Experimental General Physics for Engineers II

Laboratory Report PHYS 194 summer 2022

Section: _L01____

Experiment name: # Earth magnetic field

Student Name:	Talha Abdullah Punjabi	Student ID	201903446

Date submitted:	13/6/2022

Table of results (1.25 pts)	
Graph (1.25 pts)	
Data analysis (2 pts)	
Discussion (0.5 pt)	
References	
Others	
Report Grade (5 pts)	

1. Geometry of the coil

Radius R of the coil: R=10 ± 0.1 cm

Number of turns n of the coil: n= 10 turns

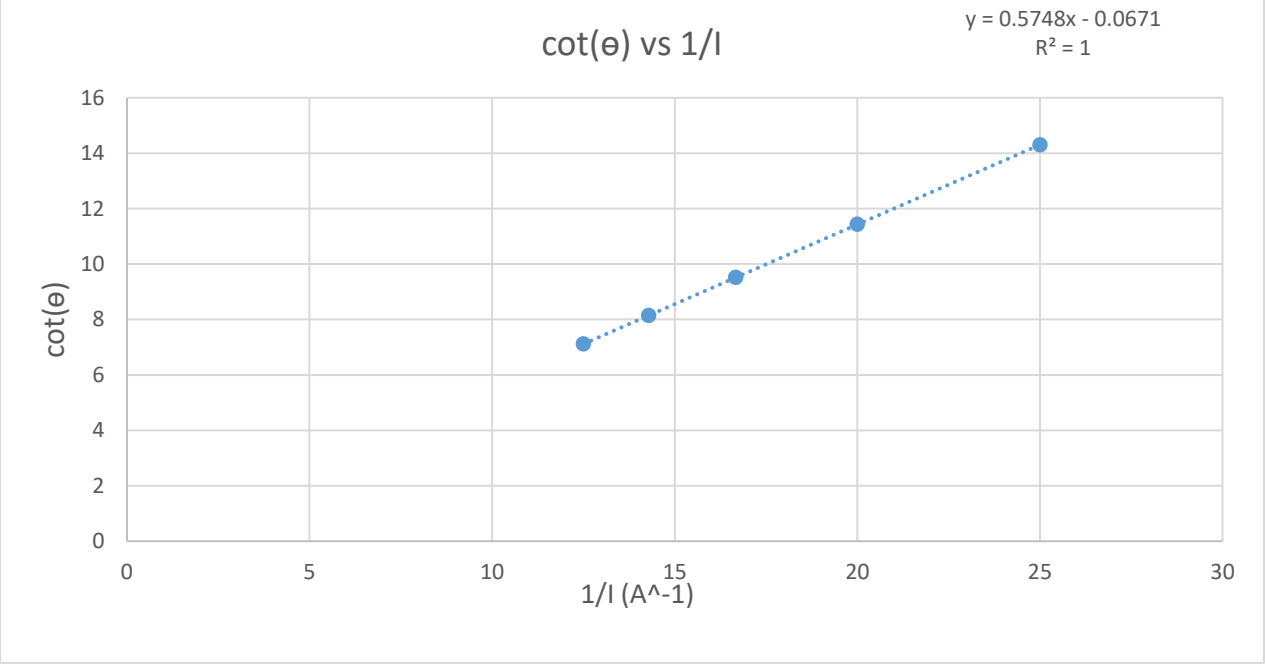
Permeability of free space μ_0 : $\mu_0 = 4\pi\ 10^{-7}$ Tm/A

2. Table of Results

I (A)	u(I) (A)	θ (°)	u(θ) (°)	θ (rad)	u(θ) (rad)	$\frac{1}{I}$ (A^{-1})	u($\frac{1}{I}$) (A^{-1})	cot(θ)	u(cot(θ))
0.04	±0.1	4	±1	0.070	±0.017	25	±625	14.30	±3.59
0.05	±0.1	5	±1	0.087	±0.017	20	±400	11.43	±2.30
0.06	±0.1	6	±1	0.104	±0.017	16.67	±277.8	9.51	±1.59
0.07	±0.1	7	±1	0.122	±0.017	14.28	±204	8.14	±1.17
0.08	±0.1	8	±1	0.140	±0.017	12.5	±156.2	7.12	±0.90

3. Graph of cot(θ) vs. $\frac{1}{I}$

Plot cot(θ) vs $\frac{1}{I}$ in Excel



4. Data analysis

4.1. Uncertainties on $\frac{1}{I}$ and cot(θ)

Show how you calculate u ($\frac{1}{I}$) and u (cot (θ))

U(I)= ±0.1 A U (θ)= ±1 degree = ± pi /180 radian = ±0.017 rad

U(1/I) = sqrt ((d(1/I)/d(I) * U(I))^2) = sqrt ((-1/I^2) * U(I))^2) = sqrt ((0.1/0.04^2)^2) = **±62.5 (A^{-1})**

U (cot (θ)) = sqrt ((d (cot (θ))/d (θ) * U (θ))^2) = sqrt ((-csc^2(θ) *U (θ))^2)

= sqrt ((-csc^2(0.07) *pi/180)^2) = **±3.58**

4.2. Slope, intercept of the graph and their uncertainties

Give the values of the slope intercept and their uncertainties

Slope = 0.574779 A

U(Slope) = ±0.000217 A

Intercept = -0.06715

U(Intercept) = ±0.003961

4.3. Value of the horizontal component of the earth's magnetic field B_h

Calculate B_h based on the value of the slope of the graph and the geometry of the coil

cot (θ) = B_h/A * 1/I slope = B_h/A

A=μ_0n/2R is constant, A= 6.28 x 10^{-5} ((Tm/A)/m)

B_h = slope * A = 0.575 * 6.28 x 10^{-5} = **3.61 x 10^{-5} T**

4.4. Uncertainty on B_h.

Calculate u(B_h) based on the value of the slope of the graph and the geometry of the coil. I.e. take u(R) into account in the calculation.

U(B_h) = sqrt((d(slope)*1.257x10^{-5}/2R)/d(slope)*U(Slope))^2+((d(slope)*1.257x10^{-5}/2R)/d(R)*U(R))^2)

= sqrt ((1.257 x 10^{-5} /2R * 0.0002)^2+((0.575*1.257x10^{-5}/2R^2 * 0.001)^2)

= sqrt ((1.257 x 10^{-8})^2+(3.61 x 10^{-7})^2)

= **±3.6 x 10^{-7} T**

4.5. Comparison with the accepted value.

Compare your results to the commonly accepted value of B_h in Doha.

| (Theoretical value – obtained value)/theoretical value | * 100

= | (3.37 x 10^{-5} – 3.61 x 10^5)/3.37 x 10^5 | * 100 = **7.16%**

5. Discussion of the result

The results in agreement with what is expected with small margin of error. With a value error percentage 7.16% different from the actual value of B_h.

Sources of error can be due to human error and inaccuracy while observing the data and while measuring the angle.

The experiment was successful with an error percentage 7.16%

6. References