Student Name ______________________________________ Date _______________

Electromagnetic Induction – Changing Magnetic Flux Can Induce an Electric Current – What is Lenz's Law?

Pre-Lesson Warm-Up Quiz

1. Draw the magnetic field lines on these two bar magnets. Would they attract or repel each other?

2. How do we define the magnetic flux, Φ, in terms of the magnetic field, B, and what are the units of magnetic flux?

3. What is the name of the law that describes the mathematical relationship of electromagnetic induction due to a change in magnetic flux in a coil of wire (see equation in question 4)?

4. $$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$$

Where $\mathcal{E}$ is the induced EMF, N is the number of coils of wire, and $\Delta\Phi/\Delta t$ is the change in magnetic flux over time.

What does the acronym EMF mean? What is another word we use for the EMF in a circuit?

5. Describe a couple physical ways you can create a changing magnetic flux in a coil of wire?

Predictions and Data Record **Student Name: _______________ Date: ______**

Conduct all initial drop tests with the N42 Neodymium cube magnet and with N/S vertically oriented.

Base Line - Plastic tube T1: ____ s T2: ____ s T3: ____ s T4: ___ s T(avg): ___ s

Plastic tube with open coil, do you predict the drop time will increase, decrease or stay the same? ____________

Reason: ____

Take measurements: T1: ___ s T2: ___ s T3: ___ s T4: ___ s T(avg): ___ s

Was the result as you expected? If not, why not? ___________________________________

Plastic tube with closed coil, do you predict the drop time will increase, decrease or stay the same? ___________

Reason: ____

Take measurements: T1: ___ s T2: ___ s T3: ___ s T4: ___ s T(avg): ___ s

Was the result as you expected? If not, why not? ___________________________________

What is happening on the oscilloscope? Can you explain the shape of the EMF curve using Lenz's law? ____

Copper tube, do you predict the drop time will increase, decrease or stay the same compared to the closed coil? _________

Reason: ____

Take measurements: T1: ___ s T2: ___ s T3: ___ s T4: ___ s T(avg): ___ s

Was the result as you expected? If not, why not? ___________________________________

Copper tube with vertical slits, do you predict the drop time will increase, decrease or stay the same compared to the solid Copper tube? __________

Reason: ____

Take measurements: T1: ___ s T2: ___ s T3: ___ s T4: ___ s T(avg): ___ s

Was the result as you expected? If not, why not? ________________________________

Aluminum tube, do you predict the drop time will increase, decrease or stay the same compared to Copper? __________

Reason: ____

Take measurements: T1: ___ s T2: ___ s T3: ___ s T4: ___ s T(avg): ___ s

Was the result as you expected? If not, why not? ________________________________

Stainless steel tube, do you predict the drop time will increase, decrease or stay the same compared to Copper and Aluminum? __________

Reason: ____

Take measurements: T1: ___ s T2: ___ s T3: ___ s T4: ___ s T(avg): ___ s

Was the result as you expected? If not, why not? ________________________________

Carbon fibre tube, do you predict the drop time will increase, decrease or stay the same compared to Copper? __________

Reason: ____

Take measurements: T1: ___ s T2: ___ s T3: ___ s T4: ___ s T(avg): ___ s

Was the result as you expected? If not, why not? ________________________________

All of the above drop tests were done using an N42 cube magnet. Try the other drop materials available, such as the spherical magnet, the stainless steel cube, the Aluminum cube. Make some predictions and do some drop tests to prove (or disprove) your hypotheses!

Post-Demonstration Quiz

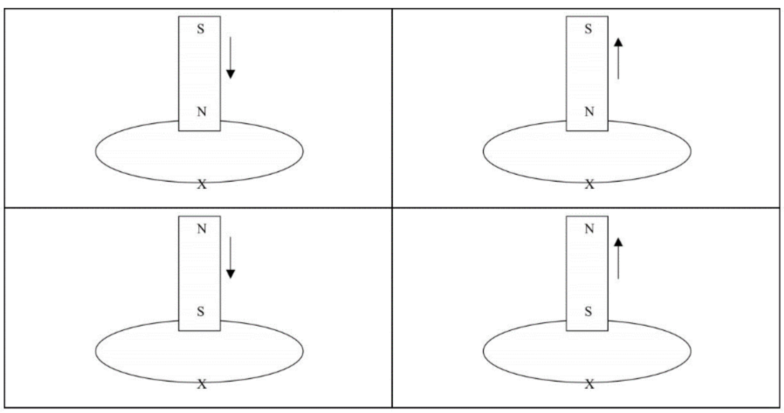
1. What is the name of the law that determines the direction of induced current in a closed wire loop?

2. What happens when a coil of wire (or a solid conductor) encounters a changing magnetic flux?

3. Explain the “right-hand” rule for determining the magnetic field around a current carrying wire.

4. A permanent bar magnet is pushed toward and pulled away from a closed circular wire coil. Using the law asked for in question 1, determine the direction of the induced current.

   Draw the field lines from the bar magnet that are entering the coil, show the direction of the induced magnetic field from the coil, and indicate the direction of the current on the segment of the wire marked with an “X”.



5. Thinking about part of the demonstration again, explain why the magnet falls faster through a Copper tube with slits cut into it.

6. What is a real-world application of electromagnetic induction?

7. What is a real-world application of eddy currents?

8. You discover a conductor that has zero resistance to electric current. If you made a tube out of it and conducted a similar experiment as we did today, what do you predict the magnet would do? Fall faster or fall slower through the tube, compared with the Copper tube? Or something else?