Physics 09-06 Motional emf and Magnetic Damping   *Name: ______________________*

Motional emf

- Another way to produce an induced emf is by moving a conducting ____________ through a constant magnetic ____________.
- Each ____________ in the rod is ____________ through the magnetic field with velocity, *v*.
- So, each charge experiences a magnetic ____________.

$$F = qvB \sin\theta$$

- Since the ____________ can move they are _________ to one end of the rod leaving __________ charges at the other end.
- If there was a ____________ connecting the ____________ of the rod, the electrons would flow through the ____________ to get back to the ____________ charges.
  - This is called ____________ ____________ ($\mathcal{E}$)
- If the rod did ____________ have the wire, the electrons would move until the ____________ electrical force is balanced with the ____________ force.

$$emf = vBL$$

- It takes a ____________ to move the ____________.
- Once the electrons are ____________ in the rod, there is another ____________. The moving electrons in a B-field create a magnetic ____________ on the rod itself.
- According to the RHR, the force is ____________ the motion of the rod. If there were no ____________ pushing the rod, it would ____________.

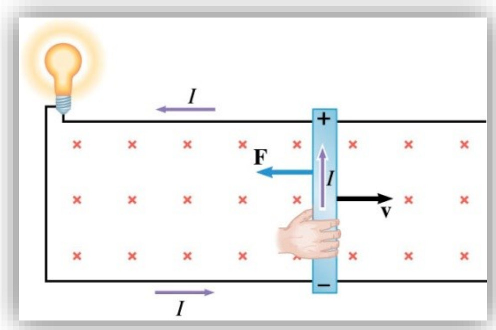

Figure 1

Damping

- When a conductor moves ____________ (or out of) a magnetic field, an ____________ current is created in the conductor
- As the conductor moves into B-field, the ____________ increases
- This produces a current by ____________ Law and is ____________ in way that ____________ change in flux.
- This current's ____________ causes a ____________ on the conductor
- The direction of the force will be ____________ the ____________ of the conductor

Applications of Magnetic Damping

- Stopping a ____________ from moving
- ____________ on trains/rollercoasters
  - No actual ____________ parts, not effected by rain, smoother
  - Since based on speed, need _________________ brakes to finish
- Sorting ____________
  - Metallic objects move ____________ down ramp with ____________ under it
- ____________ Detectors

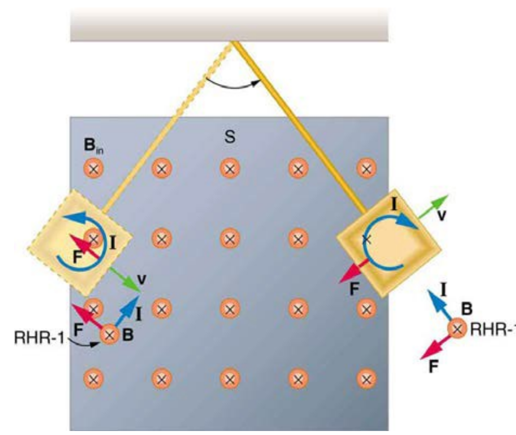

Figure 2

Practice Work

1. Why must part of the circuit be moving relative to other parts, to have usable motional emf? Consider, for example, that the rails in Figure 1 above are stationary relative to the magnetic field, while the rod moves.
2. A powerful induction cannon can be made by placing a metal cylinder inside a solenoid coil. The cylinder is forcefully expelled when solenoid current is turned on rapidly. Use Faraday's and Lenz's laws to explain how this works. Why might the cylinder get live/hot when the cannon is fired?

3. An induction stove heats a pot with a coil carrying an alternating current located beneath the pot (and without a hot surface). Can the stove surface be a conductor? Why won't a coil carrying a direct current work?
4. (a) A jet airplane with a 75.0 m wingspan is flying at 280 m/s. What emf is induced between wing tips if the vertical component of the Earth's field is 3.00×10^{-5} T? (b) Is an emf of this magnitude likely to have any consequences? Explain. (OpenStax 23.17) **0.630 V, no**
5. (a) A nonferrous screwdriver is being used in a 2.00 T magnetic field. What maximum emf can be induced along its 12.0 cm length when it moves at 6.00 m/s? (b) Is it likely that this emf will have any consequences or even be noticed? (OpenStax 23.18) **1.44 V, no**
6. At what speed must the sliding rod in Figure 1 move to produce an emf of 1.00 V in a 1.50 T field, given the rod's length is 30.0 cm? (OpenStax 23.19) **2.22 m/s**
7. The 12.0 cm long rod in Figure 1 moves at 4.00 m/s. What is the strength of the magnetic field if a 95.0 V emf is induced? (OpenStax 23.20) **198 T**
8. A coil is moved through a magnetic field as shown in Figure 3. The field is uniform inside the rectangle and zero outside. What is the direction of the induced current and what is the direction of the magnetic force on the coil at each position shown? (OpenStax 23.27) **none; CW I, left F; none; CCW I, left F; none**

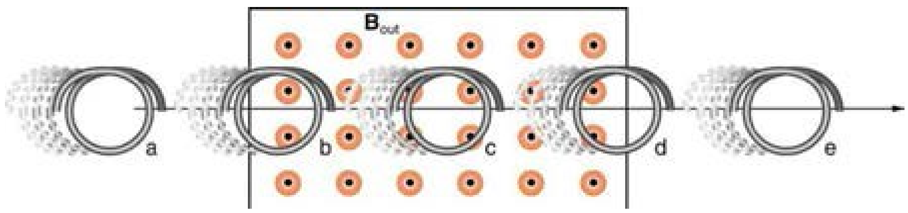

Figure 3