Name: _____

Activity – Induced EMF in a Coil of Wire

Objectives:

- Observe the motional EMF produced when a coil of wire moves through a magnetic field or a magnetic field moves through a coil of wire.
- Observe the induced EMF when a magnetic field through a coil of wire is increased.
- Charge a conductor using current from an induced EMF.

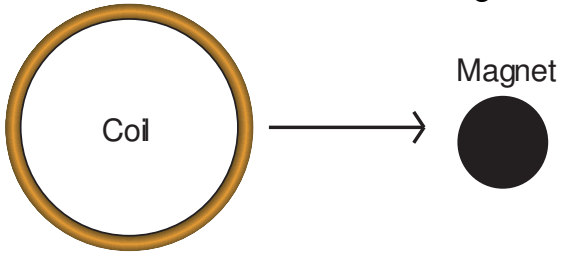
Materials:

Item	Quantity
Gilley Coil	2
Rubber coated NdFeB Magnet	1
Multimeter	1
6V Lantern Battery	1
1000 Ohm Resistor	1
Wires with Alligator Clip Leads	3
Hookup Wires	Several
Diode	1
LED	1
100 microfarad capacitor	1
Breadboard	1

Procedure:

1. Connect one coil to your multimeter. Set the multimeter to voltage mode on its most sensitive level (generally 200 mV).

2. Place the magnet on the table with the north pole (or south pole) pointing up. Move the coil across the field of the magnet as shown below:



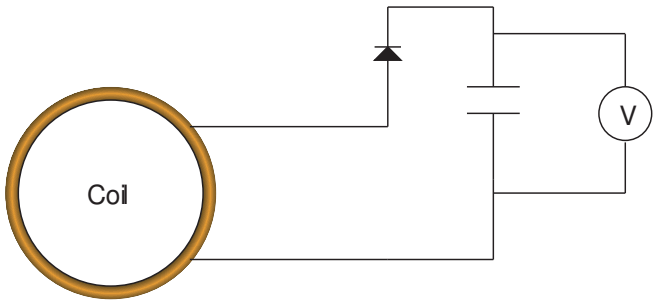
As the coil moves over the magnet, you should see a voltage appear for a brief instant that is either positive or negative. As the coil continues to move past the magnet, the voltage should reverse. If you stop the coil, the voltage will disappear. This potential difference is the result of a current in the wire created by the motion of the electrons in the wire through the magnetic field. If you think carefully about the magnetic force on the free electrons in the wire, and which way the magnetic field should produce a current by moving the electrons, you should be able to tell from the voltage which pole of the magnet is north or south.

3. Now repeat step 2, instead moving the magnet. You should see the same effect, only now the electrons are only moving relative to the field.

4. Try moving the magnet through the wire loop, or vice versa. In either case you should see a voltage appear while the motion ensues. Experiment with a variety of positions. Try turning the loop in a circle near the magnet.

5. Now remove the magnet and place the second coil on top of the first. Connect one lead of the second coil to the battery or power supply. Quickly connect and disconnect the second lead. You may see an extremely brief reading of voltage on the meter when the second coil is connected and disconnected. This is the induced EMF from the changing magnetic field produced by the second coil. The voltage should reverse when the second coil is disconnected.

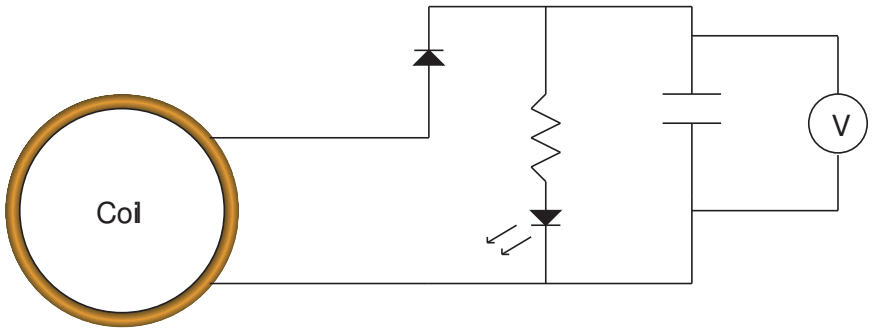
6. The brief induced current in the first coil when the second was initially connected to the battery can be used to charge a capacitor. Construct the following circuit using the capacitor, diode, wires, voltmeter, and breadboard:



The diode will prevent any induced current in a certain direction, so that there will only be induced current either when the second coil is connected or disconnected to the battery. The voltmeter will read the voltage across the capacitor, giving you a reading of how much charge has been deposited from the induced current.

7. Briefly complete the circuit on the second coil (which should be laid above the first) several times. Notice how the voltage only increases when the second circuit is either connected or disconnected. Continue until the capacitor is charged to above 3 volts. Do not leave the second coil connected for more than a few seconds as you may overheat the coil.

8. Now add the resistor and LED to the circuit as shown below. When the addition is complete, the capacitor will discharge through the LED, and you will see the voltage across the capacitor drop:



Lab Report:

Please prepare a written summary of the lab. Your report should include your answers to the following questions, your observations throughout the lab, and any problems or sources of error you encountered during the lab.

Application Questions:

1. How is this experiment related to an MRI machine?
2. Why might Biomedical Engineers be interested in magnetic fields and the voltages they create?
3. What have you learned during this experiment related to creating a safe environment around an MRI machine?
4. Do you still have questions about Magnetic Fields, and if so, what are they?