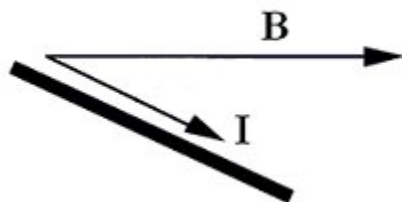


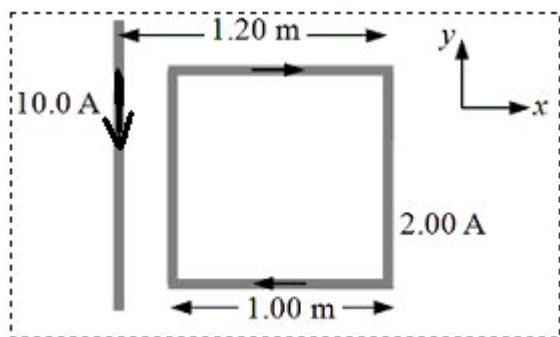
1. A 0.0150-m wire in a magnetic field of strength 0.845 T. The wire carries a direct current of 9.5 A. The magnetic force on the wire is 0.0509 N. What is the approximate angle (in degrees) between the direction of the magnetic field and the wire?



- A) 21
- B) 22
- C) 23
- D) 25
- E) None of these

Use the following to answer question 2:

A long, straight wire carries a 10.0-A current in the -y direction as shown in the figure.

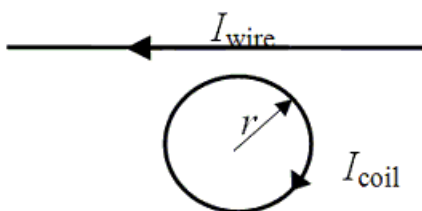


Next to the wire is a square copper loop that carries a 2.00-A current clockwise, as shown. The length of each side of the square is 1.00 m.

2. What is the magnetic field at the center of the square loop?
- A) 8.0×10^{-7} T
 - B) 3.4×10^{-7} T
 - C) 1.4×10^{-7} T
 - D) 1.7×10^{-7} T
 - E) None of these

3. A ray of light propagates through glass ($n = 1.51$), and exits into water ($n = 1.33$). If the angle of refraction in the water is 35.2° , determine the angle of incidence.
- A) 30.3°
 - B) 32.8°
 - C) 35.2°
 - D) 30.5°
 - E) None of these

4. The radius of a coil of wire with N turns is $r = 0.28$ m. A clockwise current of $I_{\text{coil}} = 1.0$ A flows in the coil, as shown. A long, straight wire carrying a current $I_{\text{wire}} = 29$ A toward the left is located 0.04 m from the edge of the coil. The magnetic field at the center of the coil is zero. Determine N , the number of turns.



- A) 8
 - B) 2
 - C) 6
 - D) 4
 - E) None of these
5. A radio wave sent from the surface of the earth reflects from the surface of the moon and returns to the earth. The elapsed time between the generation of the wave and the detection of the reflected wave is 2.6444 s. Determine the distance from the surface of the earth to the surface of the moon. **Note:** The speed of light is 2.9979×10^8 m/s.
- A) 3.7688×10^8 m
 - B) 3.8445×10^8 m
 - C) 3.9638×10^8 m
 - D) 4.0551×10^8 m
 - E) None of these
6. Which one of the following statements is *not* a characteristic of a plane mirror?
- A) The image is real.
 - B) The magnification is $+1$.
 - C) The image is always upright.
 - D) The image is reversed right to left.
 - E) The image and object distances are equal in magnitude.

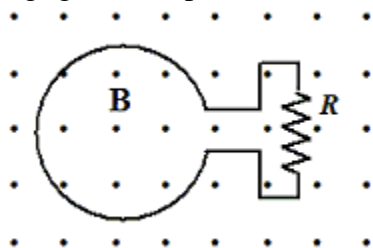
7. A concave mirror in an amusement park has a radius of curvature of 4.0 m. A child stands in front of the mirror so that she appears 3.0 times taller than her actual height. If the image is inverted, how far is she standing from the mirror?
- A) 1.1 m
 - B) 1.3 m
 - C) 2.7 m
 - D) 3.0 m
 - E) None of these
8. A convex mirror in an amusement park has a radius of curvature of 3.00 m. How far (in meters) in front of the mirror should a person stand in order to see an image that is one-fourth as tall?
- A) 9.00 m
 - B) 3.00 m
 - C) 4.50 m
 - D) 5.00 m
 - E) None of these
9. The focal point of a convex mirror is 4.0 m behind the mirror. A woman stands 2.0 m in front of the mirror. What is the distance between the woman and her image?
- A) 0.67 m
 - B) 1.33 m
 - C) 2.00 m
 - D) 5.67 m
 - E) None of these
10. A concave mirror has a focal length of 20 cm. An object is placed 25 cm from the mirror. Which of the following descriptions of the image is correct?
- A) real, inverted, smaller
 - B) virtual, inverted, larger
 - C) real, upright, larger
 - D) virtual, upright, larger
 - E) None of these
11. The focal point of a convex mirror is 58 cm behind the mirror. An image is 29 cm behind the mirror. What is the object distance?
- A) +22 cm
 - B) +15 cm
 - C) +58 cm
 - D) +28 cm
 - E) None of these

12. An FM radio station emits an electromagnetic wave which is received by a circuit containing a 3.33×10^{-7} H inductor and a variable capacitor set at 7.31×10^{-12} F. What is the frequency of the radio wave?
- A) 1.02×10^8 Hz
 - B) 8.80×10^7 Hz
 - C) 1.58×10^8 Hz
 - D) 9.40×10^7 Hz
 - E) 9.80×10^7 Hz
13. What would the speed of an observer be if a green (6.0×10^{14} Hz) traffic light appeared red 4.9×10^{14} Hz) to the observer?
- A) 4.4×10^8 m/s
 - B) 2.2×10^8 m/s
 - C) 8.4×10^7 m/s
 - D) 5.5×10^7 m/s
 - E) None of these
14. In a time of 0.036 s, a 0.80-m metal rod aligned along the x-axis moves 0.11 m upward in the +y direction in a 0.60 T magnetic field that points along the z-axis. What is the average voltage induced between the ends of the rod?
- A) 1.1 V
 - B) 0.2 V
 - C) 1.5 V
 - D) 2.3 V
 - E) None of these
15. A conducting loop has an area of 0.065 m^2 and is positioned such that a uniform 1.40 T magnetic field makes an angle of 60° with respect to the line that is normal to the plane of the loop. What will be the average induced voltage (emf) in the loop if the loop rotates to an angle of 30° in 0.012 s?
- A) 0.42 T
 - B) 0.75 T
 - C) 0.87 T
 - D) 2.78 T
 - E) None of these

16. A magnetic field is directed perpendicular to the plane of a $0.15\text{-m} \times 0.30\text{-m}$ rectangular coil consisting of 240 loops of wire. To induce an average emf of 2.5 V in the coil, the magnetic field is increased from 0.1 T to 1.8 T during a time interval Δt . Determine Δt .
- A) 1.3 s
 - B) 7.3 s
 - C) 12 s
 - D) 6.4 s
 - E) None of these

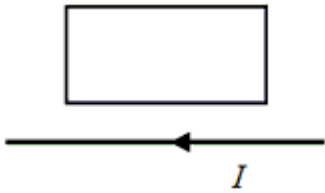
Use the following to answer question 17:

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.



17. If the magnetic field is held constant at 3.0 T and the loop is pulled out of the region that contains the field in 0.2 s , at what rate is energy dissipated in R ?
- A) $1.8 \times 10^{-2}\text{ W}$
 - B) $4.9 \times 10^{-4}\text{ W}$
 - C) $3.8 \times 10^{-3}\text{ W}$
 - D) $2.7 \times 10^{-4}\text{ W}$
 - E) None of these

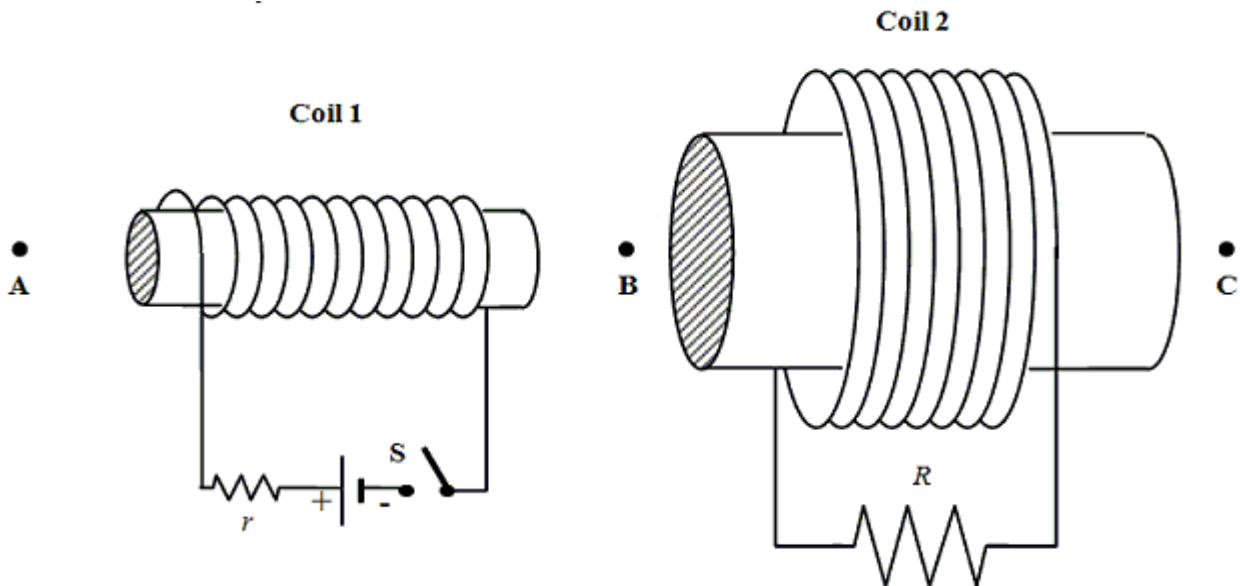
18. A long, straight wire is in the same plane as a rectangular, conducting loop. The wire carries a constant current I as shown in the figure. Which one of the following statements is true if the wire is suddenly moved *toward* the loop?



- A) There will be no induced emf and no induced current.
 B) There will be an induced emf, but no induced current.
 C) There will be an induced current that is clockwise around the loop.
 D) There will be an induced current that is counterclockwise around the loop.
 E) There will be an induced electric field that is clockwise around the loop.
19. 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

Use the following to answer question 20:

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.



20. Immediately after the switch **S** is closed, which one of the following statements is true?
- A) An induced current will flow from right to left in R .
 - B) An induced current will flow from left to right in r .
 - C) A magnetic field that points toward **B** appears inside coil **1**.
 - D) An induced magnetic field that points toward **B** appears inside coil **2**.
 - E) A current will pass through r , but there will be no current through R .

Answer Key

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