**General Physics eJournal 6**

**Magnetic Fields**

**Instructions:**

Follow the Writeup and fill out the eJournal as you complete the lab activities. Submit your eJournal report by uploading the completed WORD or PDF document to our class Learninghub site. If the Learninghub site is down, email the completed report file directly to a lab TA.

**Preliminaries:**

* Title:
* Name(s):
* Date:
* Time In & Out:

**Plan:**

**Hypothesis**

Predict the shape of the field of the bar magnet, assuming a magnetic dipole. Sketch the predicted field and insert a photo of your sketch.

*Insert image of your sketch*

Form a hypothesis regarding the magnetic field produced by a current loop.

**Experiment Outline**

Briefly describe your plan for testing your hypothesis.

**Equipment List**

* List
* Equipment
* Here

**Action:**

Describe the techniques used to collect data by responding to the bullet point questions:

* How did you trace a single magnetic field line from the bar magnet?
* How did you begin additional magnetic field lines from the bar magnet?
* How did you record the background magnetic field strength, Bz0?
* How did you record the net field, Bz, when current was flowing through the coil?
* How did you measure the coil current?
* How did you adjust the coil current?

*Insert labeled image of your apparatus*

**Results:**

Insert a picture of your bar magnet field mapped out on paper.

*Insert image of your bar magnet field*

Record the diameter, D, of your coils in meters, and divide by 2 to get the radius, R.
Record the number, N, of turns in the coil (see equipment list).

Coil Diameter, D = \_\_\_\_\_\_\_\_\_\_\_\_ m

Coil Radius, R = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ m

Coil Turns, N = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turns

Insert a sample screenshot of a magnetic field measurement from the Phyphox app.

*Insert sample screenshot of magnetic field measurement*

Fill in the current measurements, I, and magnetic field measurements, Bz, in Table I.

**Table I: Resistance, Current, and Bz for the magnetic field of a coil**

|  |  |  |
| --- | --- | --- |
| **Resistance (Ω)** | **I (mA)** | **Bz (μT)** |
| ∞ | 0 | Bz0 =  |
| 160 |  |  |
| 120 |  |  |
| 82 |  |  |

**Analysis:**

Generate a plot of Bz (y-axis) vs. I (x-axis). Apply a linear fit and record the absolute value of the slope, |m|, and the y-intercept, b. Convert the slope into SI units.

*Insert graph of Bz vs I*

**Table II: Slope (original units and SI units) and y-intercept (original units)**

|  |  |  |
| --- | --- | --- |
| **Slope, |m| (μT/mA)** | **Slope, |m| (T/A)** | **y-int, b (μT)** |
|  |  |  |

Use Eq. (4) with the unit-converted slope, coil radius, and number of turns to determine your measured permeability of free space, μ0 meas. Compare μ0 meas to the generally accepted value, μ0 = $4π×10^{-7} T∙m/A$, by calculating the percent error.

**Table III: Permeability of Free Space, μ0**

|  |  |  |
| --- | --- | --- |
| **μ0 (T∙m/A)** | **μ0 meas (T∙m/A)** | **% Error** |
| 4π x 10-7 |  |  |

Compare the measured background field strength from Table I, Bz0, with the y-intercept, b, by calculating the percent difference.

**Table IV: Background Magnetic Field Strength, Bz0**

|  |  |  |
| --- | --- | --- |
| **Bz0 (μT)** | **y-int, b (μT)** | **% Difference** |
|  |  |  |

**Conclusion:**

Interpret your results in light of your hypothetical predictions. How well did your hypotheses agree with the measured results? How might you improve this experiment or explore it further? Could you expect improved results for μ0 if you could allow more current to flow?