5-2-14

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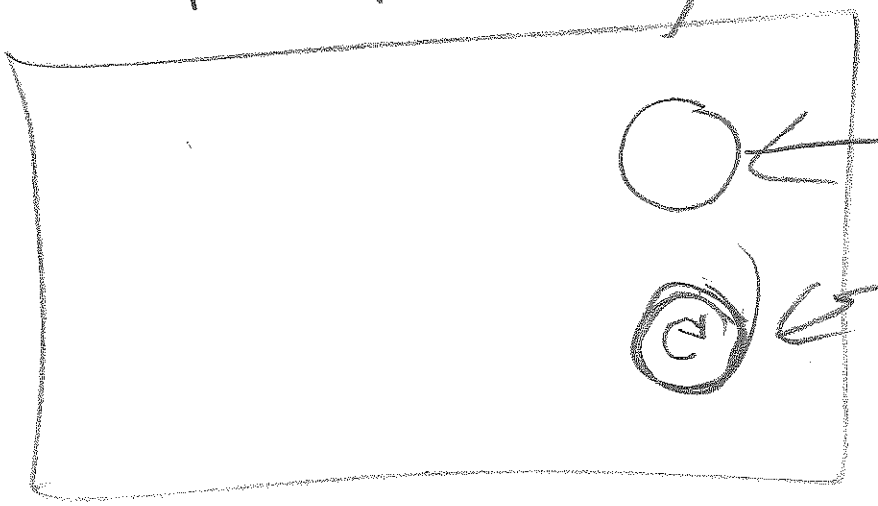
Important Lab

NOTE: Slinky PT2a

Power Supply



Lab report

analysis questions

4 – 11

Extensions: 1 – 5 and 7

ANALYSIS

1. Plot a graph of magnetic field B *vs.* the current I through the solenoid. Use either Graphical Analysis or graph paper.
2. How is magnetic field related to the current through the solenoid?
3. Determine the equation of the best-fit line, including the y-intercept. Note the constants and their units.
4. For each of the measurements of Part II, calculate the number of turns per meter. Enter these values in the data table.
5. Plot a graph of magnetic field B *vs.* the turns per meter of the solenoid (n). Use either Graphical Analysis or graph paper.
6. How is magnetic field related to the turns/meter of the solenoid?
7. Determine the equation of the best-fit line to your graph. Note the constants and their units
8. From Ampere's law, it can be shown that the magnetic field B inside a long solenoid is

$$B = \mu_0 nI$$

where μ_0 is the permeability constant. Do your results agree with this equation? Explain.

9. Assuming the equation in the previous question applies for your solenoid, calculate the value of μ_0 using your graph of B *vs.* n.
10. Look up the value of μ_0, the permeability constant. Compare it to your experimental value.
11. Was your Slinky positioned along an east-west, north-south, or on some other axis? Will this have any effect on your readings?

EXTENSIONS

1. Carefully measure the magnetic field at the end of the solenoid. How does it compare to the value at the center of the solenoid? Try to prove what the value at the end should be.
2. Study the magnetic field strength inside and around a toroid, a circular-shaped solenoid.
3. If you have studied calculus, refer to a calculus-based physics text to see how the equation for the field of a solenoid can be derived from Ampere's law.
4. If you look up the permeabilty constant in a reference, you may find it listed in units of henry/meter. Show that these units are the same as tesla-meter/ampere.
5. Take data on the magnetic field intensity *vs.* position along the length of the solenoid. Check the field intensity at several distances along the axis of the Slinky past the end. Note any patterns you see. Plot a graph of magnetic field (B) *vs.* distance from center. Use either Graphical Analysis or graph paper. How does the value at the end of the solenoid compare to that at the center? How does the value change as you move away from the end of the solenoid
6. Insert a steel or iron rod inside the solenoid and see what effect that has on the field intensity. Be careful that the rod does not short out with the coils of the Slinky. You may need to change the range of the Magnetic Field Sensor.
7. Use the graph obtained in Part I to determine the value of μ_0.