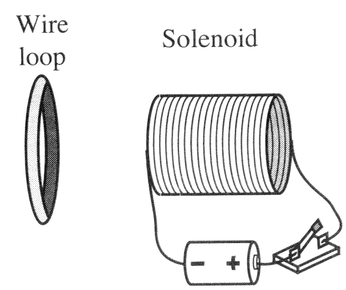
LENZ' LAW

Name ____________________

1. The diagram at right shows a copper wire *loop* held in place near a *solenoid*. The switch in the circuit containing the solenoid is initially open.



a. Use Lenz' law to predict whether current will flow through the wire of the loop in each of the following cases. Explain your reasoning.

- just after the switch has been closed

- a long time after the switch has been closed

- just after the switch has been reopened

- a long time after the switch has been reopened

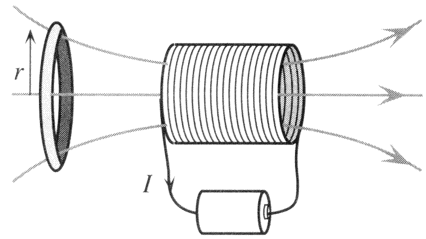
b. For each of the cases in which you predicted that there will be an induced current, draw a diagram that illustrates:

- the direction of the current through the wire of the loop,
- the direction of the magnetic moment of the loop, and
- the direction of the magnetic force exerted on the loop.

Is the force on the wire loop in a direction that would tend to *increase* or *decrease* the change in net flux through the wire loop?

2. A copper wire loop is constructed so that its radius, r, can change. It is held near a solenoid that has a constant current through it.

   a. Suppose that the radius of the loop were increasing. Use Lenz' law to explain why there would be an induced current through the wire. Indicate the direction of that current.



   b. Check your answer regarding the direction of the induced current by considering the magnetic force that is exerted on the charge in the wire of the loop.

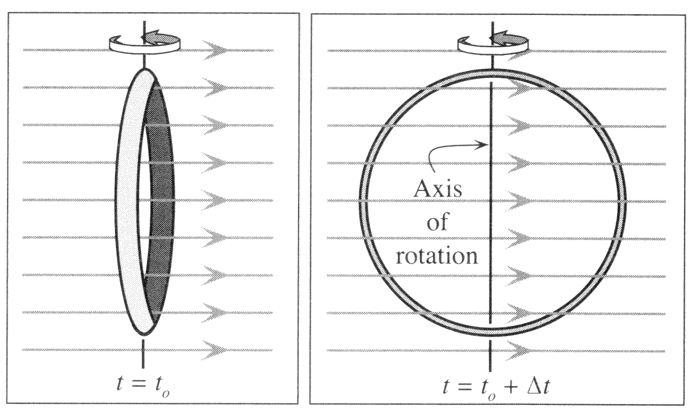
   c. Find:

   - the direction of the magnetic moment of the loop and

   - the direction of the force exerted on the loop by the solenoid.

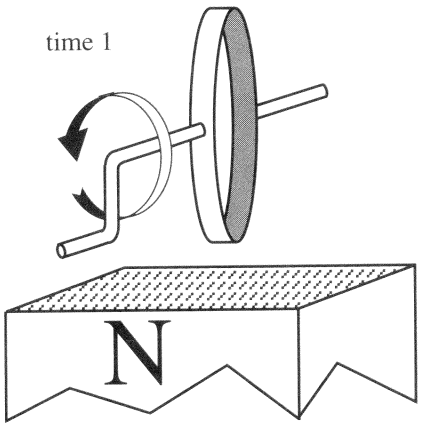
3 A copper wire loop is initially at rest in a uniform magnetic field. Between times $t = t_o$ and $t = t_o + \Delta t$ the loop is rotated about a vertical axis as shown.

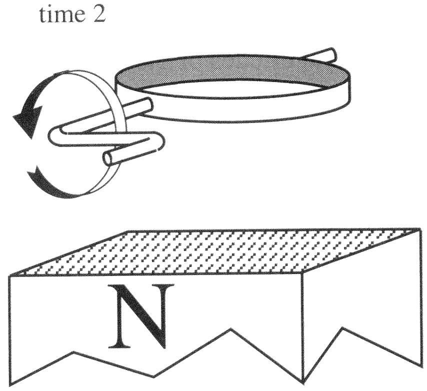
Will current flow through the wire of the loop during this time interval? If so, indicate the direction of the induced current and explain your reasoning. If not, explain why not.



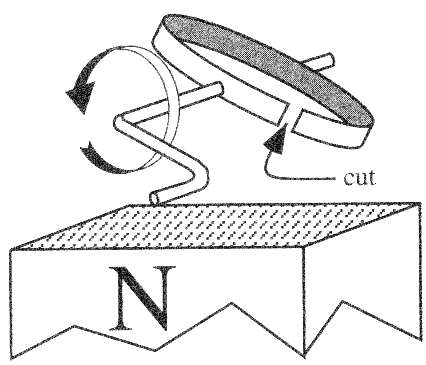
1. A metal loop is attached to an axle with a handle as shown. The north pole of a magnet is placed below the loop and the handle turned so that the loop rotates counterclockwise at a constant angular speed ω.

   a. On the two diagrams below, indicate the direction of the induced current in the loop at each of the instants shown. If the current is zero, state that explicitly. Explain how you determined your answers.





   b. Suppose the loop were replaced by a second loop that is identical to the first except for a small cut in it (as shown). The loop is rotated as before.

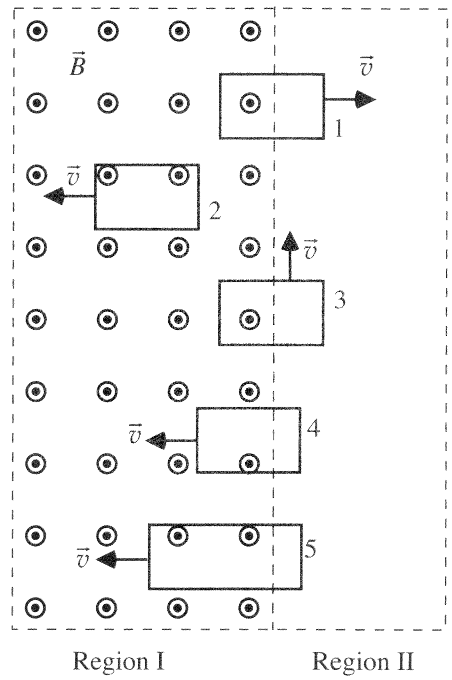


      i. How does the maximum induced emf in the uncut loop compare to the maximum induced emf in the cut loop? Explain.

      ii. How does the maximum induced current in the uncut loop compare to the maximum induced current in the cut loop? Explain your reasoning.

2. Five loops are formed of copper wire of the same gauge (cross-sectional area). Loops 1–4 are identical; loop 5 has the same height as the others but is longer. At the instant shown, all the loops are moving at the same speed in the directions indicated.

There is a uniform magnetic field pointing out of the page in region I; in region II there is no magnetic field. Ignore any interactions between the loops.



a. For any loop that has an induced current, indicate the direction of that current.

b. Rank the magnitudes of the *emfs* around the loops. Explain your reasoning.

c. Rank the magnitudes of the currents in the loops. Explain your reasoning.