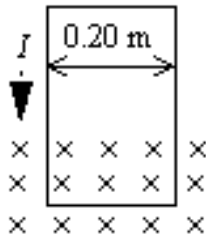


1. Two electrons are located in a region of space where the magnetic field is zero. Electron **A** is at rest; and electron **B** is moving westward with a constant velocity. A non-zero magnetic field directed eastward is then applied to the region. In what direction, if any, will each electron be moving after the field is applied?

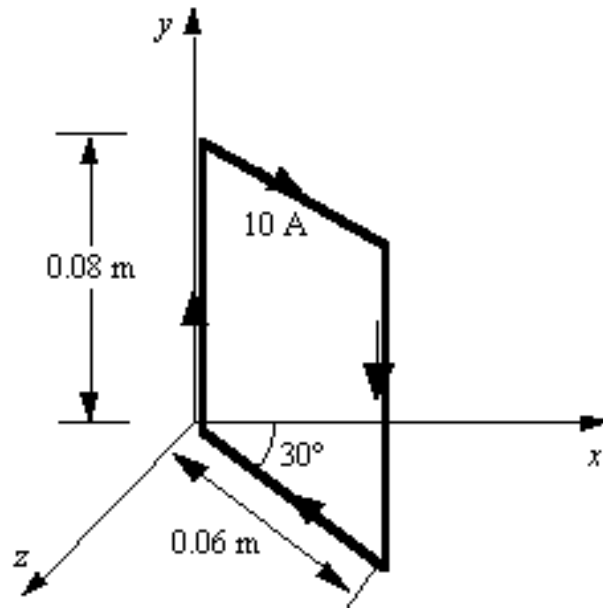
*electron A*      *electron B*

- \_\_\_ A.      at rest      westward
- \_\_\_ B.      northward      eastward
- \_\_\_ C.      at rest      eastward
- \_\_\_ D.      southward      downward, toward the earth
- \_\_\_ E.      upward, away from earth      westward
2. A loop of wire with a weight of 1.47N is oriented vertically and carries a current  $I = 1.75$  A. A segment of the wire passes through a magnetic field directed into the plane of the page as shown. The net force on the wire is measured using a balance and found to be zero. What is the magnitude of the magnetic field?



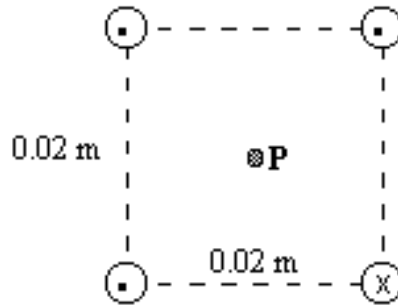
- \_\_\_ A. zero
- \_\_\_ B. 0.51 T
- \_\_\_ C. 0.84 T
- \_\_\_ D. 1.5 T
- \_\_\_ E. 4.2 T
3. A solenoid of length 0.25 m and radius 0.02 m is comprised of 120 turns of wire. Determine the magnitude of the magnetic field at the center of the solenoid when it carries a current of 15 A.
- \_\_\_ A.  $2.26 \times 10^{-3}$  T
- \_\_\_ B.  $4.52 \times 10^{-3}$  T
- \_\_\_ C.  $9.05 \times 10^{-3}$  T
- \_\_\_ D.  $7.50 \times 10^{-3}$  T
- \_\_\_ E. zero

4. A rectangular loop has sides of length 0.06 m and 0.08 m. The wire carries a current of 10 A in the direction shown. The loop is in a uniform magnetic field of magnitude 0.2 T and directed in the positive  $x$  direction. What is the magnitude of the torque on the loop?



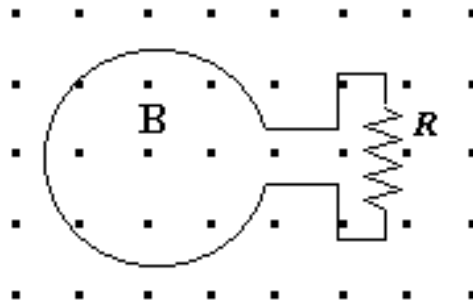
- A.  $4.2 \times 10^{-2} \text{ N}\cdot\text{m}$   
 B.  $4.8 \times 10^{-2} \text{ N}\cdot\text{m}$   
 C.  $4.8 \times 10^{-3} \text{ N}\cdot\text{m}$   
 D.  $8.3 \times 10^{-3} \text{ N}\cdot\text{m}$   
 E.  $9.6 \times 10^{-3} \text{ N}\cdot\text{m}$
5. A coil of wire with a resistance of  $0.15 \Omega$  has a self-inductance of  $0.083 \text{ H}$ . If a  $5.0\text{-V}$  battery is connected across the ends of the coil and the current in the circuit reaches an equilibrium value, what is the stored energy in the inductor?
- A. 92 J  
 B. 46 J  
 C. 16 J  
 D. 4.1 J  
 E. 1.4 J

6. Four long, straight wires are parallel to each other; and their cross-section forms a square. Each side of the square is 0.02 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.  $5.1 \times 10^{-5} \text{ T}$   
 \_\_\_ B.  $1.1 \times 10^{-4} \text{ T}$   
 \_\_\_ C.  $1.7 \times 10^{-4} \text{ T}$   
 \_\_\_ D.  $2.3 \times 10^{-4} \text{ T}$   
 \_\_\_ E. zero

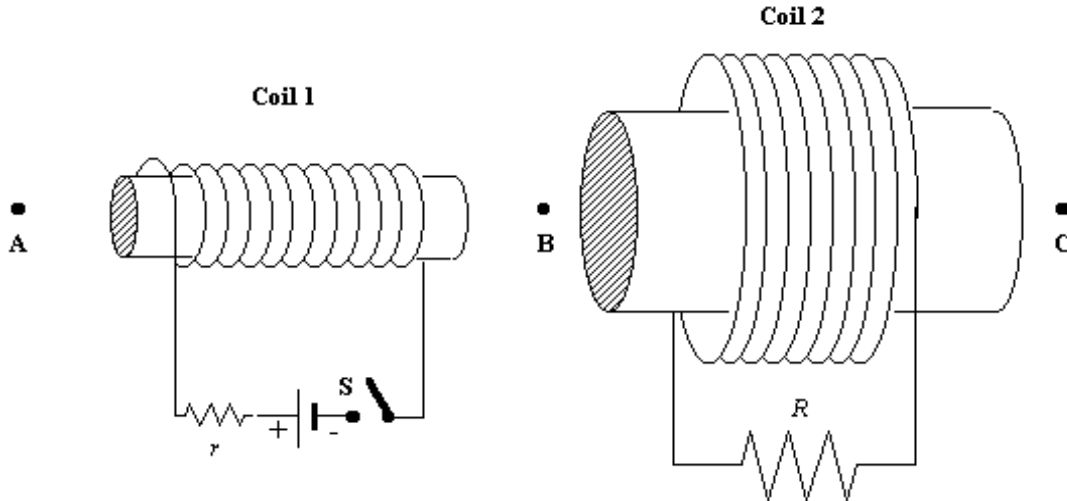
The figure shows a uniform, 3.0-T magnetic field that is normal to the plane of a conducting, circular loop with a resistance of  $1.5 \Omega$  and a radius of 0.024 m. The magnetic field is directed out of the paper as shown.



**Note:** The area of the non-circular portion of the wire is considered negligible compared to that of the circular loop.

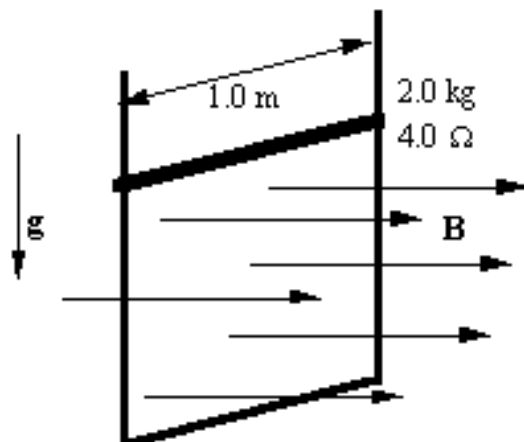
7. What is the average current around the loop if the magnitude of the magnetic field is doubled in 0.4 s?
- \_\_\_ A.  $2.8 \times 10^{-3} \text{ A}$ , clockwise  
 \_\_\_ B.  $4.5 \times 10^{-3} \text{ A}$ , clockwise  
 \_\_\_ C.  $4.5 \times 10^{-3} \text{ A}$ , counterclockwise  
 \_\_\_ D.  $9.0 \times 10^{-3} \text{ A}$ , clockwise  
 \_\_\_ E.  $9.0 \times 10^{-3} \text{ A}$ , counterclockwise

Two coils, **1** and **2**, with iron cores are positioned as shown in the figure. Coil **1** is part of a circuit with a battery and a switch.



8. Assume that **S** has been closed for a long time. Which one of the following changes will result in an induced magnetic field in coil **2** that points toward **C**?
- A. The switch **S** is opened.
  - B. The iron core is removed from coil **1**.
  - C. Coil **1** and its core are moved toward **A**.
  - D. Coil **1** and its core are moved toward **B**.
  - E. Coil **2** and its core are moved toward **C**.
9. The current in a solenoid is decreased to one-half of its original value. Which one of the following statements is true concerning the self-inductance of the solenoid?
- A. The self-inductance does not change.
  - B. The self-inductance increases by a factor of two.
  - C. The self-inductance decreases by a factor of two.
  - D. The self-inductance increases by a factor of four.
  - E. The self-inductance decreases by a factor of four.
10. In an ac circuit, a 0.025-H inductor is connected to a generator which has an rms voltage of 25 V and operates at 50.0 Hz. What is the rms current through the inductor?
- A. 0.62 A
  - B. 2.0 A
  - C. 3.2 A
  - D. 7.1 A
  - E. 14 A

11. A 2.0-kg rod has a length of 1.0 m and a resistance of  $4.0 \Omega$ . It slides with *constant speed* down a pair of frictionless vertical conducting rails that are joined at the bottom. A uniform magnetic field of magnitude 3.0 T is perpendicular to the plane formed by the rod and the rails as shown.



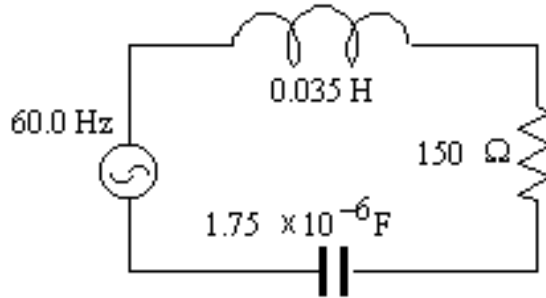
Determine the speed of the rod.

- A. 0.38 m/s  
 B. 0.90 m/s  
 C. 2.6 m/s  
 D. 5.6 m/s  
 E. 8.7 m/s
12. A variable capacitor is connected to an ac source. What effect does *decreasing* the capacitance have on the reactance and current in this circuit?
- |                             | <i>Reactance</i> | <i>Current</i> |
|-----------------------------|------------------|----------------|
| <input type="checkbox"/> A. | no change        | no change      |
| <input type="checkbox"/> B. | decreases        | no change      |
| <input type="checkbox"/> C. | increases        | increases      |
| <input type="checkbox"/> D. | decreases        | increases      |
| <input type="checkbox"/> E. | increases        | decreases      |

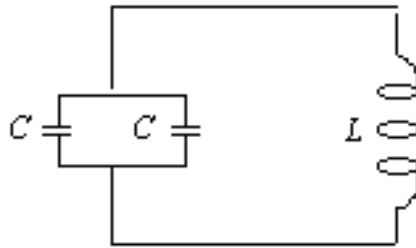
An ac generator supplies a peak (not *rms*) voltage of 120 V at 60.0 Hz. It is connected in series with a  $50.0\text{-}\Omega$  resistor and a 0.5-H inductor.

13. What is the *rms* current through the resistor?
- A. 2.4 A  
 B. 1.7 A  
 C. 1.3 A  
 D. 0.62 A  
 E. 0.44 A

14. Use the information given in the figure for the series RCL circuit to determine the phase angle between the current and the voltage.

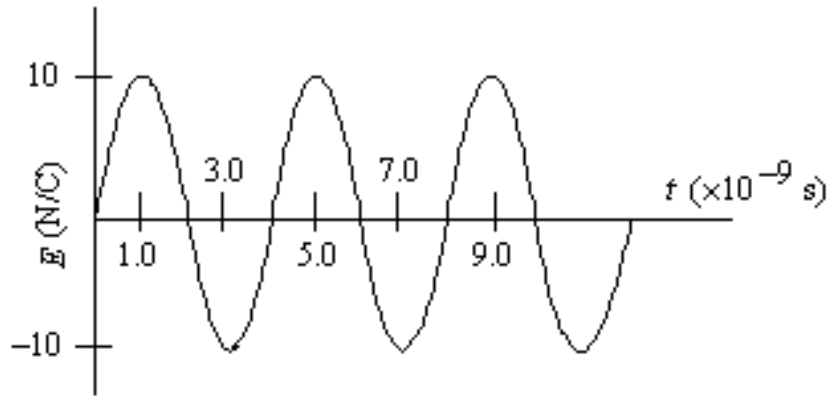


- A. zero  
 B.  $+5.3^\circ$   
 C.  $-9.6^\circ$   
 D.  $-84^\circ$   
 E.  $+90^\circ$
15. Two  $250\text{-}\mu\text{F}$  capacitors, with equal capacitances, and a  $1.5\text{-mH}$  inductor are connected as shown in the figure. It is desired to "drive" the circuit by placing an ac generator in series with the inductor. Which output voltage for the generator will produce the largest current in the above circuit? Assume that  $V$  is in volts when  $t$  is in seconds.



- A.  $V = 0.6 \sin[(1.1 \times 10^6 \text{ rad/s})t]$   
 B.  $V = 0.6 \sin[(1.2 \times 10^3 \text{ rad/s})t]$   
 C.  $V = 1.2 \sin[(5.3 \times 10^6 \text{ rad/s})t]$   
 D.  $V = 1.2 \sin[(2.3 \times 10^6 \text{ rad/s})t]$   
 E.  $V = 2.8 \sin[(4.6 \times 10^6 \text{ rad/s})t]$

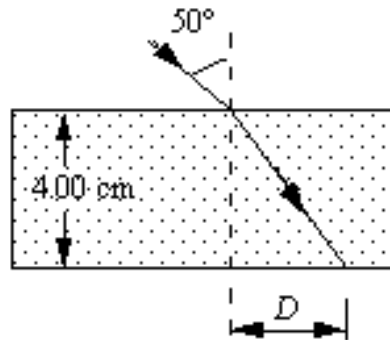
The figure shows the time variation of the magnitude of the electric field of an electromagnetic wave produced by a wire antenna.



16. What is the *rms* value of the magnitude of the magnetic field?

- A.  $1.4 \times 10^{-8} \text{ T}$
- B.  $2.4 \times 10^{-8} \text{ T}$
- C.  $3.3 \times 10^{-8} \text{ T}$
- D.  $4.6 \times 10^{-8} \text{ T}$
- E.  $5.4 \times 10^{-8} \text{ T}$

17. A ray of light passes from air into a block of glass with a refractive index of 1.50 as shown in the figure.



Note: *The drawing is not to scale.*

What is the value of the distance  $D$ ?

- A. 1.42 cm
- B. 1.66 cm
- C. 1.90 cm
- D. 2.14 cm
- E. 2.38 cm

18. Blue light with a wavelength of 425 nm passes from a vacuum into a glass lens; and the index of refraction is found to be 1.65. The glass lens is replaced with a plastic lens. The index of refraction for the plastic lens is 1.54. In which one of the two lenses does the light have the greatest speed and what is that speed?
- A. glass,  $2.28 \times 10^8$  m/s
  - B. plastic,  $2.13 \times 10^8$  m/s
  - C. glass,  $1.82 \times 10^8$  m/s
  - D. plastic,  $1.95 \times 10^8$  m/s
  - E. The speed of the blue light is the same in the vacuum and both lenses; and it is  $3.00 \times 10^8$  m/s.
19. A fiber optic line is composed of a core with an index of refraction of 1.47 and cladding with an index of 1.31. Which one of the following relations best describes angles of incidence  $\theta$  that will result in total internal reflection within the fiber optic line?
- A.  $\theta < 63^\circ$
  - B.  $\theta > 63^\circ$
  - C.  $\theta < 27^\circ$
  - D.  $\theta > 27^\circ$
  - E.  $0 \leq \theta \leq 90^\circ$
20. Light with a wavelength of 589 nm in a vacuum strikes the surface of an unknown liquid at an angle of  $31.2^\circ$  with respect to the normal to the surface. If the light travels at a speed of  $1.97 \times 10^8$  m/s through the liquid, what is the angle of refraction?
- A.  $19.9^\circ$
  - B.  $26.1^\circ$
  - C.  $34.2^\circ$
  - D.  $39.3^\circ$
  - E.  $51.9^\circ$



## Answer Key

104 Practice Exam 2 - 3/21/02

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