

Chapter 30 Magnetic Fields Due to Currents

30-1 Calculating the Magnetic Field Due to a Current

30-01

Question 858

A segment of wire is formed into the shape shown in Figure (5) and carries a current I . What is the magnitude of the resulting magnetic field at the point P ?

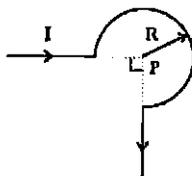


Figure # 5

- (a) $3 \mu I/(3R)$.
- (b) $3 \mu I/(6R)$.
- (c) $3 \mu I/(5R)$.
- (d) $3 \mu I/(9R)$.
- (e) $3 \mu I/(8R)$.

30-01

Question 859

Three long wires parallel to the x -axis carry currents as shown in Fig. 6. If $I=20$ A, what is the magnitude of the magnetic field at the origin?

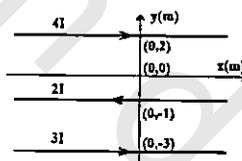


Figure # 6

- (a) 58 micro T.
- (b) 12 micro T.
- (c) 37 micro T.
- (d) 47 micro T.
- (e) 25 micro T.

30-01

0.58-47%

Question 860

What is the magnitude of the magnetic field at point P due to the current carrying wire shown in Figure 7, if $I = 2.0$ A, $a = 20$ cm and $b = 2a$?

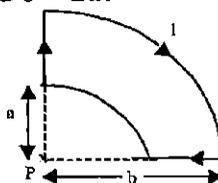


Figure 7

- (a) 2.1 micro-T
- (b) 0.8 micro-T
- (c) 0.4 micro-T
- (d) 2.8 micro-T
- (e) 1.1 micro-T

30-01

Question 861

A segment of wire is formed into the shape shown in Figure 5 and carries a current $I = 1.0$ A. What is the magnitude of the resulting magnetic field at the point P if $R = 10$ cm?

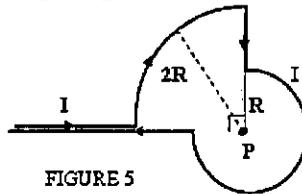


FIGURE 5

- (a) 2.6 micro-T out of the page
- (b) 1.8 micro-T into the page
- (c) 5.5 micro-T into the page
- (d) 5.5 micro-T out of the page
- (e) 1.8 micro-T out of the page

30-01

Question 862

Two long wires parallel to the x-axis carry currents I_1 and I_2 as shown in Figure 6. If $I_1 = 5$ A, what is the magnitude and direction of I_2 if the net magnetic field at the origin is 0.35 micro-T and directed out the page.

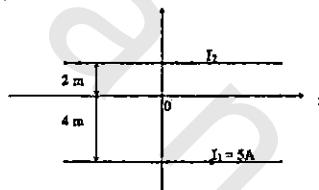


FIGURE 6

- (a) 1 A to the left
- (b) 1 A to the right
- (c) 5 A to the left
- (d) 5 A to the right
- (e) 2 A to the right

30-01

0.32-36%

Question 863

Two long straight wires carry currents perpendicular to the xy plane as shown in Figure 5. One carries a current $I_1 = 50$ A and passes through the point $x = 5.0$ cm on the x axis. The second wire has a current $I_2 = 80$ A and passes through the point $y = 4.0$ cm on the y axis. What is the magnitude of the resulting magnetic field at the origin?

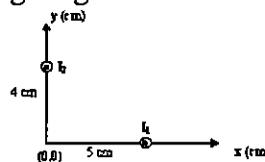


FIGURE 5

- (a) 250 micro-T
- (b) 150 micro-T
- (c) 300 micro-T
- (d) 600 micro-T
- (e) 450 micro-T

Question 86430-01
0.57-36%

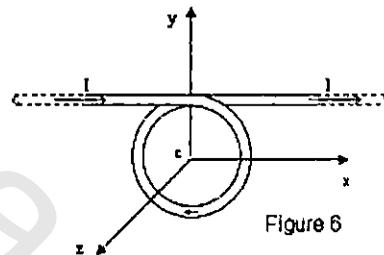
A segment of wire of total length 2.0 m is formed into a circular loop having 5.0 turns. If the wire carries a current of 1.2 A, determine the magnitude of the magnetic field at the center of the loop.

- (a) 59 micro-T
- (b) 14 micro-T
- (c) 92 micro-T
- (d) 75 micro-T
- (e) 84 micro-T

Question 865

30-01

A conductor consists of a circular loop of radius $R = 0.10$ m and two straight, long sections, as in Figure (6). The wire lies in the plane of the paper (xy -plane) and carries a current of $I = 5.3$ A. Determine the magnetic field, in Tesla, at the center of the loop. (\mathbf{k} is a unit vector in $+z$ -direction)



- (a) $-5.8 \cdot 10^{(-5)} \mathbf{k}$.
- (b) $-4.4 \cdot 10^{(-5)} \mathbf{k}$.
- (c) $1.8 \cdot 10^{(-5)} \mathbf{k}$.
- (d) $4.4 \cdot 10^{(-5)} \mathbf{k}$.
- (e) $5.8 \cdot 10^{(-5)} \mathbf{k}$.

Question 866

30-01

A long solid cylindrical conductor of radius $R = 4.0$ mm carries a current I parallel to its axis. The current density in the wire is $2 \cdot 10^{(4)} \text{ A/m}^{(2)}$. Determine the magnitude of the magnetic field at a point that is 5.0 mm from the axis of the conductor.

- (a) 30 micro-T.
- (b) 40 micro-T.
- (c) 55 micro-T.
- (d) 17 micro-T.
- (e) 12 micro-T.

Question 86730-01
0.45-36%

The magnitude of the magnetic field at 88.0 cm from the axis of an infinitely long wire is $7.3 \cdot 10^{(-6)}$ T. What is the current in the wire?

- (a) 22.2 A.
- (b) 32.1 A.
- (c) 5.30 A.
- (d) 15.4 A.
- (e) 42.8 A.

Question 86830-01
0.45-36%

Figure (8) shows two wires carrying anti-parallel currents. If i_2 is greater than i_1 , the point at which the resultant magnetic field of the two wires will be zero is located in the region (regions):

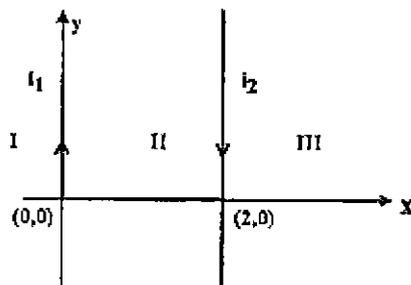


Figure (8)

- (a) I.
 (b) III.
 (c) I and III.
 (d) II and III.
 (e) II.

30-01

Question 869

Figure (10) shows four long straight wires passing through the plane of the paper. They are fixed at the corners of a square of diagonal 2.0 cm. Each wire carries a current of 2 A. Three of them are out of the paper and one is into the paper. The magnitude of the magnetic field at the center "C" of the square has magnitude:

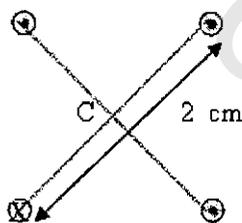


Figure 10

- (a) $1.0 \cdot 10^{(-5)}$ T.
 (b) zero.
 (c) $8.0 \cdot 10^{(-5)}$ T.
 (d) $3.0 \cdot 10^{(-5)}$ T.
 (e) $5.1 \cdot 10^{(-6)}$ T.

30-01

Question 870

A circular loop of radius 0.1 m has a resistance of 6 Ohms. If it is attached to a 12 V battery, how large a magnetic field is produced at the center of the loop?

- (a) $5.2 \cdot 10^{(-5)}$ T.
 (b) zero.
 (c) $0.5 \cdot 10^{(-5)}$ T.
 (d) $1.3 \cdot 10^{(-5)}$ T.
 (e) $3.0 \cdot 10^{(-5)}$ T.

Question 87130-01
0.50-54%

Consider the current-carrying loop shown in figure 9 with $a = 10.0$ cm, $b = 5.00$ cm, $\theta = 60.0$ degrees and $I = 0.200$ A. Find the magnitude and direction of the magnetic field at P.

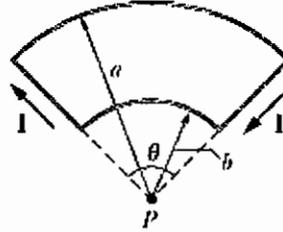


Figure 9

- (a) $5.32 \cdot 10^{(-7)}$ T into the page
 (b) $6.28 \cdot 10^{(-7)}$ T out of the page
 (c) $2.09 \cdot 10^{(-7)}$ T out of the page
 (d) $6.98 \cdot 10^{(-7)}$ T out of the page
 (e) $4.18 \cdot 10^{(-7)}$ T into the page

Question 87230-01
0.32-67%

Four long conducting wires are parallel to each other. Their cross sections form the corners of a square of side $a = 15$ cm. The directions of the currents are as shown in figure 10. The magnitude of the current in each wire is 15 A. What is the magnitude of the magnetic field at the center of the square?

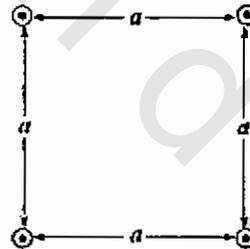


Figure 10

- (a) $8.4 \cdot 10^{(-5)}$ T
 (b) $5.7 \cdot 10^{(-5)}$ T
 (c) $1.1 \cdot 10^{(-4)}$ T
 (d) zero
 (e) $2.8 \cdot 10^{(-5)}$ T

Question 87330-01
0.66-43%

A solid cylindrical conducting wire has a radius of 15 cm. An electric current is uniformly distributed over the wire with a current density of $1.0 \cdot 10^{(-4)}$ A/m². What is the magnitude of the magnetic field at a point 5.0 cm from the axis of the wire?

- (a) $6.3 \cdot 10^{(-4)}$ T
 (b) $9.0 \cdot 10^{(-4)}$ T
 (c) $7.5 \cdot 10^{(-4)}$ T
 (d) $3.1 \cdot 10^{(-4)}$ T
 (e) zero

Question 874

30-01

0.37-40%

The segment of wire is formed into the shape as shown in Figure 7 and carries a current $I = 6$ A. When $R = 6.28$ cm, what is the magnetic field at the point P?

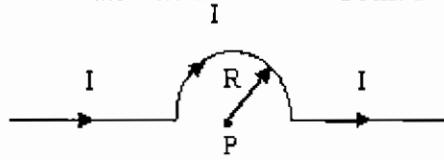


Figure 7

- (a) Zero.
 (b) 6.1×10^{-5} T into the page.
 (c) 3.0×10^{-5} T into the page.
 (d) 3.0×10^{-5} T out of the page.
 (e) 6.1×10^{-5} T out of the page.

Question 875

30-01

0.34-72%

Figure 6 shows two current segments. In the upper segment, an arc of radius 4.0 cm subtends an angle of 120 degrees with its center at P. The lower segment includes a larger semicircle of radius 5.0 cm, also with center at P. The upper segment carries a current of $2I$, whereas the lower segment carries a current I . If $I = 0.40$ A, what is the net magnetic field at point P due to these two current segments?

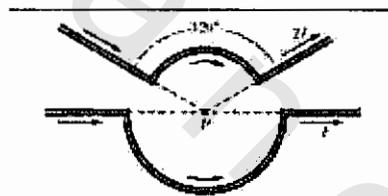


Figure 6

- (a) 1.7 micro-Tesla into the page
 (b) 0.42 micro-Tesla into the page
 (c) 4.6 micro-Tesla into the page
 (d) 4.6 micro-Tesla out of the page
 (e) 2.5 micro-Tesla out of the page

Question 876

30-01

0.35-75%

Figure 8 shows two long, thin wires that carry currents in the positive z direction. Both wires are parallel to the z axis. The 50-A wire is in the xz plane and is 5.0 m from the z axis. The 40-A wire is in the yz plane and is 4.0 m from the z axis. What is the magnitude of the magnetic field at the origin?



FIGURE 8

- (a) 2.8 micro-Tesla
 (b) zero
 (c) 5.7 micro-Tesla
 (d) 1.2 micro-Tesla
 (e) 6.8 micro-Tesla

Question 877

30-01

0.60-36%

A long, straight, hollow conductor, that has an inner radius of 1.0 mm and an outer radius of 3.0 mm, carries a current of 15 A uniformly distributed over its cross section. What is the magnitude of the magnetic field at a distance of 4.0 mm from the axis of the wire?

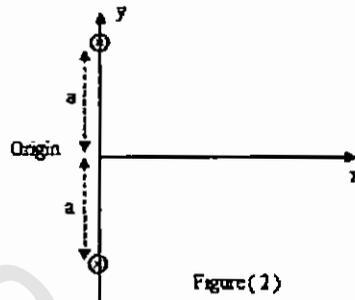
- (a) 0.75 mT
- (b) 0.64 mT
- (c) 0.71 mT
- (d) 0.79 mT
- (e) 0.24 mT

Question 878

30-01

0.35-30%

Two long wires are parallel to the z-axis as shown in figure 2. Find the resultant magnetic field at the origin, given that the wires carry equal current I and moves in the same direction. [Take $I = 1.0$ A and $a = 0.5$ m]



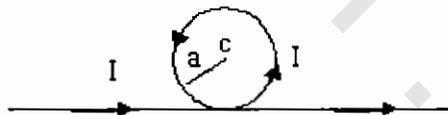
- (a) 8.0×10^{-4} Tesla, In the negative x-direction.
- (b) 3.2×10^{-4} Tesla, In the positive z-direction.
- (c) 3.2×10^{-3} Tesla, In the positive z-direction.
- (d) Zero.
- (e) 8.0×10^{-7} Tesla, In the positive x-direction.

Question 879

30-01

0.45-55%

Part of a long, flexible, current-carrying wire is made into a circular loop, while the rest of it lies in a straight line as shown in figure 3. What is the magnetic field strength at point C, the center of the loop? [Take $I = 1.0$ A and $a = 0.5$ m]



- (a) 3.4×10^{-6} T, out of the page.
- (b) 1.7×10^{-6} T, out of the page.
- (c) 1.7×10^{-6} T, into the page.
- (d) zero.
- (e) 3.4×10^{-6} T, into the page.

Question 880

30-01

0.25-66%

A copper wire is of total length 1.0 m. You want to make N-turn circular current loop, using the entire wire, that generates a 1.0 mT magnetic field at the center of the coil when the current is 1.0 A. What will be the diameter of your coil?

- (a) 0.50 m.
- (b) 0.12 m.
- (c) 0.02 m.
- (d) 0.22 m.
- (e) 0.01 m.