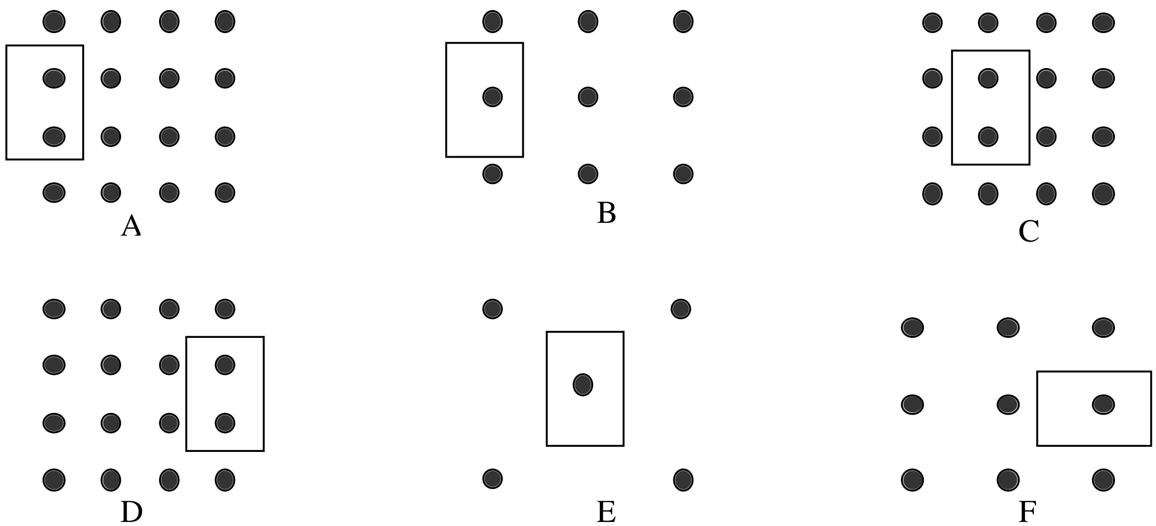
EMI 2A: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNET FIELDS-VOLTAGE

EMI2A—RT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-VOLTAGE

The six situations shown below have rectangular wire loops moving into, through, and out of uniform magnetic fields. All of the loops have the same dimensions 4 cm x 6 cm, although their orientations vary. The strengths of the magnetic fields vary among the situations. All of the magnetic fields point out of the page, and all of the loops are moving to the right at the same speed and they contain a 1 ohm resistor that is not shown.

Rank these situations, from greatest to least, on the basis of the emf across the resistor in the loop at the instant shown.



Greatest 1 _______ 2 _______ 3 _______ 4 _______ 5 _______ 6 _______ Least

OR, All six of these situations have zero emf. _______

Carefully explain your reasoning.

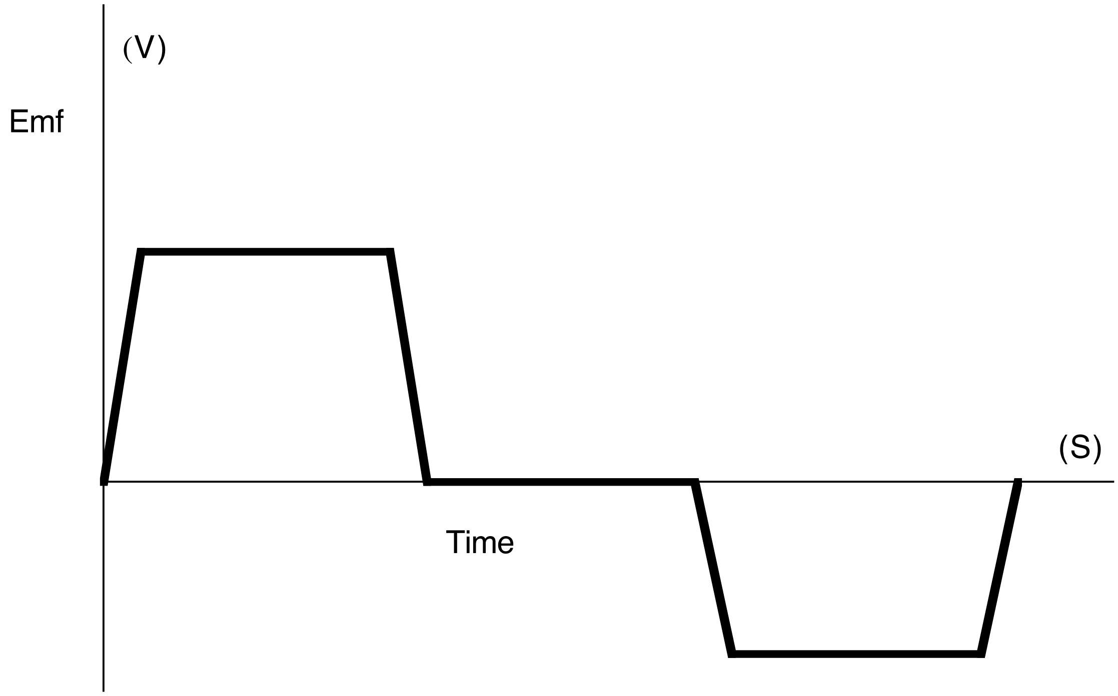
How sure were you of your ranking? (circle one)

Basically Guessed Sure Very Sure

1 2 3 4 5 6 7 8 9 10

EMI2a—WBT1: Moving Rectangular Loops and Uniform Magnetic Fields-Voltage

A situation involving a rectangular loop of wire and a uniform magnetic field resulted in the graph below. **Describe a physical situation that could produce this graph.**



Explain:

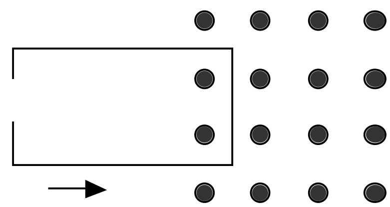
EMI2A—WWT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-VOLTAGE

What, if anything, is wrong with the following situation? If something is wrong, identify it and explain how to correct the situation. If nothing is wrong, explain why the situation works as described.

If a rectangular loop of copper with a very small resistor is moved into a region of uniform magnetic field, there will be an emf (V) across the resistor in the loop while the loop is moving into the field, but not once it is completely inside the field region.

EMI2a—CCT1: Moving Rectangular Loops and Uniform Magnetic Fields-Voltage

Consider the following statements about the open rectangular loop shown below.



Student A: *"An open rectangular loop will have an emf across the gap when moving into or out of a uniform magnetic field."*

Student B: *"An open rectangular loop will have an emf across the gap any time it is anywhere in the region of the magnetic field."*

Student C: *"An open rectangular loop will have an emf across the gap only when moving inside the field region."*

Student D: *"An open rectangular loop cannot have an emf across the gap because there is a break in the loop."*

With which, if any, student do you agree?

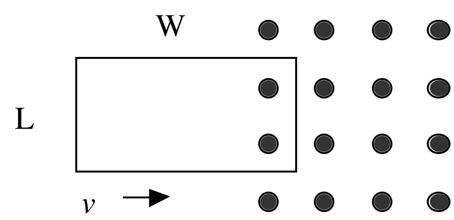
Student A _____ Student B _____ Student C _____ Student D ______

None of them _______

Carefully explain your reasoning.

EMI2a—PET1: Moving Rectangular Loops and Uniform Magnetic Fields-Voltage

A rectangular loop of wire with a small resistor (not shown) is connected to a voltmeter. The loop is going to be moved into, through, and out of a uniform magnetic field at a constant speed. The plane of the loop will be perpendicular to the direction of the magnetic field.

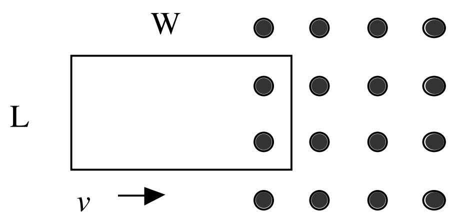


Predict what the reading(s) on the voltmeter will be from before the loop is in the field until it passes completely out of the field.

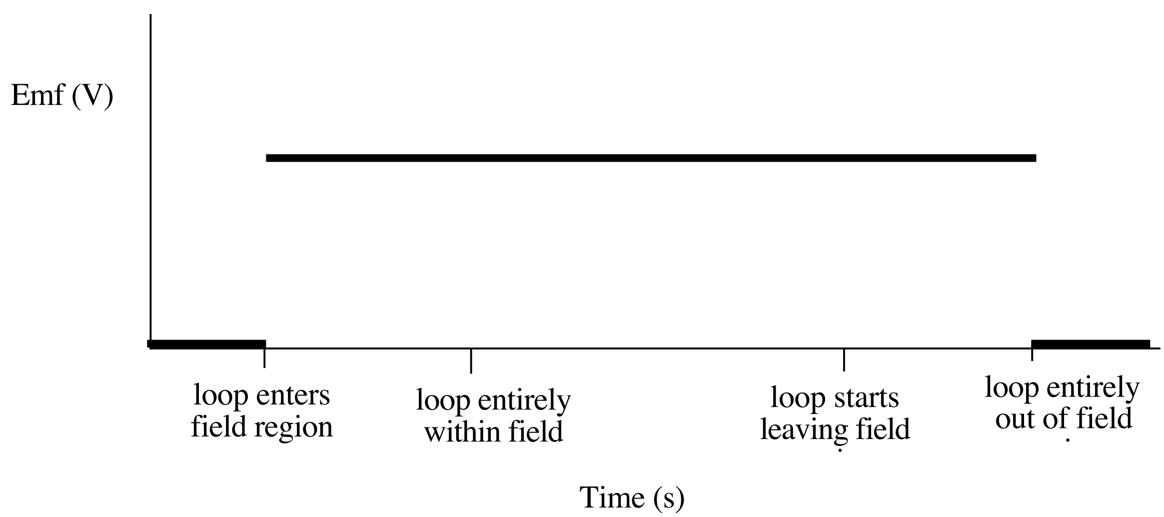
EMI2A—TT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-VOLTAGE

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

A rectangular loop with a very small resistor (not shown) is moved into, through, and out of a uniform magnetic field at a constant rate. The plane of the loop is perpendicular to the magnetic field.



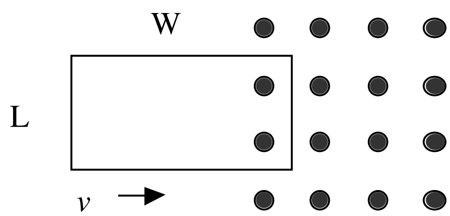
The graph of emf (V) across the resistor in the loop versus time for this whole time period would look as shown in the graph below.



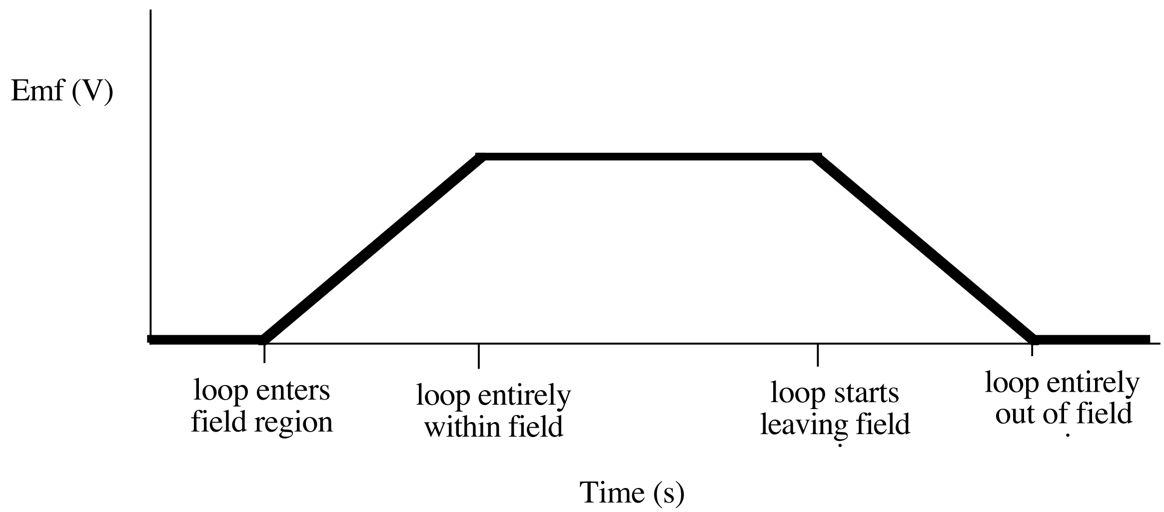
EMI2A—TT2: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-VOLTAGE

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

A rectangular loop with a very small resistor (not shown) is moved into, through, and out of a uniform magnetic field at a constant rate. The plane of the loop is perpendicular to the magnetic field.



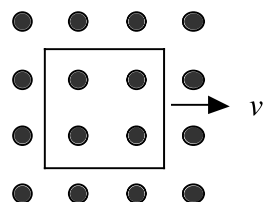
The graph of emf (V) across the resistor in the loop versus time for this whole time period would look as shown in the graph below.



EMI2A—M/MCT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-VOLTAGE

A square wire loop with a very small resistor is moving through a uniform magnetic field, of strength B, at a constant rate v. The loop is fully in the field, and the loop has side length of l. Is the calculation below for the Emf across the resistor meaningful or meaningless for this situation?

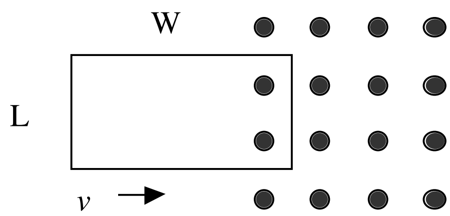
$Emf = (v)(B)(l)$



Explain fully.

EMI2A—LMCT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-VOLTAGE

A rectangular wire loop with a very small resistor (not shown) has its leading edge just moving into a uniform magnetic field. The loop has dimensions of L by W, and is moving at a constant speed.



Described below are a variety of changes to this initial situation. (ALL OF THE CHANGES DESCRIBED ARE MODIFICATIONS OF THIS INITIAL SITUATION.)

For each change, identify how the change will affect the emf across the resistor in the loop. The possible effects on emf are:

a) It will increase.
b) It will decrease.
c) It will reverse polarity.
d) It will increase and reverse polarity.
e) It will decrease and reverse polarity.
f) There will be no effect on the emf.

Changes in the situation are:

1) The magnetic field is doubled in strength. __________

2) The velocity of the loop is reduced. __________

3) The W side of the loop is tripled in length. __________

4) The direction of the magnetic field is reversed. __________

5) The L side of the loop is doubled in length. __________

EMI2A—CRT1: MOVING RECTANGULAR LOOPS AND UNIFORM MAGNETIC FIELDS-VOLTAGE

A loop of conducting wire with a small resistor is moving into a region in which there is a uniform magnetic field. **For the time shown in the graph at the left draw the corresponding Emf versus time graph at the right.**