Department of Physics

Worksheet for Lab 5: Magnetism

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Date:

Use this sheet to enter and submit your answers to the questions asked in the gray boxes on the Lab Instructions document. When you have completed this worksheet, save this file as a .pdf and upload the pdf to the canvas assignment associated with this lab. If you have any trouble converting to a pdf, please ask you Lab Instructor or Lab Assistant.

Remember to use complete sentences and that these text boxes will increase in size as you add more content.

Based on the data that you took today, write and answer the questions in the following sections. Remember that even though you will have the same data as your partner, the writing in these sections should be done individually.

Earth's Magnetic Field

What is your measured magnetic field strength and direction? How does this compare to a published value of 52 microTesla?

The direction of the magnetic field was measured in the North, and the magnetic field strength would be 0.037mT, which could be rewritten as 37µT. The maximum magnetic field was 0.015mT, and the min was -0.022mT. Therefore, the percent error was around 30.

As the Earth's magnetic field usually varies between 25 µT and 65 µT, averaging the extremes of the field strength would give us a constant value which could be used as an approximation, considering the extremes.

Magnetic Field in a Solenoid

Tables and Raw Data

Current (I)	Distance	Mean (Magnetic Field)	Uncertainty (Magnetic Field)
0.30860	0	-3.138	0.00633
0.30870	5	-3.304	0.00399
0.30870	10	-3.009	0.01423
0.30860	15	-3.101	0.00218
0.30860	20	-2.201	0.00302
0.30861	25	-2.328	0.00342
0.30860	30	-2.120	0.00258
0.30859	35	-1.912	0.00173
0.30858	40	-1.704	0.00089
0.30857	45	-1.497	0.00004
0.30856	50	-1.289	-0.00080
0.30855	55	-1.081	-0.00164
0.30854	60	-0.874	-0.00249
0.30853	65	-0.666	-0.00333
0.30852	70	-0.458	-0.00418

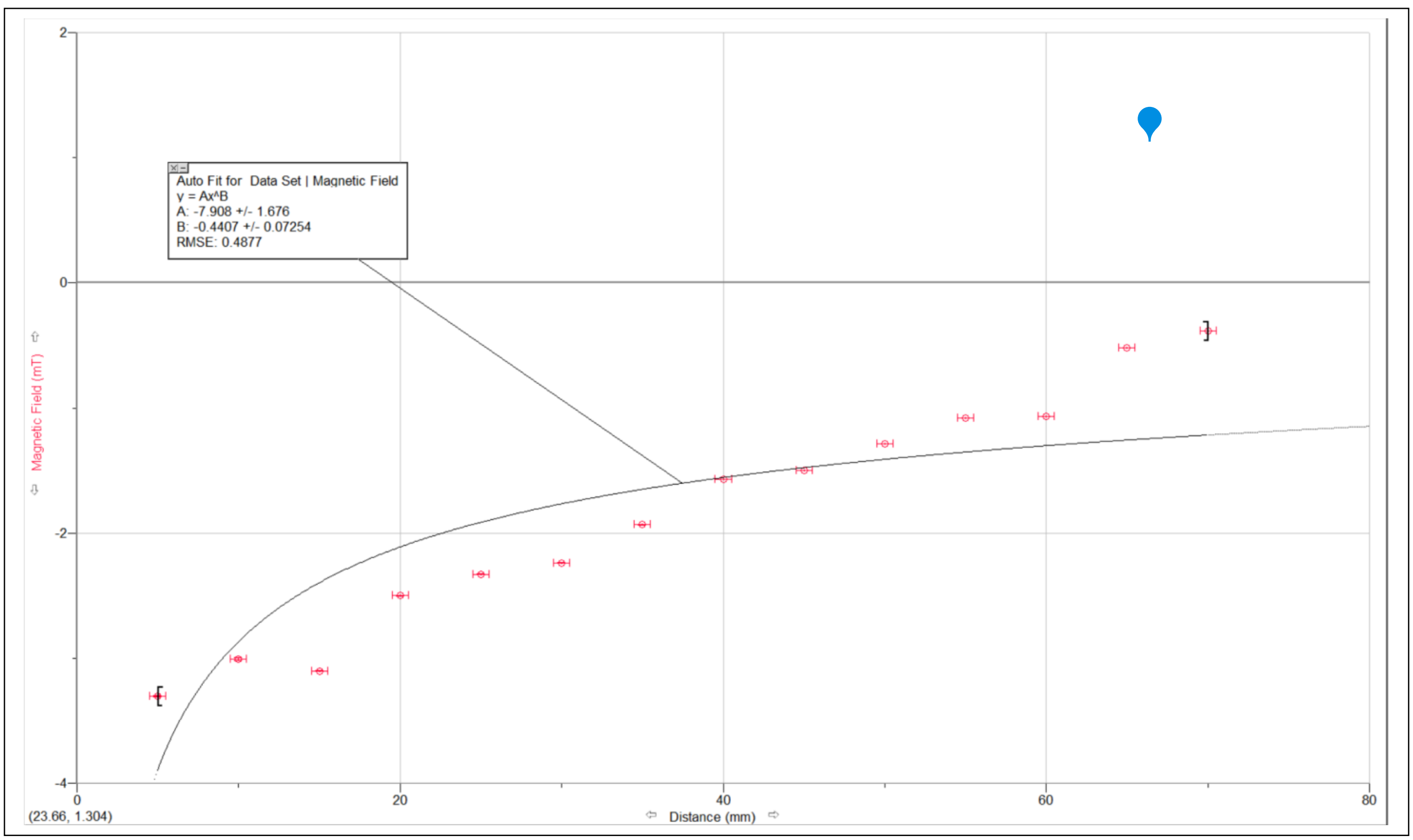
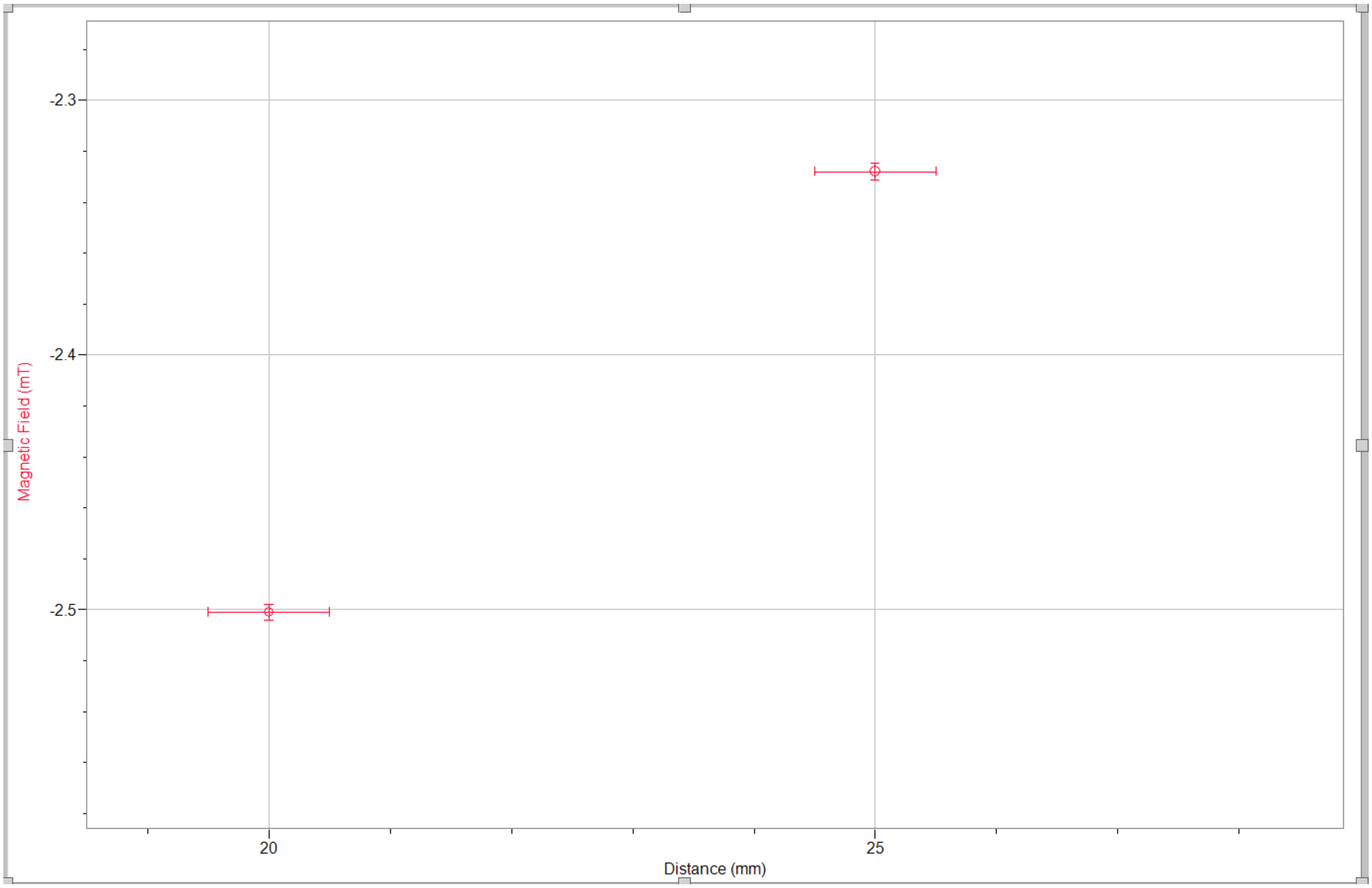


Figure: 1 – Magnetic Field (mT) vs Distance (mm)

Note:

The graph does have an error bar vertically, but it's too small visible to be visible. Therefore, a screenshot of the zoomed-up version of the data points is attached below for better reference. And as for the ruler, a constant uncertainty of +/- 0.5mm has been taken across the x-axis.



Lab Modus Operandi

The experiment is set up by connecting a solenoid to a current source to measure the magnetic field. Before turning the power supply on, the magnetic field sensor is switched to 6.5mT (This is the value for calibrating the magnetic sensors for this experiment). Once the power supply is turned on, zero the magnetic field sensors and the ammeter to avoid the error. Once zeroed, set the current to 0.3A and use the ruler to start from one end of the solenoid and gradually move it from one end (outwards), in increments of 0.5mm. More importantly, ensure that the magnetic field sensor is parallel with the ruler when taking the measurement, reducing the error involved. Between each new incremented distance, zero the magnetic field sensor.

Data Analysis

$$B = M_0 n I$$

$$n = \frac{N}{L}$$

$$n = \frac{400}{0.38m}$$

$$B = (4\pi \times 10^{-7})\left(\frac{400}{0.38m}\right)(0.3078A)$$

$$B = 4.072mT$$

Results

In general, the results suggested that the solenoid's magnetic field was stronger outside of its centre. There was a directly proportional relationship, as the trend line demonstrates. Due to the actual experiment's uncertainty, a few points of the actual experiment, there were a few points that differed from the linear trend.

Conclusion

We investigated the implications of magnetic field distance from the centre in this lab. We discovered that the magnetic field increases stronger as it moves farther from the centre and toward the poles. In order to determine whether the results are compatible with the expected trend, we also compared the trend with the theoretical calculation of the magnetic field to an ideal solenoid.

The method used to measure the magnetic field across distance may fluctuate, which is something to consider. Since this is a discrete way of collecting data, it gives rise to an unavoidable human error as the measurements are incremented manually. It could be more accurate if it were continuous, moving the magnetic field by an exact distance each time, and if there were a slider mechanism for the magnetic field sensor, it could be more accurate if it were continuous, moving the magnetic field by an exact distance each time, and perhaps if there were a slider mechanism for the magnetic field sensor, it might improve in producing correct results and reflecting the anticipated trend.