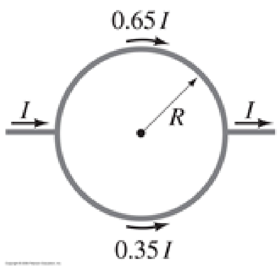
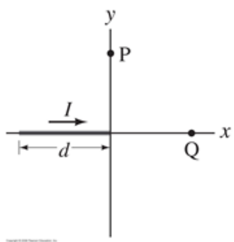


Fig. 28-44



Problem 41

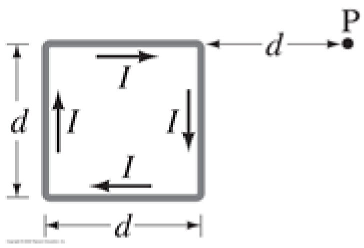


Fig. 28–50

10) Use the result of Problem 41 to find the magnetic field at point P in Fig. 28–50 due to the current in the square loop. [Result of Problem 41, magnetic field formula at point P along y axis :

$$\frac{\mu_0 I}{4\pi y}\frac{d}{\left(y^2 + d^2\right)^{1/2}}\hat{\mathbf{k}}$$]

[Answer:

$$\frac{\mu_0 I}{4\pi d}\left(\sqrt{2} - \frac{\sqrt{5}}{2}\right)\hat{\mathbf{k}}$$ **]**