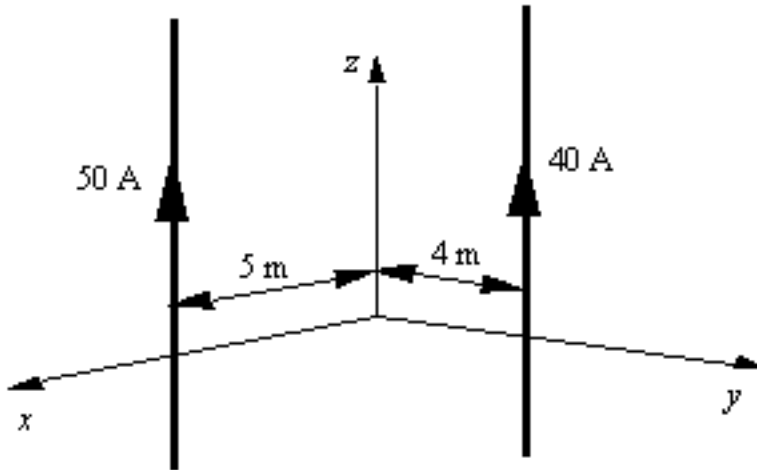
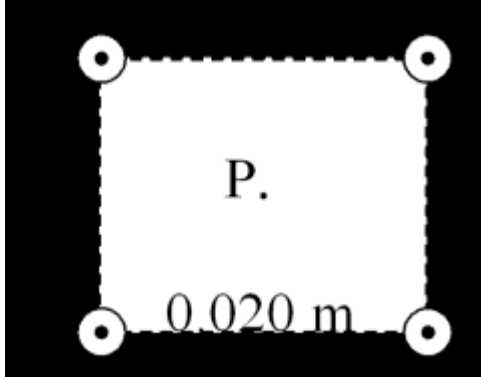


1. The drawing shows two long, thin wires that carry currents in the positive z direction. Both wires are parallel to the z axis. The 50-A wire is in the x - z plane and is 5 m from the z axis. The 40-A wire is in the y - z plane and is 4 m from the z axis. What is the magnitude of the magnetic field at the origin?



- A) zero tesla
 B) 1×10^{-6} T
 C) 3×10^{-6} T
 D) 5×10^{-6} T
 E) 7×10^{-6} T
2. A long, straight wire carries a current I . If the magnetic field at a distance d from the wire has magnitude B , what is the magnitude of the magnetic field at a distance $1/2 d$ from the wire?
- A) $4B$
 B) $B/4$
 C) $2B$
 D) $4B$
 E) None of these

3. Four long, straight wires are parallel to each other; and their cross-section forms a square. Each side of the square is 0.020 m as shown in the figure. If each wire carries a current of 8.0 A in the direction shown in the figure, determine the magnitude of the total magnetic field at **P**, the center of the square.

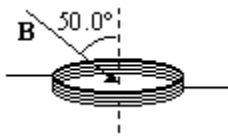


- A) 5.1×10^{-5} T
 B) 1.1×10^{-4} T
 C) 1.7×10^{-4} T
 D) 2.3×10^{-4} T
 E) zero tesla
4. A conducting loop of wire is placed in a magnetic field that is normal to the plane of the loop. Which one of the following actions will not result in an induced current in the loop?
- A) Rotate the loop about an axis that is parallel to the field and passes through the center of the loop.
 B) Increase the strength of the magnetic field.
 C) Decrease the area of the loop.
 D) Decrease the strength of the magnetic field.
 E) Rotate the loop about an axis that is perpendicular to the field and passes through the center of the loop.
5. The Earth's magnetic field passes through a square tabletop with a magnitude of 4.95×10^{-5} T and directed at an angle of 165° relative to the normal of the tabletop. If the tabletop has 1.50-m sides, what is the magnitude of the magnetic flux through it?
- A) 1.08×10^{-4} Wb
 B) 7.11×10^{-5} Wb
 C) 2.88×10^{-5} Wb
 D) 1.92×10^{-5} Wb
 E) 3.30×10^{-6} Wb

6. A circular copper loop is placed perpendicular to a uniform magnetic field of 0.50 T. Due to external forces, the area of the loop decreases at a rate of $1.26 \times 10^{-3} \text{ m}^2/\text{s}$. Determine the induced emf in the loop.

- A) $3.1 \times 10^{-4} \text{ V}$
- B) $6.3 \times 10^{-4} \text{ V}$
- C) $1.2 \times 10^{-3} \text{ V}$
- D) $7.9 \times 10^{-3} \text{ V}$
- E) 3.1 V

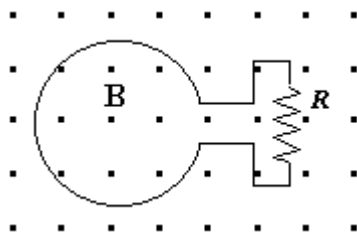
7. The area of a 333-turn conducting coil is $7.85 \times 10^{-3} \text{ m}^2$. The resistance of the coil is 10.4Ω . If the coil is oriented as shown in a magnetic field \mathbf{B} , at what rate in T/s should the magnitude of \mathbf{B} change to induce a current of $2.50 \times 10^{-3} \text{ A}$ in the coil?



- A) 0.0155 T/s
- B) 0.0996 T/s
- C) 0.228 T/s
- D) 0.757 T/s
- E) 1.52 T/s

Use the following to answer question 8:

The figure shows a uniform, 3.0-T magnetic field that is normal to the plane of a conducting, circular loop with a resistance of 1.5Ω and a radius of 0.024 m. The magnetic field is directed out of the paper as shown. **Note:** The area of the non-circular portion of the wire is considered negligible compared to that of the circular loop.

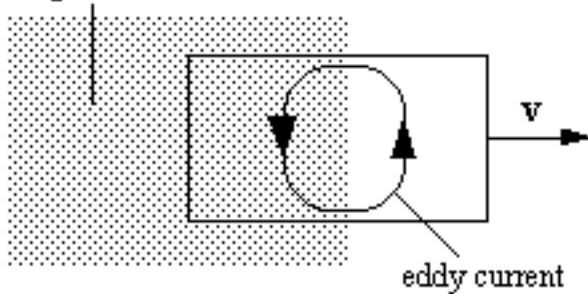


8. What is the magnitude of the average induced emf in the loop if the magnitude of the magnetic field is doubled in 0.4 s?

A) 0.43 V
 B) 0.65 V
 C) 0.014 V
 D) 0.027 V
 E) 0.038 V

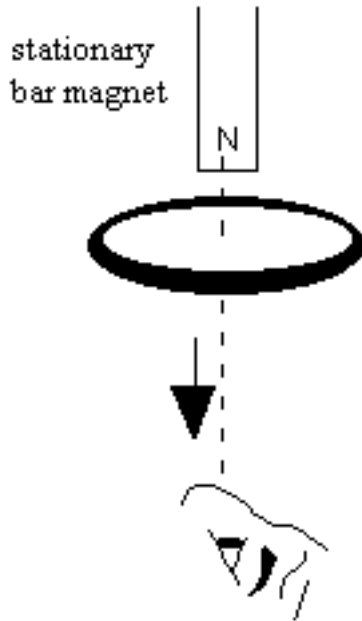
9. A sheet of copper is pulled at constant velocity \mathbf{v} from a region that contains a uniform magnetic field. At the instant shown in the figure, the sheet is partially in and partially out of the field. The induced emf in the sheet leads to the eddy current shown. Which one of the following statements concerning the direction of the magnetic field is true?

Region containing magnetic field



- A) The magnetic field points to the right.
 B) The magnetic field points to the left.
 C) The magnetic field points into the paper.
 D) The magnetic field points out of the paper.
 E) The direction of the magnetic field cannot be determined from the information given.
10. A transformer changes 120 V across the primary to 1200 V across the secondary. If the secondary coil has 800 turns, how many turns does the primary coil have?
- A) 40
 B) 80
 C) 100
 D) 400
 E) 4000

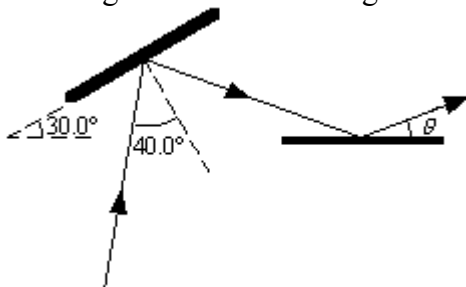
11. A metal ring is dropped from rest below a bar magnet that is fixed in position as suggested in the figure. An observer views the ring from below. Which one of the following statements concerning this situation is true?



- A) As the ring falls, an induced current will flow *counterclockwise* as viewed by the observer.
- B) As the ring falls, an induced current will flow *clockwise* as viewed by the observer.
- C) As the ring falls, there will be an induced magnetic field around the ring that appears *counterclockwise* as viewed by the observer.
- D) As the ring falls, there will be an induced magnetic field around the ring that appears *clockwise* as viewed by the observer.
- E) Since the magnet is stationary, there will be no induced current in the ring.
12. The average distance between the surface of the earth and the surface of the sun is 1.49×10^{11} m. How much time, in minutes, does it take for light leaving the surface of the sun to reach the earth?
- A) zero minutes
- B) 2.9×10^{-3} min
- C) 8.3 min
- D) 74 min
- E) 500 min

13. A local radio station transmits radio waves uniformly in all directions with a total power of $1.50 \times 10^5 \text{ W}$. What is the intensity of these waves when they reach a receiving antenna located 40.0 km from the transmitting antenna?
- A) $2.98 \times 10^{-5} \text{ W/m}^2$
 B) $7.46 \times 10^{-6} \text{ W/m}^2$
 C) $9.25 \times 10^{-7} \text{ W/m}^2$
 D) $1.17 \times 10^{-8} \text{ W/m}^2$
 E) $5.60 \times 10^{-10} \text{ W/m}^2$
14. An astronomer observes electromagnetic waves emitted by oxygen atoms in a distant galaxy that have a frequency of $5.710 \times 10^{14} \text{ Hz}$. In the laboratory on earth, oxygen atoms emit waves that have a frequency of $5.841 \times 10^{14} \text{ Hz}$. Determine the relative velocity of the galaxy with respect to the astronomer on the earth. **Note:** The speed of light is $2.9979 \times 10^8 \text{ m/s}$.
- A) $6.724 \times 10^6 \text{ m/s}$, away from earth
 B) $6.724 \times 10^6 \text{ m/s}$, toward earth
 C) $2.931 \times 10^8 \text{ m/s}$, away from earth
 D) $4.369 \times 10^4 \text{ m/s}$, toward earth
 E) $4.369 \times 10^4 \text{ m/s}$, away from earth

15. Two mirrors are arranged as shown in the drawing. Light is incident on the first mirror at an angle of 40.0° . The light reflects toward a second mirror. Determine the angle θ .



- A) 20.0°
 B) 25.0°
 C) 15.0°
 D) 30.0°
 E) 10.0°

16. A concave mirror in an amusement park has a radius of curvature of 4.0 m. A child stands in front of the mirror so that she appears 2.5 times taller than her actual height. If the image is upright, how far is she standing from the mirror?
- A) 1.2 m
 - B) 3.5 m
 - C) 2.8 m
 - D) 4.0 m
 - E) 7.0 m
17. A convex mirror in an amusement park has a radius of curvature of 3.00 m. A man stands in front of the mirror so that his image is half as tall as his actual height. At what distance must the man focus his eyes in order to see his image?
- A) 2.25 m
 - B) 3.00 m
 - C) 4.50 m
 - D) 5.00 m
 - E) 6.75 m
18. An object is placed 30 cm in front of a concave spherical mirror that has a radius of curvature 40 cm. Which one of the following phrases best describes the image?
- A) virtual and located at infinity
 - B) real and located 60 cm from the mirror
 - C) real and located 120 cm from the mirror
 - D) virtual and located 60 cm from the mirror
 - E) virtual and located 120 cm from the mirror
19. A convex mirror has a radius of curvature of 0.50 m. Where must an object be placed in front of the mirror such that the image is formed 0.15 m behind the mirror?
- A) 0.38 m
 - B) 0.19 m
 - C) 0.77 m
 - D) 0.093 m
 - E) 0.57 m
20. A convex mirror with a focal length of 58 cm is used to form an image that is 29 cm behind the mirror. What is the object distance?
- A) +22 cm
 - B) +15 cm
 - C) +69 cm
 - D) +28 cm
 - E) +58 cm

Answer Key

1. C
2. A
3. D
4. A
5. A
6. B
7. A
8. C
9. D
10. B
11. A
12. C
13. B
14. A
15. A
16. A
17. A
18. B
19. A
20. E