Name_____BOX#_____
Date_____Per_____

AP Physics B – Measuring the Magnetic Field of the Earth

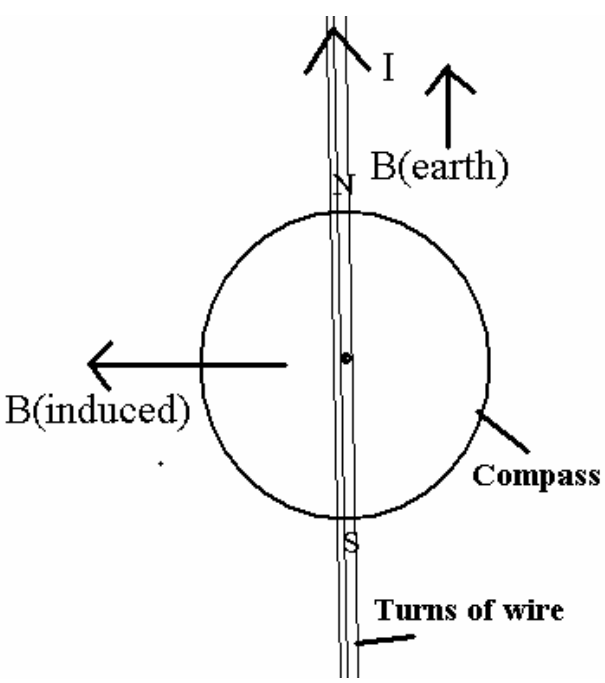
Purpose: To graphically measure the horizontal component of the earth's magnetic field

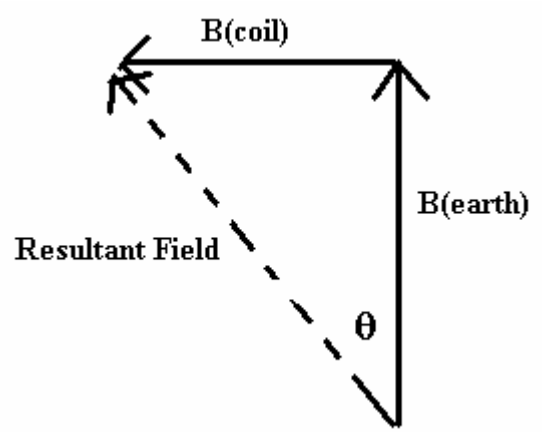
Materials: Aluminum table coil, DC power supply, compass, protractor, ammeter, 1 Ω(10 W) power resistor

Procedure:

1. **Place the compass in the center of the aluminum table.**
2. **Align the compass so that it aligns with the Earth's North and South poles as well as the coils of wire.**
3. **Record the number of coils (n) that wrap around the compass. n = _____**
4. **Attach the ammeter, dc power supply, the resistor, and the table in series with each other.**
5. **Adjust the current to a minimum value that gives you a deflection on the compass.**
6. **Measure and record this current as well as the angle at which the compass deviates from North.**
7. **Increase the current 0.5 amps and repeat step #6.**
8. **Continue to increase the current up to 4 amps.**

According to the right hand rule, when the current is turned on it sets up an induced magnetic field that is perpendicular to the direction of current. Since you lined up your wires with the earth's magnetic field, the induced field is also perpendicular to the Earth's magnetic field. The picture below illustrates the vector nature of magnetic fields.





$$Tan\theta = \frac{B_{coil}}{B_{earth}}$$

To find the magnetic field of a coil we use the formula for a solenoid.

$$B_{coil} = \mu_o nI$$

When inserted into our formula we found using vectors we have:

$$Tan\,\theta = \frac{\mu_o nI}{B_{earth}}$$

What this tells us is that if we plot the number of turns times the current on the Y AXIS and the tangent of the angle on the X AXIS we can find the slope.

$$\frac{B_{earth}}{\mu_o} = \frac{nI}{Tan\,\theta}$$

The slope times the permeability constant (4 x 10^{-7} Wb/m^2) will equal the magnetic field of the earth.

$$\frac{B_{earth}}{\mu_o} = slope$$

$$B_{earth} = slope(\mu_o)$$

Make the graph and find the slope. Calculate the magnetic field of the earth.

Calculate your % error based on U.S. Geological Survey Data provided by your instructor.