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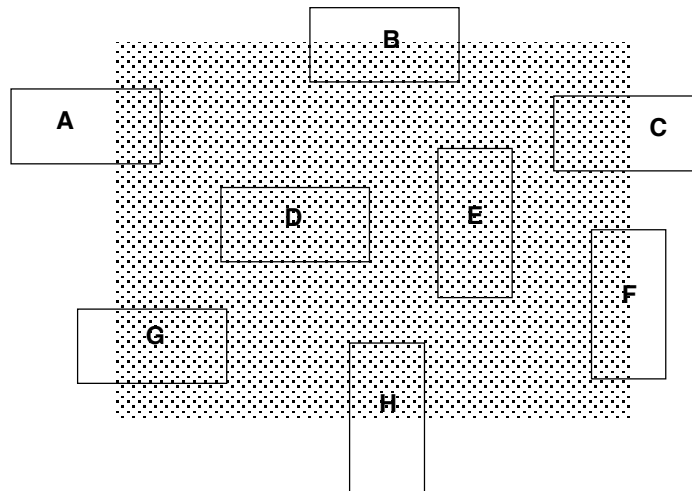
**EMI 3A: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-
CURRENT**

EMI3A—RT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

The situations below show eight rectangular wire loops that are moving to the right into, within or out of, a region in which there is uniform magnetic field coming out of the page. The rectangular loops are the same size (5 cm by 10 cm) and are being pushed to the right at a constant velocity (2 cm/s). The loops are at various locations with various portions (25%, 50%, 75%, or 100%) within the field and orientations in the field as shown.

Rank these situations, from greatest to least, on the basis of the current in the rectangular loops at the time and positions shown (assume there is no effect or interaction between the loops).

5 cm x 10 cm rectangular conducting loops all moving to the right (\rightarrow) at constant velocity $v = 2$ cm/s



Greatest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____ Least

OR, All the loops have the same current. _____

OR, There is no current in any of the loops. _____

Carefully explain your reasoning.

How sure were you of your ranking? (circle one)

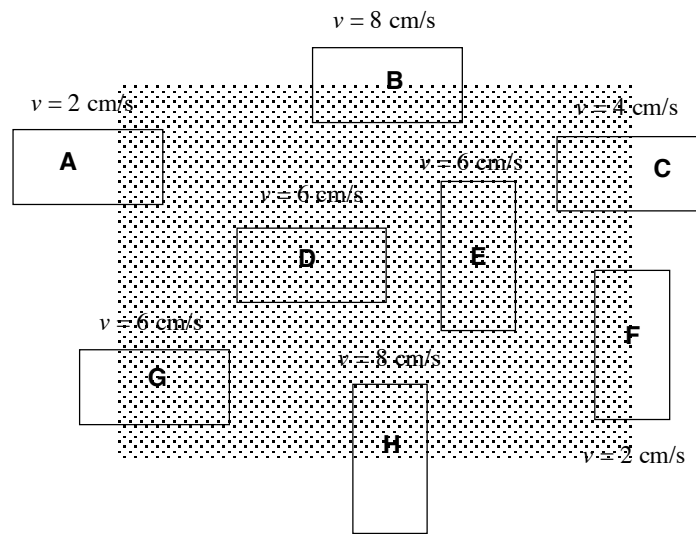
Basically Guessed Sure Very Sure
 1 2 3 4 5 6 7 8 9 10

EMI3A—RT2: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

The situations below show rectangular wire loops that are moving to the right into, within or out of, a region in which there is uniform magnetic field coming out of the page. The rectangular loops are the same size (5 cm by 10 cm) and are being pushed to the right at various constant velocities as shown. The loops are at various locations with various portions (25%, 50%, 75%, or 100%) within the field and orientations as shown.

Rank these situations, from greatest to least, on the basis of the current in the rectangular loops at the time and positions shown (assume there is no effect or interaction between the loops).

5 cm x 10 cm rectangular conducting loops moving to the right (→)



Greatest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8 ____ Least

OR, All the loops have the same current. _____

OR, There is no current in any of the loops. _____

Carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed

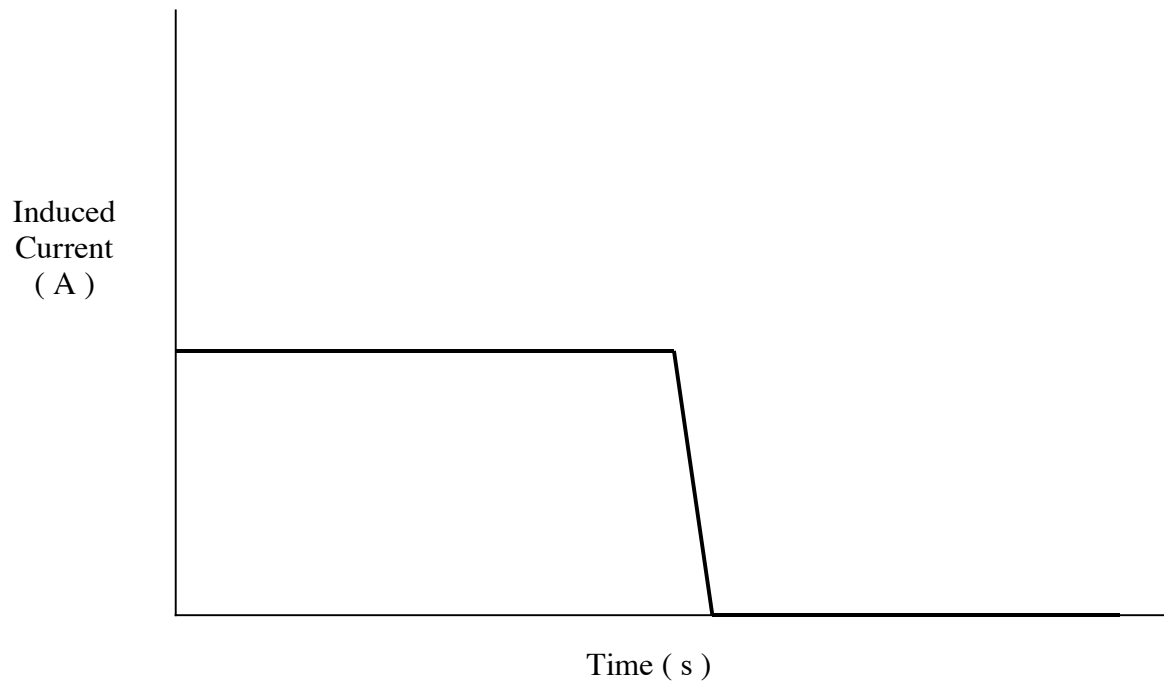
Sure

Very Sure

1 2 3 4 5 6 7 8 9 10

EMI3A—WBT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

Construct a physical situation, involving a rectangular wire loop moving in a uniform magnetic field at a constant speed, to which the graph below could apply.



Explain fully.

EMI3A—WWT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

What, if anything is wrong with the following?

A student contends: *“If a rectangular wire loop is pulled into a region where there is a uniform magnetic field, the current will increase as more of the loop gets into the field since there will be more flux inside the loop.”*

EMI3A—TT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

There is something wrong with the following. **Identify the problem and explain how to correct it.**

A student contends: *“If a rectangular wire loop is pulled into a region where there is a uniform magnetic field, the current will increase as more of the loop gets into the field since there will be more flux inside the loop.”*

EMI3A—CCT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

Three students are discussing a rectangular wire loop moving at a constant speed into a region in which there is a uniform magnetic field.

With which, if any, of the following students do you agree?

Student A: *“If a rectangular wire loop is pulled into a region where there is a uniform magnetic field, the current will increase as more of the loop gets into the field since there will be more flux inside the loop.”*

Student B: *“No, the current in the wire loop will decrease as the loop moves into the field region since less of the loop will be outside of the field.”*

Student C: *“No, the current in the wire loop will be constant from the time the loop starts into the field region until it is fully into the field region when the current will go to zero.”*

I agree with:

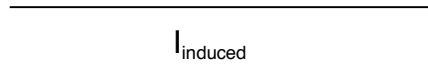
Student A _____ Student B _____ Student C _____ None of these students _____

Explain your reasoning fully.

EMI3A—BCT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

The bar chart below left shows the magnitude of the current in a rectangular wire loop that is being pushed into a region of uniform magnetic field at constant speed. The bar chart is for the time just as the loop starts into the field.

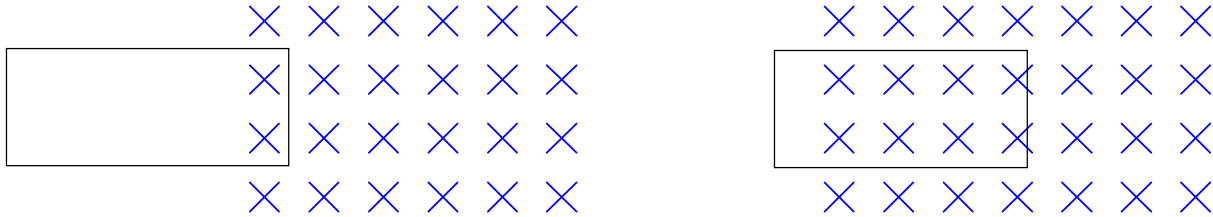
Complete the bar chart below right to show the magnitude of the current when the loop is about three-fourths into the field region.



Explain your reasoning.

EMI3A—CRT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

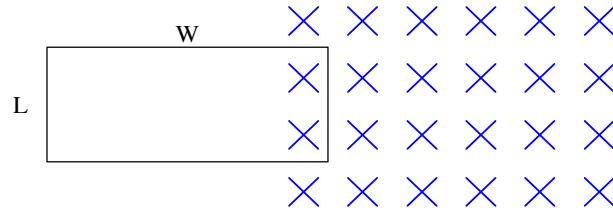
Given below are two figures depicting a rectangular wire loop that is being pushed at a constant speed into a region in which there is a uniform magnetic field pointing into the page. The figures show the loop at two different times during the process.



Draw a graph of the current in the rectangular wire loop as a function of time for the interval between the two times shown in the figures.

EMI3A—QRT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

A rectangular wire loop containing a one-ohm resistor (not shown) is being pushed into a region of uniform magnetic field. There is a current of 100 mA in the loop as it is entering the field as shown below.



How would the following changes affect, the current in the loop? Explain fully for each change.

(a) The width, W , of the loop in the direction of the velocity is doubled.

(b) The height, L , of the loop is doubled, and the field strength is cut in half.

(c) The loop is completely inside the field.

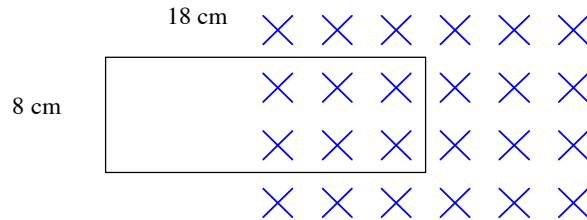
(d) The speed at which the loop is moving increases.

(e) The loop is leaving the field rather than entering it.

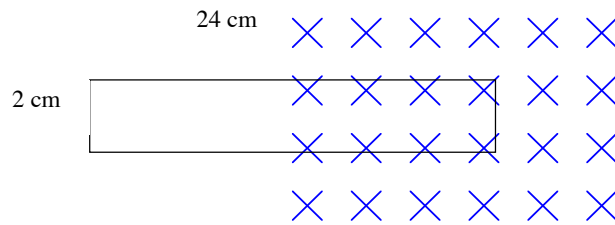
(f) The speed increases, and the field strength increases.

EMI3A—PET1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

A moving rectangular loop of wire 8cm in width and 18cm in length is halfway into a region with a uniform magnetic field, and the current in the loop is 12 mA.



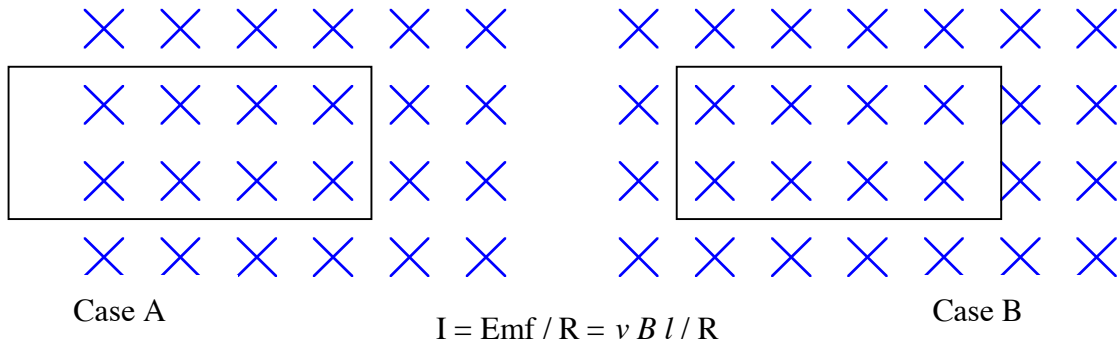
A second loop of wire 2 cm in width and 24 cm in length is being pulled at the same speed as the above loop into a magnetic field 4 times as strong. Compare the current in this second loop with the current in the first loop, when each is halfway into the field.



Explain the reasoning behind your prediction fully.

EMI3A—M/MCT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

Shown below are two figures showing a rectangular loop being pushed into and through a region at a constant speed in which there is a uniform magnetic field pointing down into the page. A student uses the equation below to determine the current for both times.

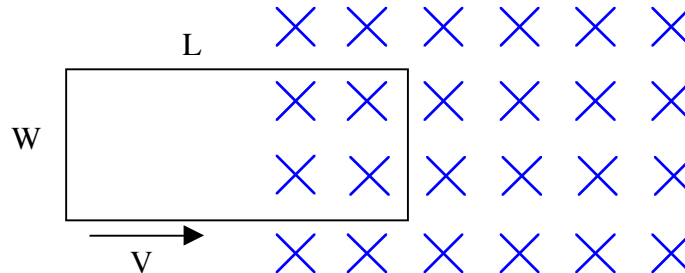


Will the answers this student gets be meaningful in Case A? Explain fully.

Will the answers this student gets be meaningful in Case B? Explain fully.

EMI3A—LMCT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-CURRENT

A rectangular wire loop containing a one-ohm resistor (not shown) is being pulled at a constant speed v into a region in which there is a uniform magnetic field pointing down into the page as shown in the figure below.



Indicate how the current in the loop will change if each of the following modifications are made from the original situation shown above.

Possible answers for all of these comparisons are:

- a) The current will be larger
- b) The current will be smaller but non-zero
- c) The current will be the same magnitude
- d) The current will be zero

- 1) The loop is almost completely in the field. _____
- 2) The speed of the loop is tripled. _____
- 3) The field direction is reversed. _____
- 4) The length, L , of the loop is increased. _____
- 5) The width, W , of the loop is decreased. _____
- 6) The loop is being pulled out the other end of the field region. _____
- 7) The field strength is decreased. _____
- 8) The loop is moving toward the bottom of the page at the same constant speed. _____
- 9) The loop is moving to the right at the speed v . _____