**Experiment to Measure the Strength of the Earth’s Magnetic Field**

Alice

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Mr. Mason

**Problem:**

Can we use the coil to measure the strength of earth’s magnetic field?

**Variables:**

1. Independent Variable: Current I
2. Dependent Variable: Angle that the needle of compass deflected from N (horizontal component of earth’s magnetic field)
3. Constant: 1) the permeability of free space

2) coil density N

3) angle of dip

**Hypothesis:**

According to =NI, representing the permeability of free space (4), N for the coil density (100 coils per meter in the experiment), and I for current, the strength for the coil magnetic field can be measured. By placing the coil in the east-west direction and the compass horizontally, the current flowing in the coil will form a magnetic field perpendicular to the horizontal component of earth’s magnetic field . Field and field will produce a resultant filed, , indicated by the pointing direction of the compass. If we know the angle between field (N) and , we can calculate the magnitude of using the formula tan = = 0NI. And since the earth’s magnetic field strength = / cos (is the angle of dip, is equal to 69.4where the experiment takes place), can also be calculated. Therefore, it is able for us to use coils to measure the strength of the earth’s magnetic field.

**Materials:**

a. coils

b. a compass

c. a rheostat

d. 2-3 wires

e. 2 bulbs

f. a switch

g. an ammeter

**Procedure:**

1. Place the coil in the east-west direction, and then put the compass in the middle of the coil. It should be pointing N.
2. Switch the power on, use the rheostat to change the current passing through the coil. Record the current and the angle that the compass needle deflects.
3. Repeat Step 2 for another 7 times. Choose different current intensities. If necessary, also turn on the bulbs to change the current.
4. Switch off the power.

**Table:**

**Measurement of Field and tan**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Current I (A) | (degrees) | tan | ()T) |
| 1. | 0.10 | 40 | 0.839 | 1.256 [1] |
| 2. | 0.15 | 51 | 1.235 | 1.884 [2] |
| 3. | 0.19 | 58 | 1.600 | 2.386 |
| 4. | 0.275 | 66 | 2.256 | 3.454 |
| 5. | 0.33 | 70 | 2.748 | 4.145 |
| 6. | 0.54 | 78 | 4.705 | 6.782 |
| 7. | 0.95 | 83 | 8.144 | 11.932 |
| 8. | 1.22 | 86 | 14.3 | 15.323 |

**Calculations:**

[1]: = NI = 4 = 1.256 T

[2]: = NI = 4 T

**Graphs:**

tanas the x-axis, and as the y-axis

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C**onclusions:**

The line connecting the points is roughly a straight one that has a y-intercept close to the origin. Therefore, is directly proportional to tan, and is a constant which is equal to the slope of the straight line. So T, and as a result, can be calculated by = 1.43/cos (69.4) = 4.06 T. In conclusion, it is able to use the coil to measure the strength of the earth’s magnetic field, and the result is 4.06 T.

**Errors:**

The result of the experiment is far from the real strength of earth’s magnetic field. Here are possible mistakes made in the experiment:

1. The measuring of angle it is hard to measure the accurate angle using the compass and naked eyes. Improvement: the compass software on phones might be a better measuring tool.
2. The measuring of current I: the resistance of the bulb will increase as its temperature increases, according to the heating effect. Solution: change an appropriate rheostat.