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Faraday's Law~~Lab Title~~

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PES 215 Report

Lab Station:

Objective

The purpose of this lab was to examine Faraday's Law of Induction to determine how Electo-motive Force (potential) is generated from the change of a magnetic field though a closed loop (i.e. Experimental verification of the Flux Rule).

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This day has been a long time coming, but it is finally time for you to leave the nest and try writing the reports on you own!

Data and Calculations

Part A – The Flux Rule:

Part 1:

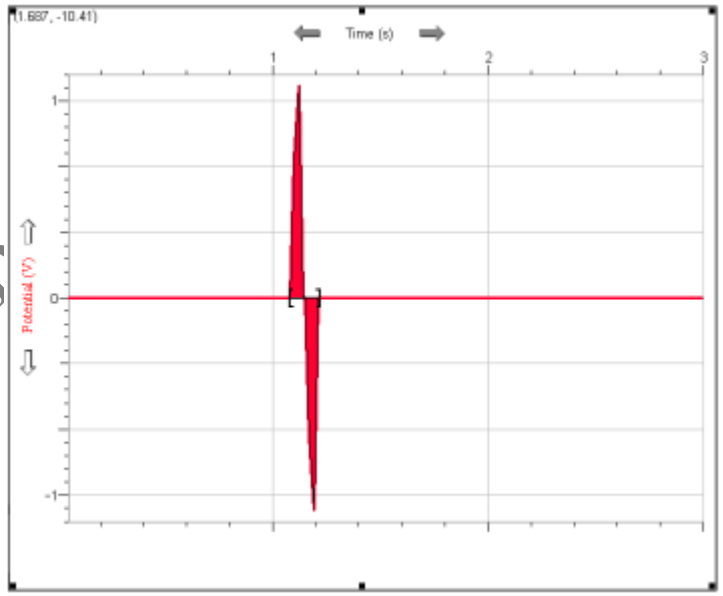

Figure 1: South End of Magnet Dropped Through Loop First

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During the execution of the experiment it was noticed that there were 2 peaks for each drop. The first peak was the potential created from the south end of the magnet passing though the coil the second peak was the potential created form the north end of the magnet passing though the coil.

It was also noticed that the outgoing peak was slightly larger than the first – this was due to the fact that the magnet had gained additional velocity over that short duration of that fall.

Similarly, the outgoing peak's delta time was slightly narrower than the first peak because there was a greater change in velocity over time than when the magnet approached the coil.

When the magnet first approached the coil the south end first passed though the coil. Traditionally the south mono-pole of a magnet is given a negative magnitude. Since the EMF as a function of flux is negative, the 2 negatives cancel giving a positive EMF. Likewise, as the north end passed through the coil; traditionally the north mono-pole of a magnet is given a positive magnitude. This means that this creates a negative EMF.

Part 2:

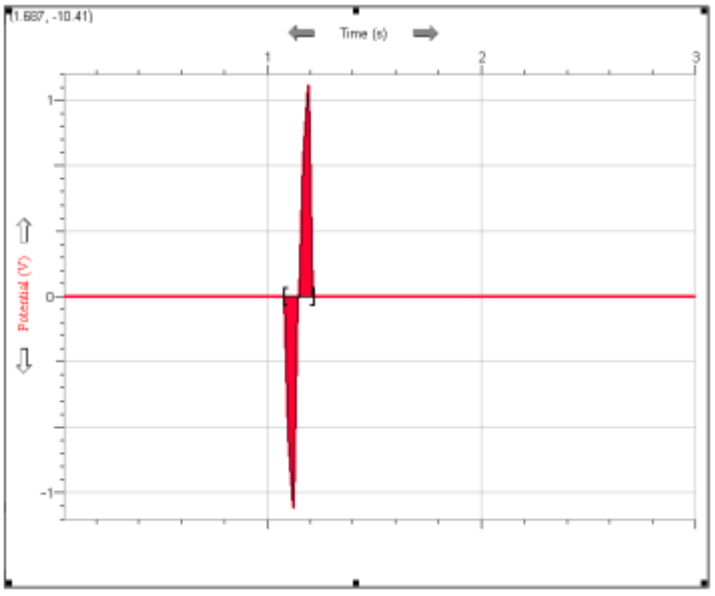

Figure 2: North End of Magnet Dropped Through Loop First

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Similarly to Part A-1, the same analysis was true.

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Part 3:

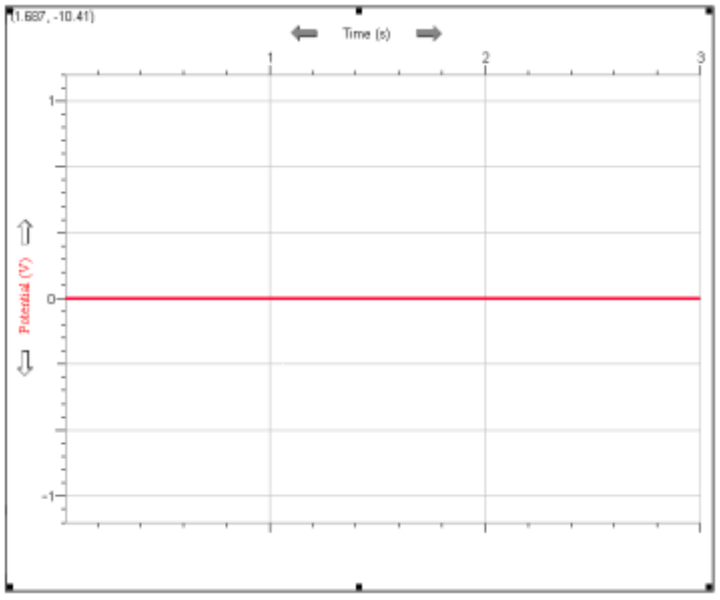

Figure 3: Magnet Held Still Inside Loop

When the magnet was held still inside the loop, there was no EMF created. This is due to the fact that if there is no movement of the magnet, there is not change in flux; and the absence of a change in flux with respect to time (i.e., equal to zero) means the EMF will also be zero.

The following table is a list of the combined results from parts A1 though A3:

	1st Peak Width [sec]	2nd Peak Width [sec]	1st Peak Max/Min Potential [V]	2nd Peak Max/Min Potential [V]	Area Under Peak 1 [V-sec]	Area Under Peak 2 [V-sec]	% difference	Area Under Entire Range [V-sec]
Dropped South End First	0.048	0.052	0.0417	-0.457	0.008015	-0.008943	11.578%	-0.009618
Dropped North End First	0.046	0.044	-0.404	0.475	-0.008977	0.008152	9.190%	-0.001061
Held Still	0	0	0	0	0	0	0	0

Part B: Peak Voltage and Speed:

We dropped the magnet North side first thought the coil from different heights. Using logger pro we got the following data for all 6 different heights:

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	Height [m]	1st Peak Max/Min Potential [V]	2nd Peak Max/Min Potential [V]	Area Under Peak 1 [V-sec]	Area Under Peak 2 [V-sec]	% difference	Area Under Entire Range [V-sec]
Top Hole	0.74	-0.555	0.656	-0.008750	0.008614	1.554%	-0.0001734
2nd Hole	0.67	-0.526	0.622	-0.008796	0.008595	2.2285	-0.0001730
3rd Hole	0.59	-0.506	0.597	-0.008853	0.008629	2.530	-0.0002667
4th Hole	0.51	-0.462	0.514	-0.008840	0.008037	9.084	-0.001362
5th Hole	0.43	-0.433	0.510	-0.008758	0.008411	2.581	-0.0002675
6th Hole	0.365	-0.389	0.480	-0.008740	0.008532	2.380	-0.0003059

Using the velocity as a function of height we calculationed the following table:

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$$v = \sqrt{2gh}$$

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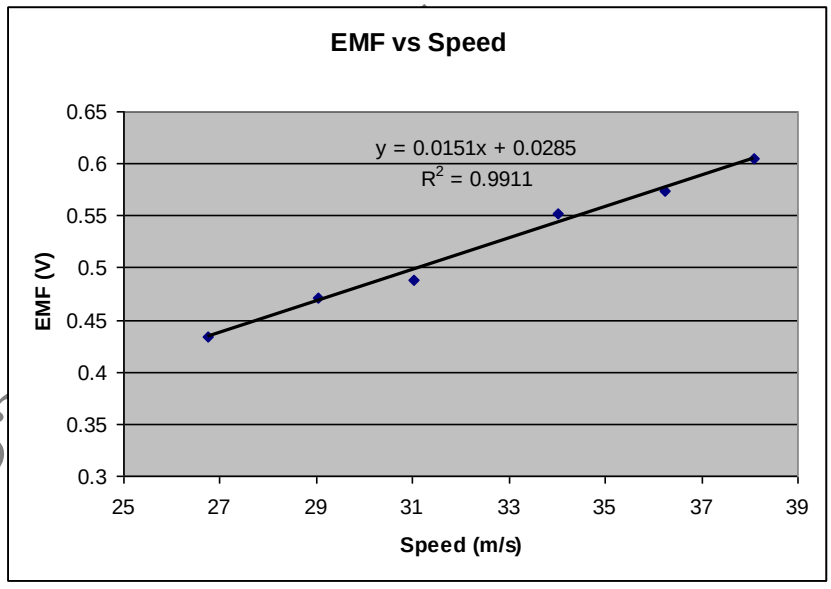
	Height [m]	Speed [m/sec]	Average of 1st and 2nd Peak Potentials [V]
Top Hole	0.74	38.0841	0.6055
2nd Hole	0.67	36.2381	0.574
3rd Hole	0.59	34.0059	0.5515
4th Hole	0.51	31.0310	0.488
5th Hole	0.43	29.0310	0.4715
6th Hole	0.365	26.7470	0.4345

Plotting EMF versus speed gave the following graph:



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As suspected, the graph of the speed of the magnet versus the average peak foltage is linear. In the pre-lab, we started with the flux rule, and showed that the EMF is linear with the speed v of the magnet:

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$$\varepsilon = -NA\frac{dB}{dx}v$$

where A is the area enclosed by the loop, N is the number of turns in the loop, and dB/dx is the spatial variation of the magnetic field.

Results and Conclusions:

You write the details. ← Include your answer here. Use complete sentences!!!!

** NOTE: There are several components of error which could significantly modify the results of this experiment. Some of these are listed below:

- Tilt/Tumble
- Simple Harmonic Motion
- Earth's Magnetic Field
- Computer Interference
- Dropped Magnet
- Ferromagnetism of Material
- ??

It is recommended that you take these and explain the "***why***" part of each for your results and conclusions sections – and possibly what could have been done (if anything) to minimize the effects of these errors.

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~~**Additional Questions**~~

~~□question 1~~

~~Conclusion~~

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