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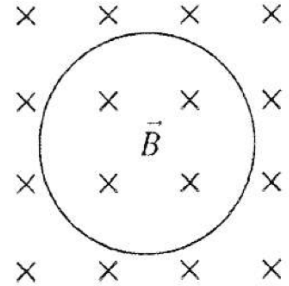
Student Number:

Physics Tutorial Magnetic Induction

Question 1

Does the loop of wire have a clockwise current, a counterclockwise current, or no current under the following circumstances? Explain.

- The magnetic field points into the page and its strength is increasing.
- The magnetic field points into the page and its strength is constant.
- The magnetic field points into the page and its strength is decreasing.

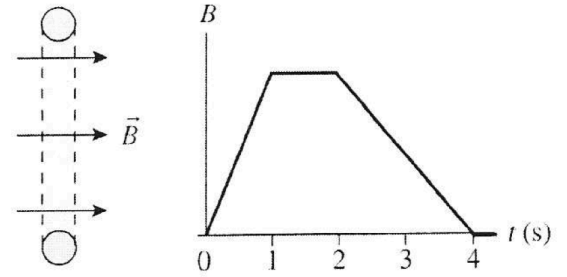


Name:

Student Number:

Question 2

A loop of wire is perpendicular to a magnetic field. The magnetic field strength as a function of time is given by the top graph. Draw a graph of the current in the loop as a function of time.

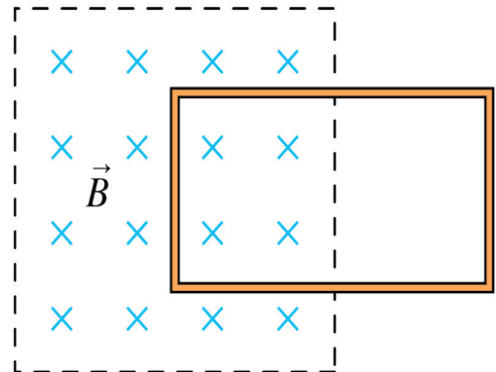


Let a positive current represent a current that comes out of the top and enters the bottom. There are no numbers for the vertical axis, but your graph should have the correct shape and proportions.



Question 3

A conducting loop is halfway into a magnetic field. Suppose the magnetic field begins to increase rapidly in strength. What happens to the loop?

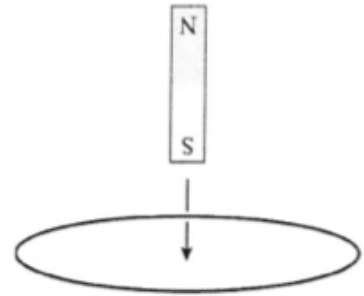


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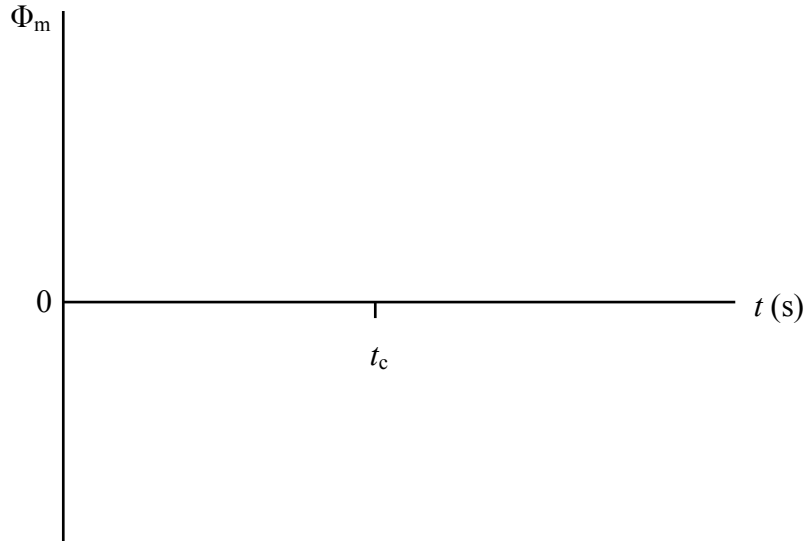
Student Number:

Question 4

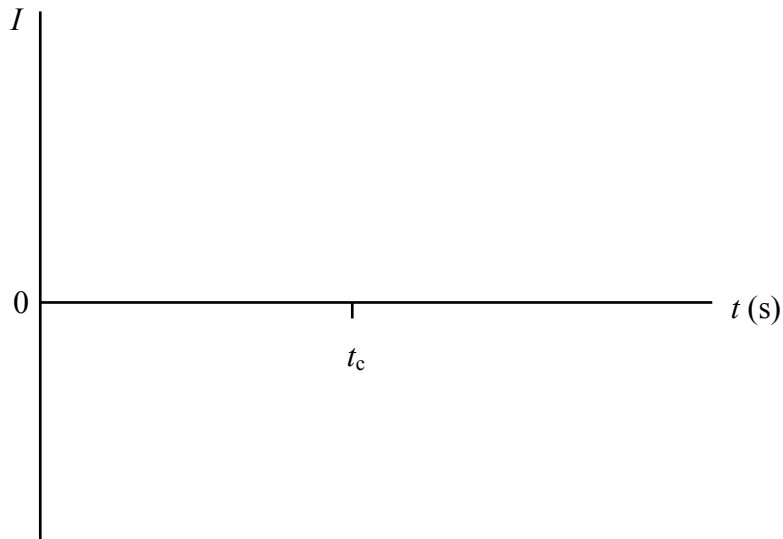
A bar magnet is dropped, south pole down, through the center of a loop of wire. The center of the magnet passes the plane of the loop at t_c .



- a. Sketch a graph of the magnetic flux through the loop as a function of time.



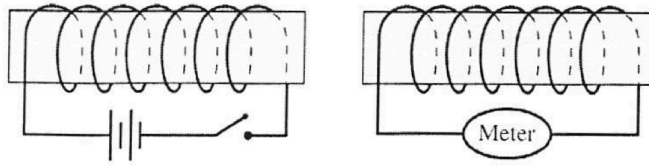
- b. Sketch a graph of the current in the loop as a function of time. Let a clockwise current be a positive number and a counterclockwise current be a negative number



Name:

Student Number:

Question 5



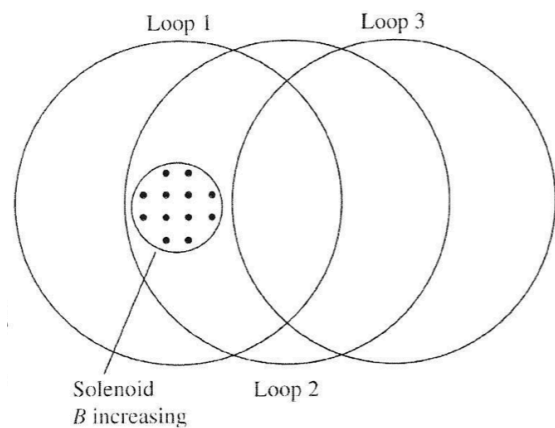
- a. Just after the switch on the left coil is closed, does current flow right to left or left to right through the current meter of the right coil? Or is the current zero? Explain.
- b. Long after the switch on the left coil is closed, does current flow right to left or left to right through the current meter of the right coil? Or is the current zero? Explain.

Question 6

A solenoid is perpendicular to the page, and its field strength is increasing. Three circular wire loops of equal radii are shown. Rank in order, from largest to smallest, the size of the induced emf in the three rings.

Order:

Explanation:

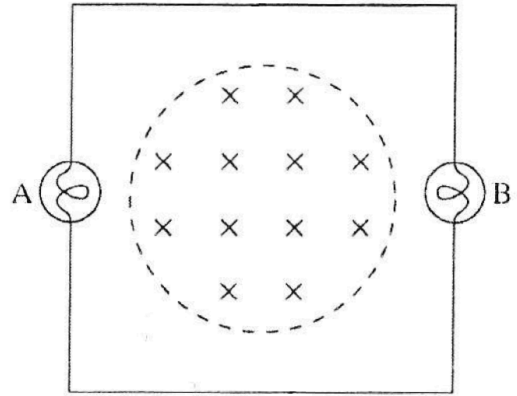


Name:

Student Number:

Question 7

A conducting loop around a magnetic field contains two light bulbs, A and B. The wires connecting the bulbs are ideal, with no resistance. The magnetic field is increasing rapidly.



a. Do the bulbs glow? Why or why not?

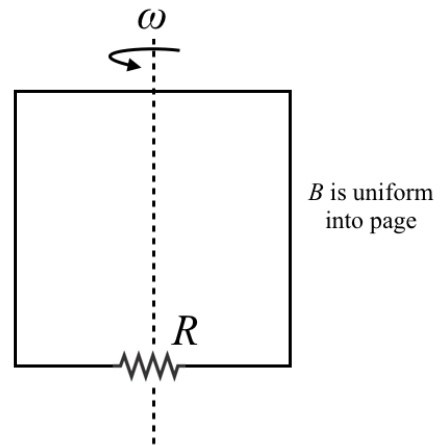
b. If they glow, which bulb is brighter? Or are they equally bright? Explain.

Question 8

Wind and water turbines use induction to generate electricity. One way to do this is to have the spinning blades rotate a wire loop sitting inside a constant magnetic field.

Imagine the loop in the picture is a square with sides of length ℓ that is rotating at a constant angular velocity ω . The wire has a total resistance of R .

Find an expression for the current generated in the loop. You'll find it helpful to start by determining how the magnetic flux through the loop changes as a function of time. This can be used to find the emf, and thus the current.



Name:

Student Number:

Question 9 (Extra)

The situation is similar Question 7, but now A and B have different resistances, R_A and R_B .

The magnetic field is increasing rapidly.

- What is the current through each light bulb? Is it the same or different?
- What is the voltage dropped across each light bulb?
- Do your results agree with Kirchhoff's loop law? Explain. If not, explain how you could modify the loop law.

