Magnetic Forces

Name:_____ Date: _____

Instructor: _____

Teammates

1.- _____ 2.- _____

3.- _____ 4.- _____

Instructions: Follow the steps on this worksheet, using your lab manual as a guide, unless directed to do otherwise by your lab instructor. Show at least one sample calculation for each step. Box final mathematical results. Do not forget the units.

1 Qualitative Observations

Magnetic Field Lines

Data

1. Explore the magnetic field surrounding the wire and sketch out the pattern of the magnetic field lines observed with the compasses. Also, indicate the direction of the electric current in your sketch.

Analysis

2. Briefly describe the right-hand rule and determine if the observed field goes around the wire in the direction predicted by this rule.

3. Give a brief description of your observations (without making guesses or speculating).

Earth's Magnetic Field

Data

4. Turn on the power supply. Use the DMM to measure the voltage across the shunt resistor, record it here and turn off the power supply. Record the resistance of the shunt resistor given in your lab manual.

5. Turn on the power supply. Use a compass to find the location along the radial to both wires where the magnetic fields are in balance. Turn off the power supply. Measure and record the distance from the closest wire, r_1, and the distance to the furthest wire, r_2.

Analysis

6. What is the current flowing through the wire?

7. Use Equation 1 to calculate the magnetic field of the Earth. The SI units for magnetic field are teslas (T). Your calculation should include a contribution from both wires.

8. Compare your result with the known value for the Earth's magnetic field written in your lab manual.

Permanent Magnet

Remove all compasses from the workspace and keep them well away from any permanent magnets. Bring over the large permanent magnet. Place one of the wires from the power supply between the poles of the magnet.

Data

9. Turn on the power supply, note the magnetic force on the wire, and sketch what happened –indicate the current's direction, the observed direction of the magnetic force, and the implied direction of the magnetic field in the gap of the magnet.

Analysis

10. Determine which pole of the permanent magnet is the north pole using the theory you know. State your reasoning and Add the polarity information to your sketch.

2 Current Balance

Data

With no current applied to the balance, mark the position where the laser beam hits the paper on the wall.

11. Turn on the variable transformer and increase the current until the forces are balanced with one of the small weights in the pan. The laser beam will return to its initial spot when this happens. Record the current. Repeat 4 times with additional weight added each trial (increments of 50 mg work well) and record all of your data in a neat table.

12. Measure and record d, the center-to-center distance between the two wires. Measure and record L, the length of the parallel bars in the current balance setup.

Analysis

13. Make a plot of the mass, m, versus the current squared, I^2. Make a linear regression fit and obtain the best-fit equation. (As your lab manual says, the best fit should be a straight line.) From the value of the slope calculate the value of μ_0. Compare with the known theoretical value.

3 Questions

1. Referencing Figure 1, explain why what is commonly called the 'North Magnetic Pole' of the Earth is really a south magnetic pole.

2. What are the units of μ_0?