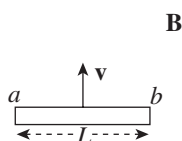


Chapter 9 Review Questions

Solutions can be found in Chapter 12.

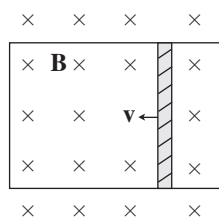
Section I: Multiple Choice

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



What is the potential difference between points a and b ?

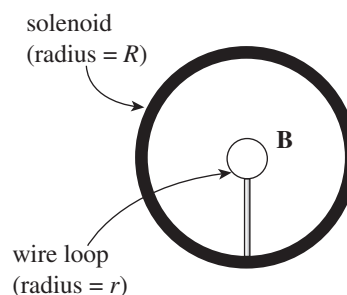
- (A) 0
 (B) $\frac{1}{2}vBL$, with point b at the higher potential
 (C) vBL , with point a at the higher potential
 (D) vBL , with point b at the higher potential
2. A conducting rod of length 0.2 m and resistance 10 ohms between its endpoints slides without friction along a U-shaped conductor in a uniform magnetic field $\mathbf{B}$ 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 $\mathbf{v} = 3$ m/s to the left, what is the magnitude and direction of the current induced in the rod?

- | <u>Current</u> | <u>Direction</u> |
|----------------|------------------|
| (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, $\mathcal{E}$, and the direction of the induced current in the loop. Note that $B = \mu_0 n I$ for a solenoid.



- (A) $\mathcal{E} = \mu_0 \pi n r^2 a$; induced current is clockwise
 (B) $\mathcal{E} = \mu_0 \pi n r^2 a$; induced current is counterclockwise
 (C) $\mathcal{E} = \mu_0 \pi n R^2 a$; induced current is clockwise
 (D) $\mathcal{E} = \mu_0 \pi n R^2 a$; induced current is counterclockwise

4. As shown in the figures below, a bar magnet is moved as a constant speed through a loop of wire. Figure A shows the bar magnet when it is as a position below the loop of wire and figure B shows the loop of wire after it has passed completely through the loop.

Figure A

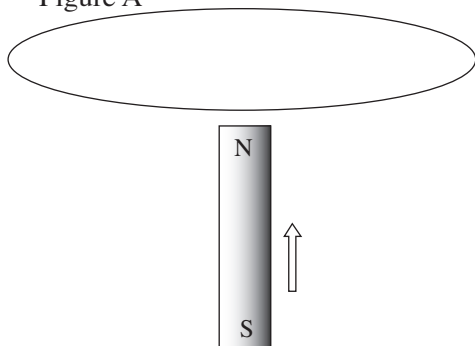
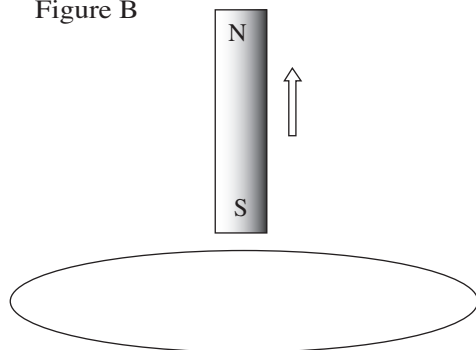


Figure B



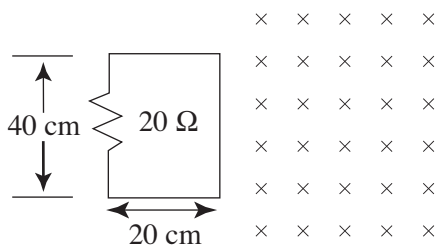
Which of the following best describes the direction or directions of the current induced in the loop when the loop is looked at from above? Note that when looking at the loop from above, the bar magnet will be moving toward the viewer.

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

5. Which of the following statements about induced emf is true?
- (A) An emf will be induced when moving the loop of wire perpendicularly through the magnetic field.
 - (B) Rotating the wire in the presence of a magnetic field always induces an emf.
 - (C) Shrinking the size of a loop of wire in constant magnetic field will induce an emf in the wire.
 - (D) A time varying magnetic field is required to induce an emf.

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 $20\ \Omega$.



- 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?
- What is the current through the circuit in the above case and in what direction does it flow?
- The region containing the magnetic field is 1 meter long in the direction the loop is being pulled. If the loop is pulled at the constant velocity of 1 m/s, describe the current in the loop from a time before the loop encounters the left edge of the region of the magnetic field until the time that the right edge of the loop completely passes out of the magnetic field region. Indicate the values and the direction of the current.
- The loop of wire is rotated 90° clockwise so that the 20 cm side is vertical and the 40 cm side is horizontal at the top. Explain, without relying solely on equations, whether the loop would have to be pulled faster than 1/s, at exactly 1 m/s, or slower than 1 m/s for the current to have the same magnitude as in part (b).