PHYS 104 Lab 8 Magnetic Fields

Introduction

In this lab you will generate electricity by *induction* and explore the workings of transformers. For your measurements you will use **Voltage Sensors**. You will collect your data using **PASCO Capstone** and you will tabulate your results using **Excel**.

Theory

*Induction* is a phenomenon in which a changing *magnetic field* produces *current* (or *voltage*) in a coil of wire. In this laboratory we will investigate how *induction* can be used to induce current. Specifically, in **Part 1** you will use a permanent magnet to induce the *current* in a solenoid. Permanent magnet, of course, produces a constant magnetic field around it, but if it is moving relative to the solenoid then the field through the solenoid is variable.

Procedure

Part 1. Induction.

**CAUTION: KEEP ALL MAGNETS AWAY FROM COMPUTERS AND SCREENS**

**OR YOU WILL DAMAGE THEM.**

1. Physically connect the solenoid with 3200 turns (or loops) and the solenoid with 800 turns to the analog channels “A” and “B” of the **PASCO** **Interface Box** via **Voltage Sensors**.
2. In the **'Experiment Setup'** from the list of sensors select the **'Voltage Sensor'** and connect it to the analog channels “A” and “B” on the picture of the **'Interface Box'**. Set Sample rate of the **Voltage Sensors** to 100 Hz.
3. In **Capstone** create one graph of the two *voltages* versus *time*.
4. Place the two solenoids side by side so they are coaxial and keep them right next to one another. Make sure their windings are aligned in the same direction. Rapidly insert the *north pole* of the **magnet** all the way into the solenoids, pause, and then rapidly remove it (try inserting and removing the **magnet** at the same *speed* each time). It is important that the **magnet** always enters both coils fully. After a few trials you should be able to complete this sequence smoothly. Repeat the action as many times as needed to answer the questions below. You can do the in stages. Rescale the graph so that you can view it easily. Copy the graphs that illustrate your findings into your report and make sure to label and reference them clearly. Follow with an appropriate and thorough discussion.
5. Is there any *voltage* induced in the solenoid (i.e. *current* flow) during the sequence described above? When? Why?
6. Is there any *voltage* induced when the **magnet** is stationary? Discuss.
7. Is the induced *voltage* dependent on the number of turns of the solenoid? Discuss.
8. Is the sign of the *voltage* induced when removing the **magnet** the opposite of that induced when inserting the **magnet**? Discuss.
9. Repeat the action (procedure **Part 1**.4) but insert and remove the **magnet** at much faster and much slower speeds. Record your results on the same graph.
10. Is the *voltage* induced proportional to the speed of motion? Discuss.
11. Moving the coils rather than the **magnet** hold the **magnet** in a horizontal position and rapidly slide the coils so that the **magnet** passes through them, pause, and then slide them off. It is important that the **magnet** always enters both coils fully. After a few trials you should be able to complete this sequence smoothly. Repeat the action as many times as needed to answer the question below.
12. Does it make any difference whether it is the **magnet** or the solenoids that are moved? Discuss.
13. Flip the **magnet** over and repeat the action (procedure **Part1**.4) with the *south pole* inserted first.
14. Does inserting the *south pole* induce the opposite *voltage* then inserting the *north pole*? Discuss.

**Save your data once you acquired it.**

**Print tables and graphs you have made and attach them to your report.**

**SAVE PAPER.**

**Delete your files from the computer when finished.**

**Disconnect all equipment, close all applications, and shut down your PC.**

**lab 8 Report** Name……………………………...

Name……………………………...

Name……………………………...

Data Presentation:

Part 1. Induction.

a)

b)

c)

d)

e)

f)

g)

**REMINDERS:** Include units.

Make sure to attach all your data and graphs. No data = No credit

Please do not hand in the manual, just the report.