

Investigation of an Electromagnet

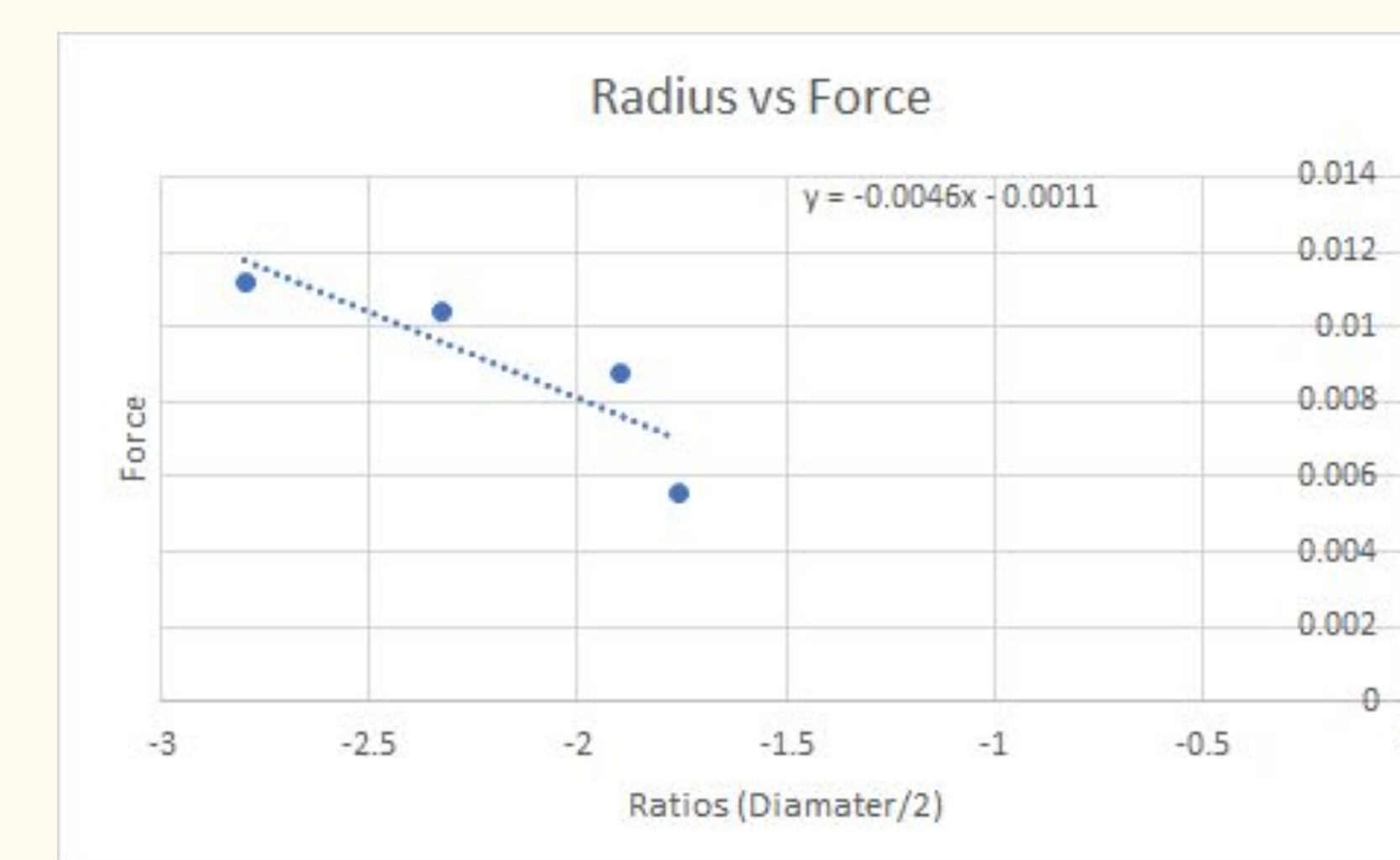
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Introduction

The main point of this experiment is to investigate an electromagnet and determine what exactly affects its magnetic field. So a master equation can be formulated. The parts that will be studied are number of nails, length of solenoid, number of turns, and number of batteries.

Tables & Graphs

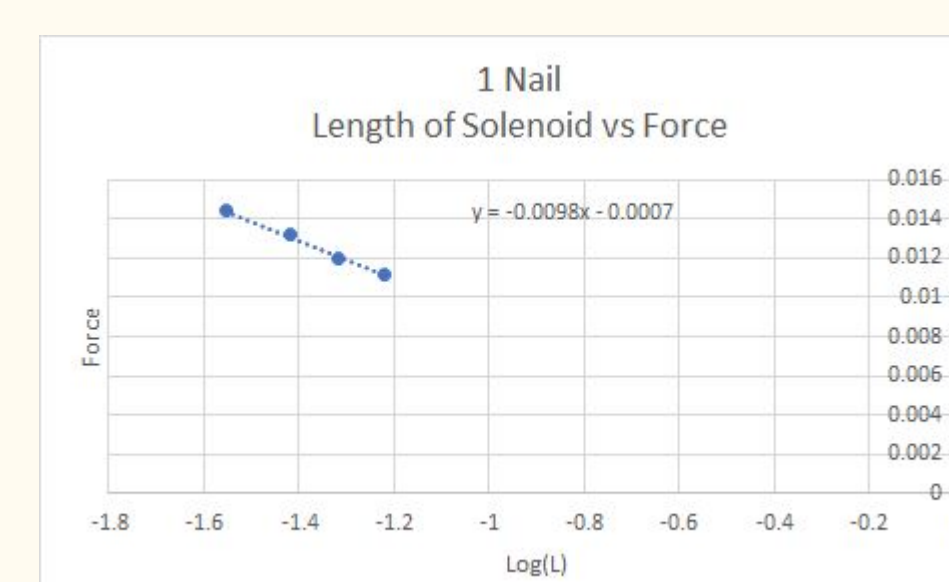
Part 1					
Number of Nails	1	3	5	7	9
Avg Diameter (m)	0.003175 m	0.009525 m	0.01905 m	0.0254 m	0.034925 m
Number of Turns	20	20	20	20	20
Length of Solenoid (m)	0.060325 m	0.060325 m	0.060325 m	0.060325 m	0.060325 m
Voltage	1.5	1.5	1.5	1.5	1.5
Current	2.5 amp	2.5 amp	2.5 amp	2.5 amp	2.5 amp
Number paper clips	28	26	22	19	14
Weight paperclips (kg)	0.0112 kg	0.0104 kg	0.0088 kg	0.0076 kg	0.0056 kg
Heads	Y	Y	Y	Y	Y
Tails	Y	Y	Y	Y	Y



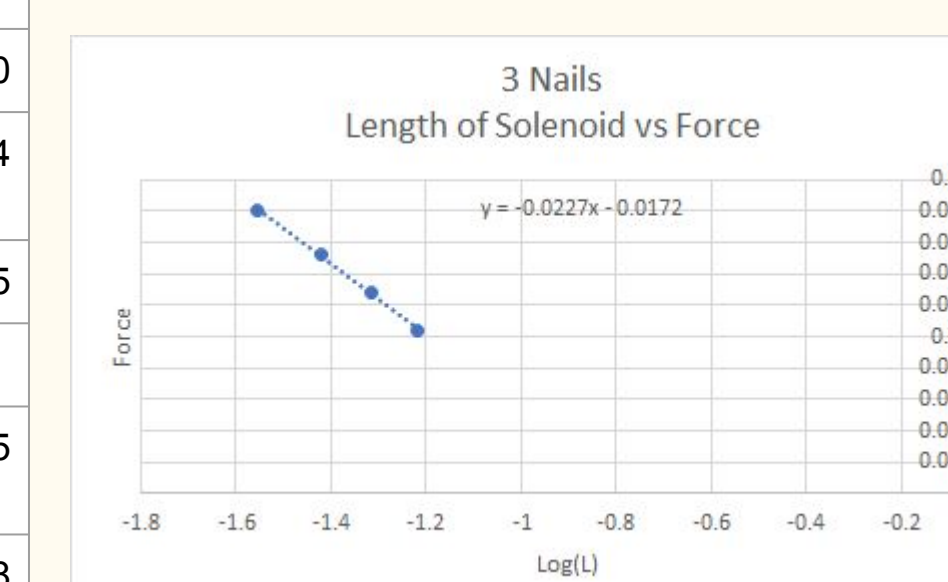
Materials

- 28 AWG magnet wire
 - D or C batteries
- 3 inch fluted nails
 - Paper clips
 - Food scale
- Wire cutters
- Sand paper
- Electrical tape

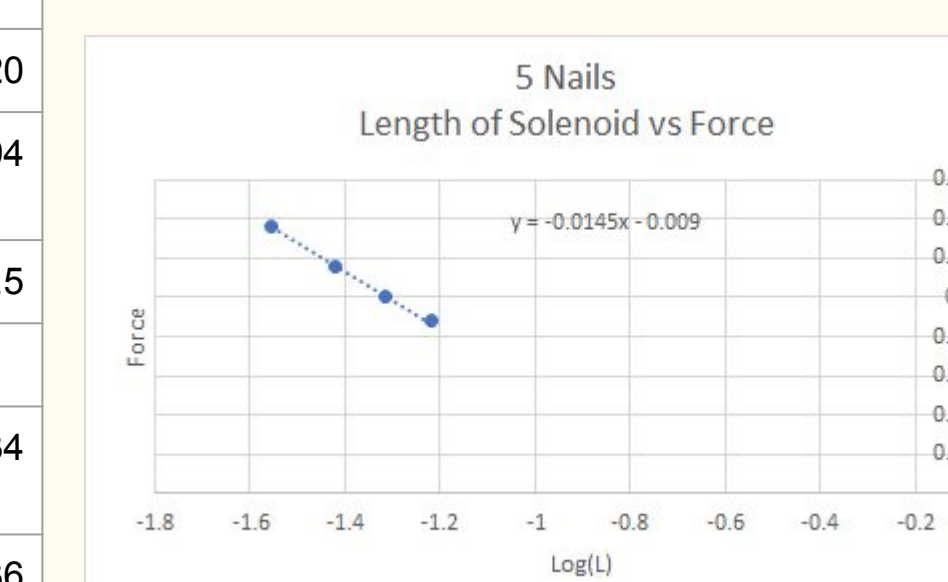
1 Nail				
Avg Diameter	0.003175	0.003175	0.003175	0.003175
# of Turns	20	20	20	20
Length Solenoid	0.060325	0.04826	0.0381	0.02794
Voltage	1.5	1.5	1.5	1.5
Current	2.5 amp	2.5 amp	2.5 amp	2.5 amp
# paperclips	28	30	33	36
Weight paperclips	0.0112 kg	0.012	0.0132	0.0144
Heads	Y	Y	Y	Y
Tails	Y	Y	Y	Y



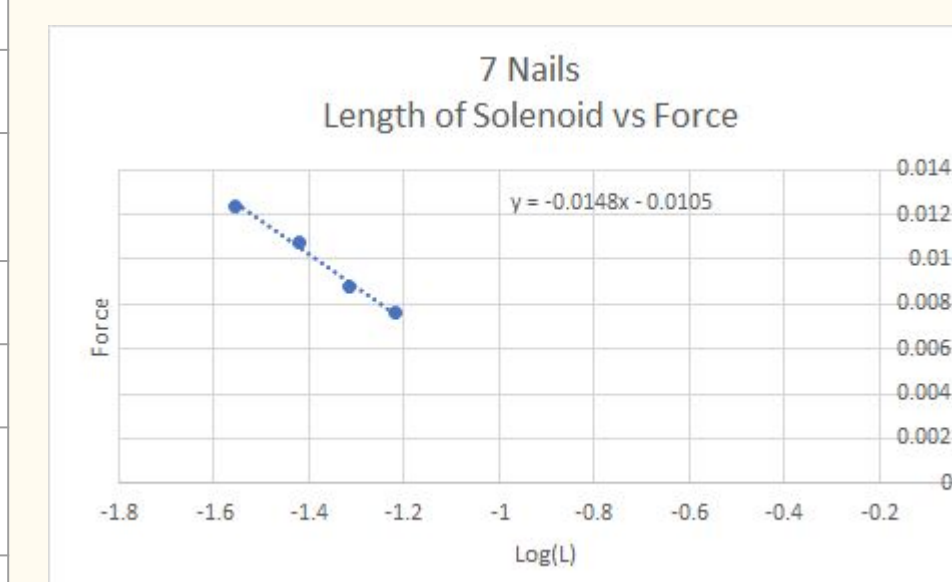
3 Nail				
Avg Diameter	0.009525	0.009525	0.009525	0.009525
# of Turns	20	20	20	20
Length Solenoid	0.060325	0.04826	0.0381	0.02794
Voltage	1.5	1.5	1.5	1.5
Current	2.5 amp	2.5 amp	2.5 amp	2.5 amp
# paperclips	26	32	38	45
Weight paperclips	0.0104	0.0128	0.0152	0.018
Heads	Y	Y	Y	Y
Tails	Y	Y	Y	Y



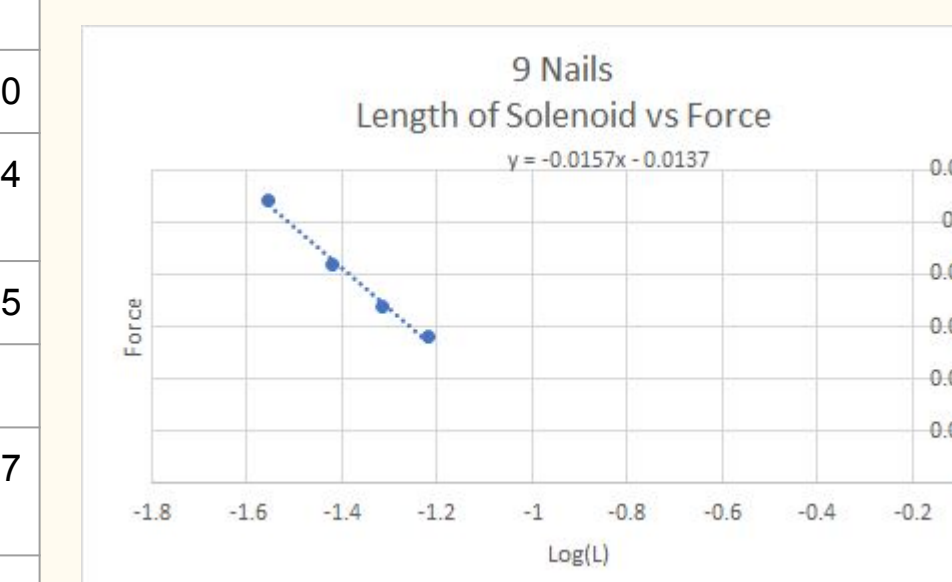
5 Nail				
Avg Diameter	0.01905	0.01905	0.01905	0.01905
# of Turns	20	20	20	20
Length Solenoid	0.060325	0.04826	0.0381	0.02794
Voltage	1.5	1.5	1.5	1.5
Current	2.5 amp	2.5 amp	2.5 amp	2.5 amp
# paperclips	22	25	29	34
Weight paperclips	0.0088	0.01	0.0116	0.0136
Heads	Y	Y	Y	Y
Tails	Y	Y	Y	Y



7 Nail				
Avg Diameter	0.0254	0.0254	0.0254	0.0254
# of Turns	20	20	20	20
Length Solenoid	0.060325	0.04826	0.0381	0.02794
Voltage	1.5	1.5	1.5	1.5
Current	2.5 amp	2.5 amp	2.5 amp	2.5 amp
# paperclips	19	22	27	31
Weight paperclips	0.0076	0.0088	0.0108	0.0124
Heads	Y	Y	Y	Y
Tails	Y	Y	N	Y



9 Nail				
Avg Diameter	0.034925	0.034925	0.034925	0.034925
# of Turns	20	20	20	20
Length Solenoid	0.060325	0.04826	0.0381	0.02794
Voltage	1.5	1.5	1.5	1.5
Current	2.5 amp	2.5 amp	2.5 amp	2.5 amp
# paperclips	14	17	21	27
Weight paperclips	0.0056	0.0068	0.0084	0.0108
Heads	Y	Y	Y	Y
Tails	Y	Y	N	N



Procedure

Step 1: number of nails

- Wrap 1 nail with 20 turns of the wire
- Measure Length and Diameter of the coil
- Connect battery and pick up paperclips
- Repeat above for 3, 5, 7, and 9 nails

Step 2: length of solenoid

- Using the models from part one decrease the length of the coil by 80%
- Run the experiment
- Decrease the coil at least 2 more times and run the experiment
- Repeat for 3, 5, 7, and 9 nail bundles.

Analysis

The entire experiment could not be completed but for the parts that could be found are R and L. R is $1/R^{0.0046}$ and L was averaged from the multiple nail bundles to be $1/L^{0.0155}$.