LAB 4 Report (Magnetism)

Abstract

This experiment tries to discover the variation and strength of a bar magnet's magnetic field by measuring it with a compass and using the power law relationship B ∝ r^P. The magnet is placed at different distances from the compass in order to map out a relationship between field strength and deflection angle. The second part of the experiment is to make a hypothesis about using the Hall effect magnetometer, which is a way of measuring a magnetic field by passing an electric current through a substance and measuring the force exerted on the moving charges by the magnetic field around it. The experiment involves the careful manipulation of currents through the solenoids in order to cancel their fields at the probe position and obtain the data. The conclusion of the experiment is to be able find how the magnetic field of a magnet changes with the distance. In order to predict this I used the power law relationship in order to find P in B ∝ r^P. In which the P was found to be -2.504 for part A and for part B -2.560.

Procedure

The material needed in this lab are a bar magnet, compass, Hall effect magnetic field probes, LabPro interfaces, DC power supplies, and USB cables, 2-meter stick, Heath solenoids, power supply, wood blocks, two multimeters, D-cell batteries and a resistor box. For part A of the experiment, is to measure the deflection of a compass at multiple points from a magnet, the first measurement should be 45 degree between the magnetic field of the earth and the magnet. For the second part of the lab, first connect the probe to CH 1 of the LabPro interface and plug it into the computer's USB port and start Logger Pro to display magnetic fields in millitesla. Next set up the two solenoids with the two power supplies one of them fixed and adjust the voltage of both of the power supplies so the tesla in the logger pro program is zero and measure the distance and voltage and repeat 10 times in different positions.

Raw Data

Part A

r (m)	**θ(degrees)**	**θ(degrees) - 25**	**tanθ**	**p value**
0.23	70	45	1	-2.503674849
0.46	35	10	0.17632698	

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Part B

	r_f (m)	r_m (m)	vf (Volt)	vm (Volt)	$\ln(v_f/v_m)$	$\ln(r_m)$
1	0.13	0.13	2.331	8.35	-1.2759642	-2.0402208
2	0.13	0.2	4.731	39.57	-2.1239347	-1.6094379
3	0.13	0.25	2.79	39.59	-2.652535	-1.3862944
4	0.13	0.3	1.58	35.62	-3.1154824	-1.2039728
5	0.13	0.35	1.135	35.63	-3.4465553	-1.0498221
6	0.13	0.4	1.071	49.98	-3.8430301	-0.9162907
7	0.13	0.45	0.769	49.99	-4.1744873	-0.7985077
8	0.13	0.5	0.449	43.78	-4.5799095	-0.6931472
9	0.13	0.55	0.347	46.3	-4.8935725	-0.597837
10	0.13	0.6	0.241	41.17	-5.1406682	-0.5108256

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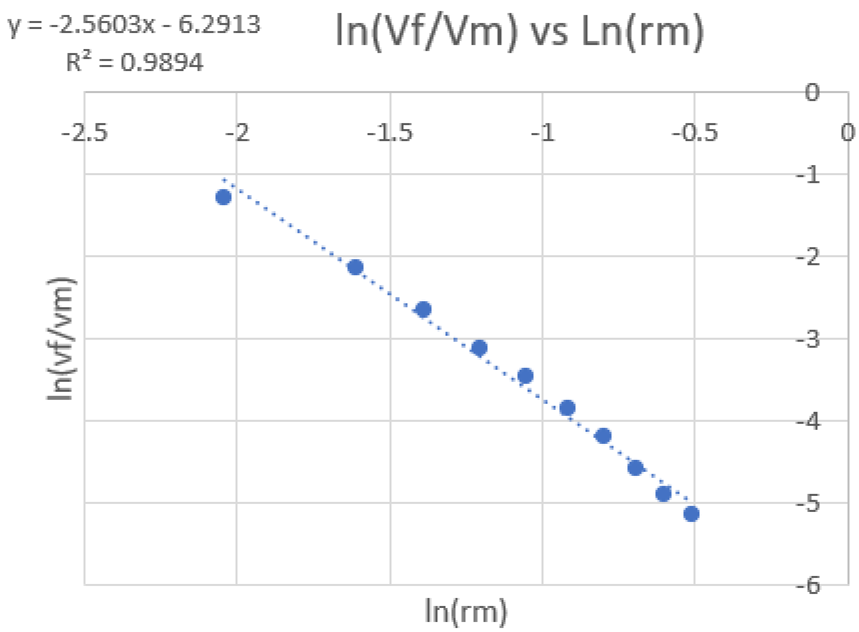
Graph



Calculation and Reasoning

For part A In order to get the p from the power law relationship of B ∝ r^P or in this case $\frac{Bmg(2r)}{Bmg(r)} = (\frac{2r}{r})^P$ where Bmg represents the tan of the angle and r represents the radius of the compass to the magnet. So plugging in the numbers $\frac{tan(45)}{tan(10)} = 2^P$. Solving for P would get $P = \frac{ln(\frac{tan(45)}{tan(10)})}{ln(2)}$. Solving the equation would get P to be equal to -2.504.

For part B in order to get the P value I would have to make a graph of log(rf divided by rm) vs the log of the radius rm and the slope of it would be the P value which is -2.560. Which is very close to the P value of part A.