# LAB 8 Report (Electromagnetism)

## Abstract

This experiment tries to explore Lenz's law and how an electric field can be produced through a number of coils and a moving magnetic field. The lab also shows how to build a generator from a rotating magnetic field and what those fields may look like when seen through an oscilloscope. The experiment attempts to solve the relationships between magnetic field changes, induced electric fields, and resultant currents through Faraday's law, in addition seeing what movements of the magnet does to the frequency and the amplitude of the electricity produced.
The conclusion is that the experiment proved the principles of electromagnetic induction and Lenz's Law effectively. As the magnet or solenoid moves, the changing magnetic field induces a voltage, and the direction and magnitude of the voltage depend on the magnet's movement and orientation.

## Procedure

The materials used in the lab are an oscilloscope, a microphone, tuning forks, a solenoid, banana plugs, a magnet, masking tape, string and a power source. To set up the oscilloscope, first connect the solenoid to the oscilloscope and plug the power cable to the wall and turn it on. To control the oscilloscope press the DEFAULT SETUP to reset it, use the SEC/DIV knob to adjust the time and use the VOLTS/DIV to adjust the voltage seen on screen. Press the TRIG MENU to set it to channel 1 and select AC power on the channel. Press the TRIG MENU in order to specify how much voltage is needed to see on the screen and lastly use the RUN/STOP to freeze the screen. Now move the magnet around or through the solenoid to and observe the osculations that are occurring.

## Calculation and reasoning A-G

**Part A: Connect the solenoid to the oscilloscope. Then, move a stack of 5 magnets in front of the solenoid. (Set Voltage to the most sensitive voltage range and a time base of 100 ms. Set trigger option to automatic.) After the experiment, write down the observation.** Moving the magnet through the solenoid causes the light bulb to turn on. The faster the magnet moves through the higher the voltage. Moving the North side of the magnet to the left causes it to make the voltage negative and moving the South side to the left causes the voltage to be positive. So as the magnet moves left the voltage becomes negative then positive.

**Part B: Oscillate the magnet 5~10 times and then stop the magnet close to the solenoid. Then write down your observations.** The faster the magnetic vibrates the more frequency and amplitude is shown on the graph. When not moving the magnet there is no voltage only when there is movement, voltage occurs.

**Part C: What happens if you hold the magnet still and move the solenoid? We will use a compass to determine the orientation of the magnet.** The result is the same as moving the magnet as pushing it. Moving the solenoid produces the same amount of voltage.

**Part D: Follow the lab manual instruction and build a simple generator and write down your observations.** When spinning the pencil with a magnet produces a constant angular velocity like a sine wave on the screen. The voltage produced is fluctuating to positive voltage and back down to negative voltage.

**Part E: Change the speed of your generator and write down your observations.** The amplitude and frequency both increase as the spinning increases. The voltage is a lot higher and osculates more as the spinning increases.

**Part F: Use the two-meter cable to make a second solenoid with the same diameter but fewer loops. (We already have a wire with fewer loops) Compare the strength of the induced signals.** The voltage is 20 times less than the regular solenoid and there was a lot more frequency with almost no space between the osculations.

**Part G: How does the signal picked up by your generator change with distance?** The strength of the voltage decreases the further the generator is from the solenoid however the frequency does not change.

## Question in the Lab Manual

**Pick the correct statement.**

**1. The electric field forms a pattern that is clockwise when viewed along the direction of the B vector of the changing magnetic field.**

**2. The electric field forms a pattern that is counterclockwise when viewed along the direction of the B vector of the changing magnetic field.**

**3. The electric field forms a pattern that is clockwise when viewed along the direction of the $\Delta$B vector of the changing magnetic field.**

**4. The electric field forms a pattern that is counterclockwise when viewed along the direction of the $\Delta$B vector of the changing magnetic field.**

The third answer is correct, The electric field forms a pattern that is clockwise when viewed along the direction of the $\Delta$B vector of the changing magnetic field. Lenz's law states that the induced current is equal to the - amount of coils times the change in magnetic flux divided by the change in time. Since the magnetic flux needs to have change in order to induce a current or electric field so that rules out the first two definitions. The electric field is positive because the magnetic field is going into the page making the magnetic flux negative. In addition using the right hand rule the current is moving clockwise.

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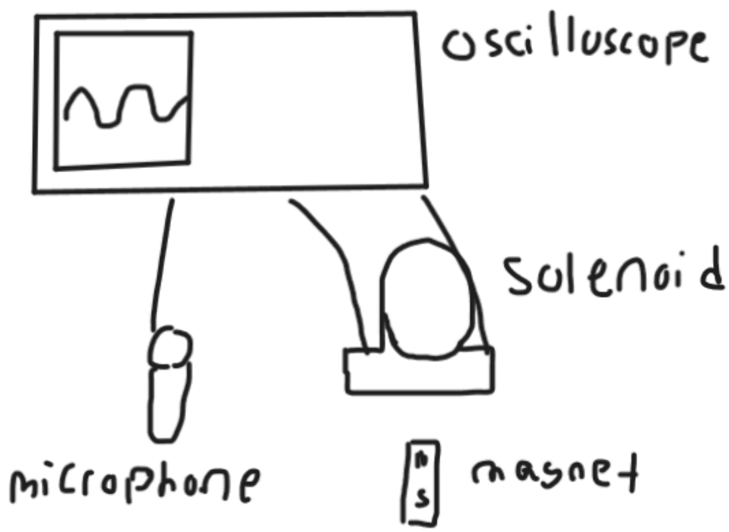


Schematic Diagram