Experiment No. 8
Magnetic field of the Earth

Objective:

To measure the magnitude of the horizontal component of the earth's magnetic field.

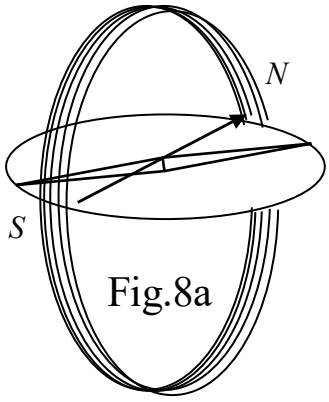
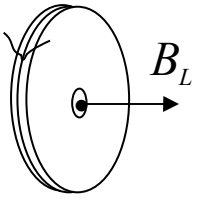


Fig.8a

Equipment:

Tangent galvanometer, multimeter, wires, power supply.

Theory:



The magnetic field produced by a circular loop of wire at its center is given by:

$$B_L = \frac{\mu_o NI}{2r}$$

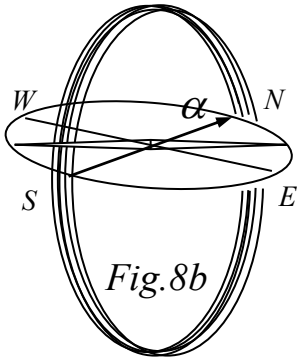


Fig.8b

where B_L is the magnetic field , μ_o is the permeability constant ($\mu_o = 4\pi .10^{-7}$ T.m /A), I is the current, N is the number of the turns, and r is the radius of the circle. The right – hand rule, gives the direction of this field. If the finger of the right hand curl in the direction of the current flow around the wire, the thumb will point in the direction of loop magnetic field at the center. This field can be used to measure an unknown magnetic field by the following manner. If the coil of the tangent galvanometer aligned with field when the current I is on , the two magnetic field will add

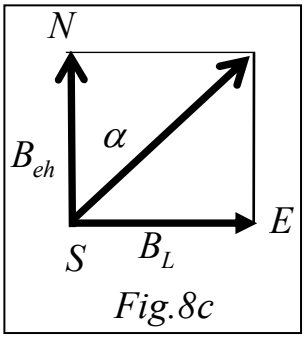


Fig.8c

to give a resultant field, the needle of **the tangent galvanometer** will **line-up** with **this resultant** field. The direction angel **α can be measured** and the magnetic field of earth B_{eh} can be calculated from:

$$tan\ \alpha = \frac{B_L}{B_{eh}} = \frac{\mu_o N I}{2rB_{eh}}, \qquad \Rightarrow \boxed{tan\ \alpha = \frac{\mu_o N}{2rB_{eh}} I},$$

Where B_{eh} is the horizontal component of the earth's magnetic field.

Plot $tan\ \alpha$ versus I, slope is $\boxed{S_1 = \frac{\mu_o N}{2rB_{eh}} \quad \Rightarrow B_{eh} = \frac{\mu_o N}{2rS_1}}$

Plot of I versus $tan\ \alpha$: $\boxed{B_{eh} = \frac{\mu_o N}{2r}\frac{I}{tan\ \alpha} = \frac{\mu_o N}{2r} \cdot S_2}$

$$S_2 = \frac{I}{tan\,\alpha} = \frac{2rB_{eh}}{\mu_o N} \quad \Rightarrow B_{eh} = \frac{\mu_o N S_2}{2r}$$

Experiment No. 8
Magnetic field of the Earth

Name: ……..… Day and Date: ……

Student's No.: …….. Sec.: ……..

Partners Names: …… ……..…….

Data and Calculation

r = 7.5 cm N = 500 turns

I (mA)							
α forward							
α reverse							
α average							
tan α							

Plot *tan* α vs. I, from the slope determine B_{eh}.