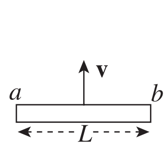
Chapter 9 Review Questions

Solutions can be found in Chapter 12.

Section I: Multiple Choice

1. A metal rod of length L is pulled upward with constant velocity **v** through a uniform magnetic field **B** that points out of the plane of the page.



What is the potential difference between points a and b?

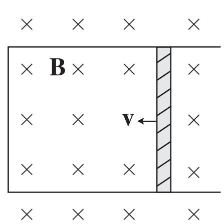
(A) 0

(B) $\frac{1}{2}vBL$, with point b at the higher potential

(C) vBL, with point a at the higher potential

(D) vBL, with point b at the higher potential

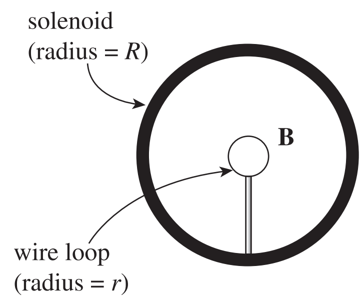
2. A conducting rod of length 0.2 m and resistance 10 ohms between its endpoints slides without friction along a U-shaped conductor in a uniform magnetic field B of magnitude 0.5 T perpendicular to the plane of the conductor, as shown in the diagram below.



If the rod is moving with velocity **v** = 3 m/s to the left, what is the magnitude and direction of the current induced in the rod?

	Current	Direction
(A)	0.03 A	down
(B)	0.03 A	up
(C)	0.3 A	down
(D)	0.3 A	up

3. In the figure below, a small, circular loop of wire (radius r) is placed on an insulating stand inside a hollow solenoid of radius R. The solenoid has n turns per unit length and carries a counterclockwise current I. If the current in the solenoid is decreased at a steady rate of a amps/s, determine the induced emf, ε, and the direction of the induced current in the loop. Note that $B = \mu_0 n I$ for a solenoid.



(A) $\varepsilon = \mu_0 \pi n r^2 a$; induced current is clockwise
(B) $\varepsilon = \mu_0 \pi n r^2 a$; induced current is counterclockwise
(C) $\varepsilon = \mu_0 \pi n R^2 a$; induced current is clockwise
(D) $\varepsilon = \mu_0 \pi n R^2 a$; induced current is counterclockwise

4. In the figures below, a permanent bar magnet is below a loop of wire. It is pulled upward with a constant velocity through the loop of wire as shown in Figure b.

Figure a

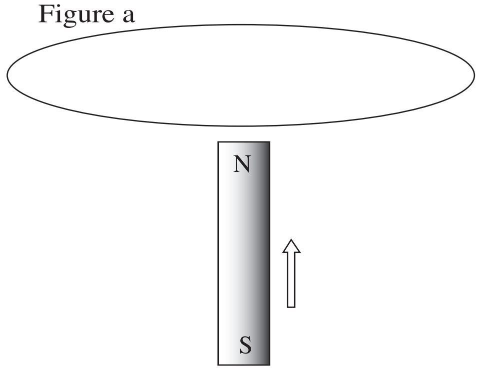
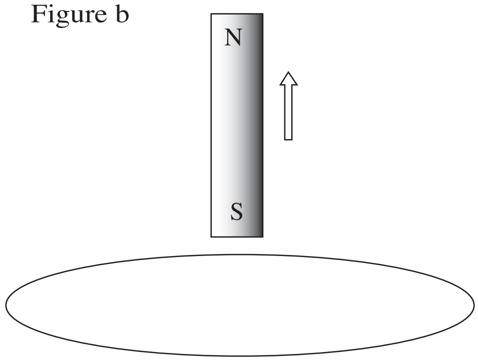


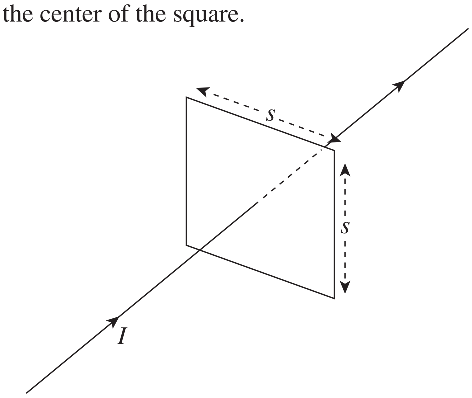
Figure b



Which of the following best describes the direction(s) of the current induced in the loop (looking down on the loop from above)?

(A) Always clockwise
(B) Always counterclockwise
(C) First clockwise, then counterclockwise
(D) First counterclockwise, then clockwise

5. A square loop of wire (side length = s) surrounds a long, straight wire such that the wire passes through the center of the square.



If the current in the wire is I, determine the current induced in the square loop.

(A) $\dfrac{2\mu_0 Is}{\pi\left(1+\sqrt{2}\right)}$

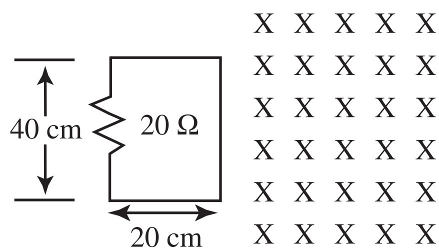
(B) $\dfrac{\mu_0 Is}{\pi\sqrt{2}}$

(C) $\dfrac{\mu_0 Is\sqrt{2}}{\pi}$

(D) 0

Section II: Free Response

1. A rectangular wire is pulled through a uniform magnetic field of 2 T going into the page as shown. The resistor has a resistance of 20 Ω.



(a) What is the voltage across the resistor as the wire is pulled horizontally at a velocity of 1 m/s and it just enters the field?

(b) What is the current through the circuit in the above case and in what direction does it flow?

(c) What would the voltage be if the wire were rotated 90 degrees and pulled horizontally at the same velocity?

(d) What would the velocity have to be in order to maintain the same voltage as in part (a) but with the orientation of part (c)?