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Faraday's Law and Lenz's Law: Virtual Lab

AP Physics C – E&M

Unit 5 Introduction

https://phet.colorado.edu/sims/html/faradays-law/latest/faradays-law_en.html

Enduring Understanding FIE-6:

A changing magnetic field over time can induce current in conductors. (From AP Course and Exam Description)

Objective: I will describe the direction of an induced current in a conductive loop based on a changing magnetic field.

Explore how a changing magnetic field affects the direction of the induced current in a conductive loop, and how the number of turns affects the magnitude of induced emf in the loop. This will be done using a virtual lab activity. Inductors are important in power lines, to protect from short-circuiting during sudden changed in current. Faraday's Law will help us learn how to use inductors in circuits.

Guiding Question: How does the movement of a magnet near or inside a conducting loop cause an induced current in the loop? How do the direction and magnitude change with the number of loops and movement of the magnet?

Comment and fill out the table below. Detail the steps you took to arrive at your data, in the Procedure section.

Claim (what the theory should say):	The theory should say that as a magnetic field is changing near a circuit with no power source, there is a small period of induced current in the loop, making the light bulb momentarily light up. It also depends on how quickly the magnetic field is changing.
Evidence (what you observed):	When we move the bar magnet close to the loop from far away, the light bulb lights up. Moving it away does the same thing. When moving the magnet close to the solenoid really fast, the light bulb gets very bright. When slowly moving it, the bulb is less lit.

Reasoning (why the observation is important and how it holds given your knowledge of magnetism):	Increasing the strength of the magnetic field by moving the bar magnet closer creates a current while moving it further away to decrease the strength of the magnetic field also creates a current.

Procedure (write down steps or put screenshots of your steps, either is fine)

1. Click the single coil option in the virtual lab.
2. Click the magnet in a configuration such that the left side is the “N” of the maganent.
3. Move the maganent around the screen to induce forces. Make sure to put it on the top, bottom, and inside the coil. Examine what happens as a result.
4. Click the double coil option, and repeat steps 2 and 3.

Postlab Questions

1. Does magnetic field itself induce a current in a loop of wire?

No. Although magnetic field does exert a force, it requires an already existing velocity in the charged particles of a loop of wire. If a loop of wire has no current, adding a static magnetic field will not induce any charge.

2. How can you determine whether the voltage will be positive or negative? Is there a rule that may lend you a hand in identifying this?

The right hand rule can “lend you a hand”.

The voltage can be determined from the magnetic field direction by using Right Hand Rule to determine the direction of current and thus the voltage.

Checklist and feedback: work to complete the first and last columns with your partners, based on the criteria from the middle column. To do this, use your “Reasoning” row and your postlab questions to help you with determining your level of confidence on each criteria.

Goals and Areas of Growth	Proficiency Criteria	Areas of Excellence
We need to work on our understanding of magnetism as a whole. WE currently understand the lab level, however, we have a test coming up so we need to study all of our material.	· I can explain how increasing the number of loops in the conductor changes the induced current for a given change in magnetic field. · I can explain how the magnetic flux changes as the magnet gets closer to or farther away from the loop. · I can justify why moving the magnet parallel to the loop causes a very minimal induced current.	Our evidence shows that we have a strong understanding of Faraday’s and Lenz’s law, and can apply it in more realistic situations.