Expt. No. 1 Page No.

Experiment No. 1
Magnetic field and Biot-Savart Law

Aim:

Calculation of magnetic field along the axes of a circular current carrying coil using tangent law of magnetism and determination of the radius of the current carrying coil from Biot-Savart law.

formulas used:

$$B_x = \frac{\mu_0 n I R^2}{2(x^2+R^2)^{3/2}} \quad T$$

Here, R = radius of the coil (m)
n = number of turns in the coil
I = current passing throug in the coil
x = distance of the point (magnetometer) from the centre of the coil along its axes (m)

Calculations:

$$B_x = \frac{\mu_0 n I r^2}{2(x^2+R^2)^{3/2}} \quad T$$

Teacher's Signature

Real

$$6.314 = \frac{4\pi \times 10^{-7} \times 10 \times 0.454 \times r^2}{2(a^2 + r^2)^{3/2}}$$

$$6.314 = \frac{3.14 \times 4 \times 10^{-7} \times 10 \times 0.454}{2} \times \frac{1}{r}$$

$$\Rightarrow r = \frac{3.14 \times 4 \times 10^{-7} \times 10 \times 0.454}{2 \times 6.314}$$

$$\Rightarrow r = \frac{57.0224 \times 10^{-7}}{12.628} = \underline{4.51 \text{ cm}}$$

percentage error = ~~$\frac{5 - 4.51}{5} \times 100$~~

$$\left| \frac{4.51 - 5}{5} \right| \times 100 = 9.8\% \text{ error}$$

Conclusion: The ~~rod~~ law has been verified since observed r and r taken are nearly equal.

Teacher's Signature _____

Table-1

$r = 5\,cm$

position of compass (cm)		Direct current		Reverse current		Mean θ	$\tan\theta$	$B_x = B_0 \times \tan\theta \times (10^{-5}\,T)$
		θ_1	θ_2	θ_3	θ_4			
	-14	4	-14 4	4	4	4	0.069	0.241
	-12	5	-12 5	5	5	5	0.087	0.304
LEFT	-10	11	-10 11	11	11	11	0.194	0.679
SIDE	-8	14	-8 14	15	15	14.5	0.258	0.903
	-6	24	-6 24	24	24	24	0.445	1.557
	-4	39	-4 39	39	39	39	0.809	2.831
	-2	53	-2 53	54	54	53.5	1.351	4.728
CENTER	0	61	0 61	61	61	61	1.804	6.314
	2	54	2 54	54	54	54	1.376	4.816
	4	39	4 39	40	40	39.5	0.824	2.884
RIGHT	6	24	6 24	24	24	24	0.445	1.557
	8	14	8 14	14	14	14	0.249	0.871
SIDE	10	11	10 11	11	11	11	0194	0.679
	12	5	12 5	5	5	5	0.087	0.304
	14	4	14 4	4	4	4	0.069	0.241

Table-2

$r = 8\,cm$

Position of Compass (cm)		Direct current θ_1	θ_2	Reverse current θ_3	θ_4	Means	tan θ	$B_H = B_0 \times \tan\theta$ $(\times 10^{-5})$
LEFT SIDE	-14	7	7	7	7	7	0.122	0.427
	-12	10	10	10	10	10	0.176	0.616
	-10	15	15	15	15	15	0.29	1.015
	-8	20	20	20	20	20	0.363	1.27
	-6	29	29	29	29	29	0.554	1.939
	-4	35	35	36	36	35.5	0.713	2.495
	-2	44	44	44	44	44	0.965	3.377
CENTER	0	46	46	46	46	46	1.035	3.622
RIGHT SIDE	2	43	43	43	43	43	0.932	3.262
	4	35	35	35	35	35	0.700	2.45
	6	29	29	30	30	29.5	0.565	1.977
	8	20	20	20	20	20	0.363	1.27
	10	15	15	14	14	14.5	0.258	0.903
	12	10	10	10	10	10	0.176	0.616
	14	7	7	7	7	7	0.122	0.427

Table 1

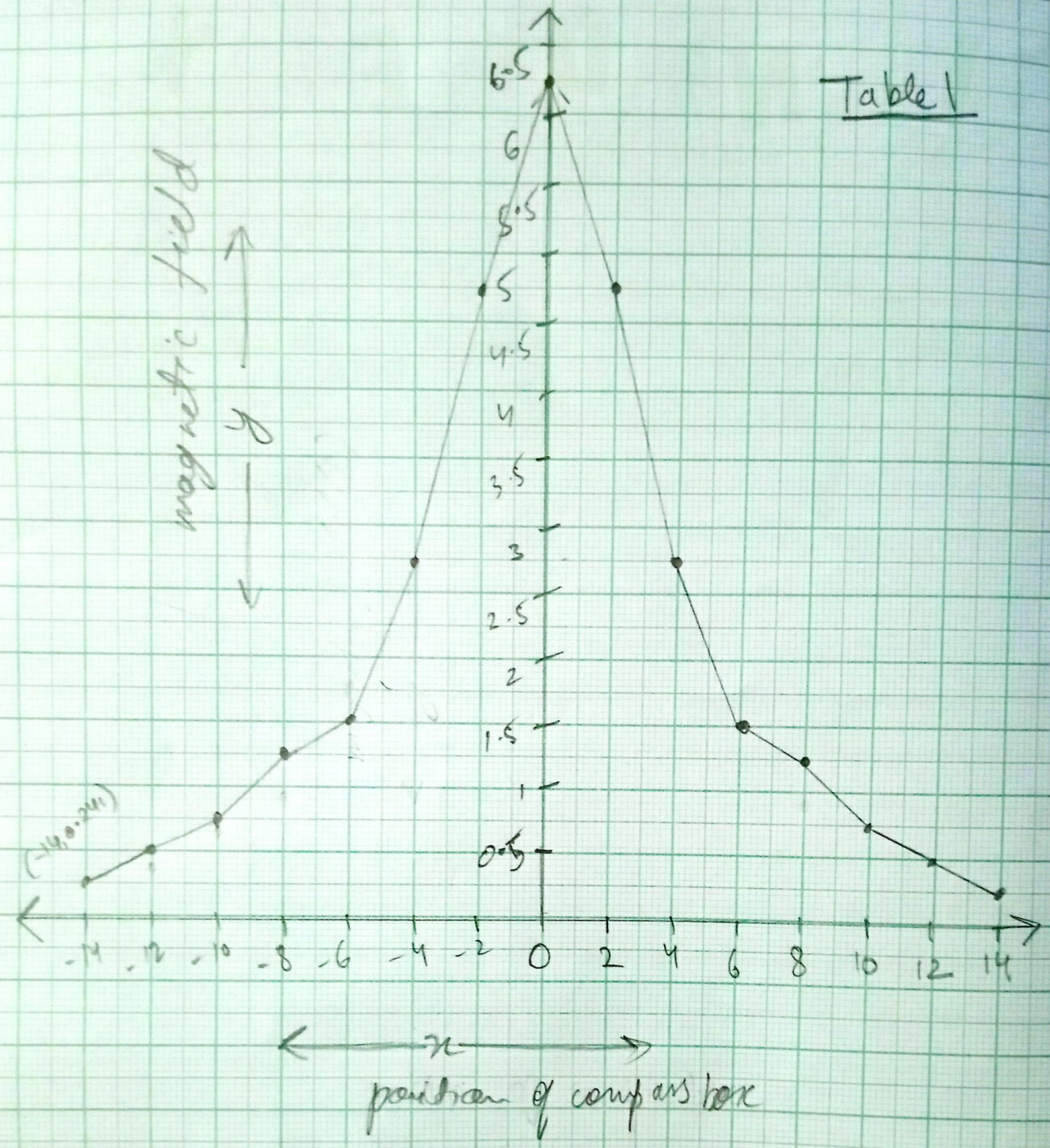
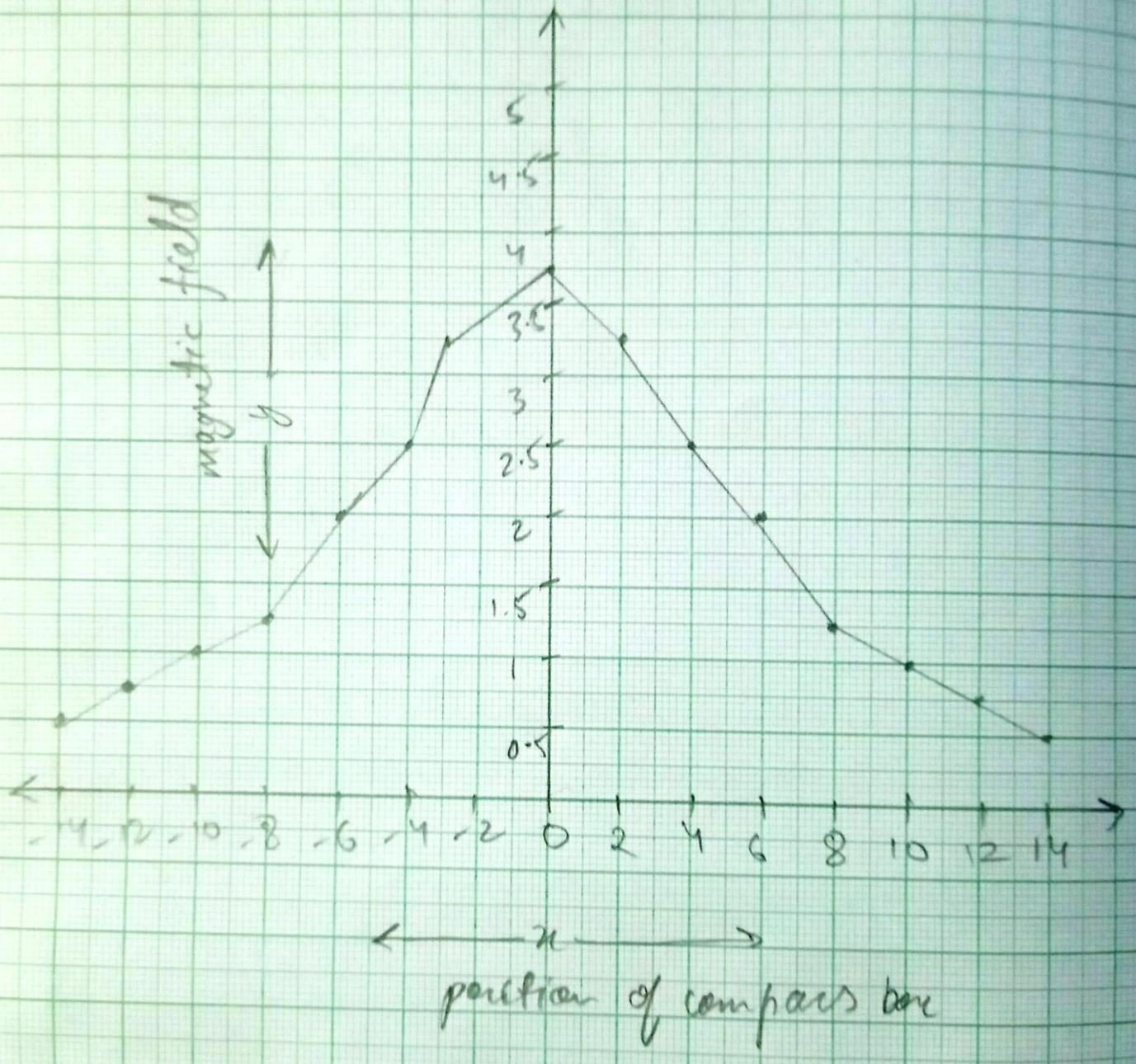

magnetic field
y
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
(-14, 0.24)
-14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14
x
position of compass box

Table 2


magnetic field
y
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
-14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14
x
position of compass bar