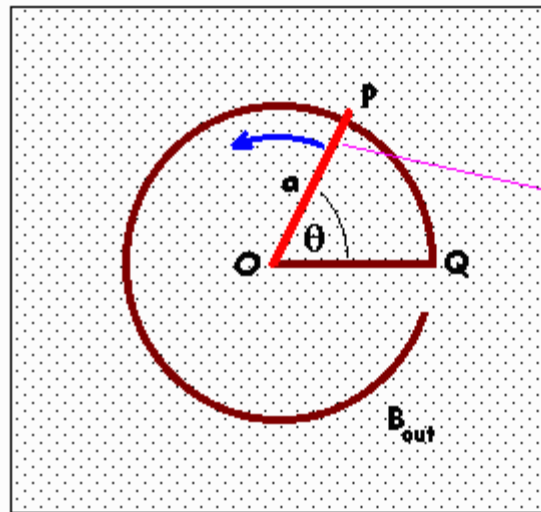


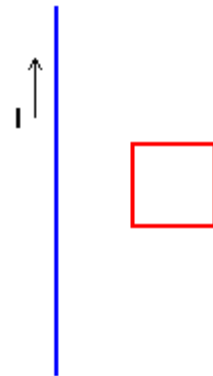
DAY 20 - Homework

- The figure shows a stationary conductor, whose shape is similar to the letter "e" ($a = 50.0$ cm), that is placed in a constant magnetic field of magnitude $B = 0.500$ T directed out of the page. A 50.0 cm long, straight conducting rod pivoted about point O rotates with constant angular speed of 2 rad/s. (a) Determine the induced voltage in loop POQ . (b) If the conducting material has resistance per unit length of 5.00 ohms/meter, what is the induced current in loop POQ at 0.250 s?



- In the previous problem, calculate the torque needed to keep the rod rotating.
- A 5.0 T magnetic field passes perpendicularly through a loop of wire that measures 20 cm in diameter. The field turns off in 0.1 seconds. What voltage is induced in the loop?
- In the figure, current flows upward through the blue wire (which is very long - much longer than just what is shown here).

If the red wire is moved to the right from the position shown at constant speed, will a current be induced in it? If so, what direction will it flow? Will a force be necessary to keep the red wire moving to the right at constant speed? If so, will the force get weaker, stronger, or not change as the red wire moves away from the blue wire?



Now answer all these questions if the red wire is moved vertically from the position shown.

- A solenoid (brown) has no current flowing through it. A conducting ring is located to the right of the solenoid.

Current is switched on in the solenoid. If the flow of current is as shown (red), sketch the current and field induced in the ring when the current is first switched on? What kind of force will be exerted on the ring when the current is first switched on?

After the current has been on for a while, sketch the current and field induced in the ring. What kind of force will be exerted on the ring?



6. Determine the inductance of an air-core solenoid 1 inch long and $\frac{1}{4}$ inch in diameter if it contains 50 turns of wire. Give your answer in milliHenrys (mH).
7. 100 ft of thin copper wire is wrapped around a rod 0.25 inch in diameter and 1 foot long. What is the resulting inductance? The rod's relative permeability is roughly 1.
8. What will make a better inductor? Wrapping thin wire around a rod or wrapping thick wire around a rod? Is there an optimum thickness of wire?
9. What sort of current would induce a constant voltage on an inductor? Explain your answer.
10. **PHY 232 Only**
What sort of current would induce a steadily increasing voltage on an inductor? What sort of current would induce a sinusoidally varying voltage on an inductor? Explain your answers. HINT -- what function has a derivative which is a line with positive slope? What function has a derivative which is sinusoidal?
11. **PHY 232 Only**
A wire loop of area A contains N turns of wire. The loop is immersed in a uniform magnetic field B. If the loop rotates at angular speed ω , show that the voltage induced in the loop is given by the equation below. This is the basic principle behind an alternator.

$$V = NBA\omega \sin(\omega t)$$

or

$$V = NBA\omega \cos(\omega t)$$