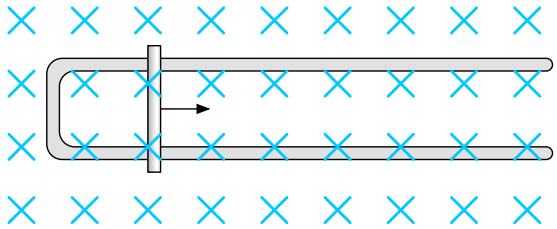
Metal Bar Sliding on Rails and Induced Currents **Name** _____

Physics II Ch 21 Assignment 3 **Date** _____ **Period** _____

For the next four items
The arrangement below consists of a "U-shaped" piece of metal with its open end to the right. We are looking at it from above. Resting on this U-shaped metal is a straight copper bar that is sliding along the U-shaped piece of metal to the right. The whole arrangement is within a magnetic field produced by an external magnet that we cannot see. Its magnetic field is directed downward into the page as shown.



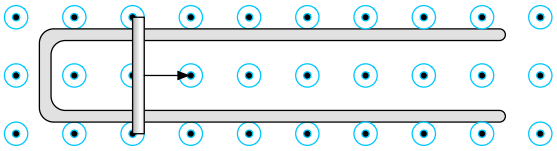
1. Is there a closed conducting loop in this arrangement through which there is magnetic flux?
   Yes / No

2. If there is magnetic flux through this arrangement, is it directed into this page or up out of this page?
   Into / Up out of

3. If there is magnetic flux through this arrangement, is the amount of flux increasing, decreasing, or remaining the same as the bar moves along to the right?
   Increasing / Decreasing / Staying the same

4. In which direction will electrons within this bar experience a force due to the magnetic field?
   Up toward the top of the page / Down toward the bottom of the page
   Toward the left side of the page / Toward the right side of the page
   Up out of the page / Down into the page

5. A 30 cm metal bar having 5 Ω of resistance is sliding at 20 m/s to the right on a "U"-shaped copper wire in a magnetic field of strength 0.20 T that is produced by another magnet. We call this an "external" magnetic field. This magnetic field is shown below.



(a) In which direction will electrons within this bar experience a force due to the magnetic field?
Up toward the top of the page / Down toward the bottom of the page
Toward the left side of the page / Toward the right side of the page
Up out of the page / Down into the page

(b) What is the emf $\mathcal{E}$ that is produced in this scenario?

_____

(c) How much current will flow through the sliding metal bar, and in which sense, clockwise or counterclockwise will it (conventional current) flow? [Note: This current is said to be "induced current."]

_____

(d) How big a force will the current in the bar experience because of the magnetic field? In which direction will this force act?

_____

(e) In which direction will the magnetic field produced by this induced electric current (as distinct from the external magnetic field that is already there from an external magnet) point within the loop? We call this the "induced magnetic field."

_____

(f) The flux due to the external magnetic field is directed out of the page as one can see in the diagram. Is this external flux decreasing, increasing or remaining the same as the bar moves to the right?