Module 09 Homework

1. For this question, consider Figure 1. **Example Problem Write-up:** Assume that the loop of wire shown is moved with a constant velocity from left to right. Determine the direction of the current induced in the loop at each position a - e.

2. For this question, consider Figure 2. A conducting bar is pulled across two conducting rails in a uniform magnetic field, inducing an emf that will drive a current through the resistor. The bar is pulled with a force that causes it to slide at a constant speed v.

    1. Derive an equation for the current that runs through the resistor in terms of the variables given in the figure. Assume that the bar and rails are perfect conductors with zero resistance.

    2. Use Lenz's Law to determine what direction the induced current flows through the resistor (up or down)?

    3. What is the power dissipated by the resistor?

3. For this question, consider Figure 3. In the Figure 3, a rectangular loop of wire, with length a and width b, has a resistance R. The loop is placed near a very long, straight, wire which carries a constant current i, and then moved away at a constant speed v. Determine the following when the center of the loop is a distance r away from the wire:

    1. the magnetic flux through the loop.

    2. the induced emf in the loop.

    3. the current that runs through the loop.

    4. the direction of the current that runs through the loop.

    5. the power dissipated by the loop.

4. For this question, consider Figure 4. A metal rod that is free to rotate about the point O. The rod slides along a wire that forms a circular arc with radius r and the entire system sits in a uniform magnetic field that points out of the page. Assume that the resistor R is the only element with resistance in this setup.

    1. If the rod is rotated counter-clockwise at a constant angular velocity ω, how much current will run through the resistor?

    2. What direction will current run through the resistor (up or down), if the rod is rotated counter-clockwise?

    3. What torque must be exerted on the rod to rotate it at a constant angular velocity ω?

5. For this question, consider Figure 5. Answer the following questions from the perspective of an observer at the position of the green eye.

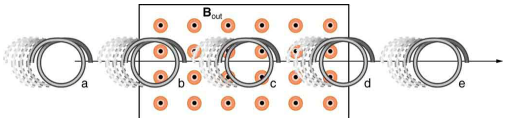

Figure 1: A loop of wire is moved through a magnetic field. Assume that the loop of wire is in the plane of the page.

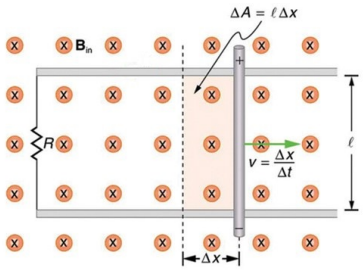

Figure 2:

1. If current runs counter-clockwise in coil A and increases from 1 A to 2 A, what direction will the induced current in coil B flow?

2. If current runs clockwise in coil B and increases from 1 A to 2 A, what direction will the induced current in coil A flow?

3. If current runs clockwise in coil A and decreases from 2 A to 1 A, what direction will the induced current in coil B flow?

4. If current runs counter-clockwise in coil A and decreases from 2 A to 1 A, what direction will the induced current in coil B flow?

6. For this question, consider Figure 6. Answer the following questions from the perspective of an observer at the position of the green eye.

   1. If current runs counter-clockwise in coil A and increases from 1 A to 2 A, what direction will the induced current in coil B flow?

   2. If current runs clockwise in coil B and increases from 1 A to 2 A, what direction will the induced current in coil A flow?

   3. If current runs clockwise in coil B and decreases from 2 A to 1 A, what direction will the induced current in coil A flow?

   4. If current runs counter-clockwise in coil A and decreases from 2 A to 1 A, what direction will the induced current in coil B flow?

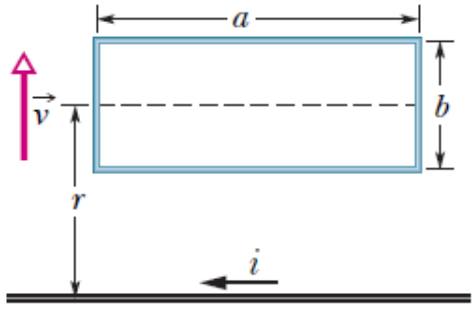

Figure 3:

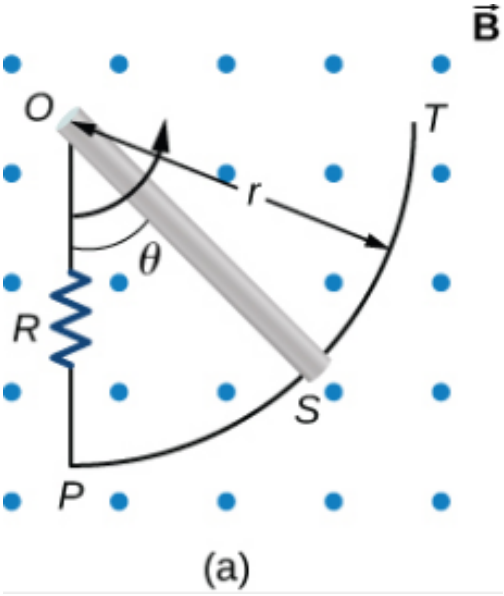

Figure 4:

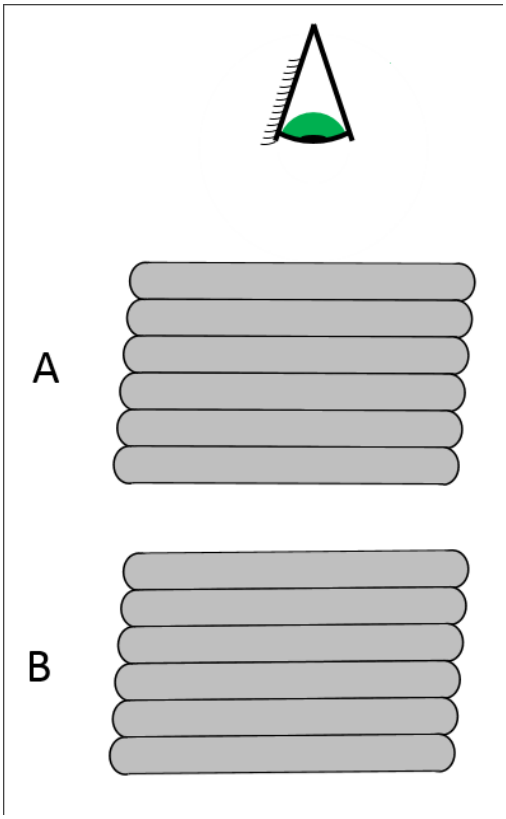

Figure 5:

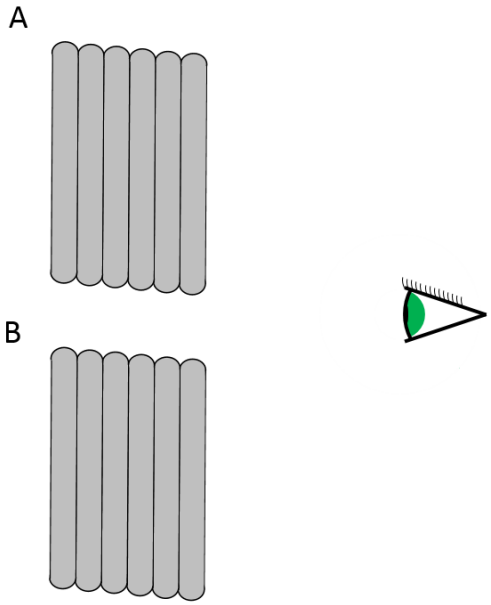

Figure 6: