Hall Effect

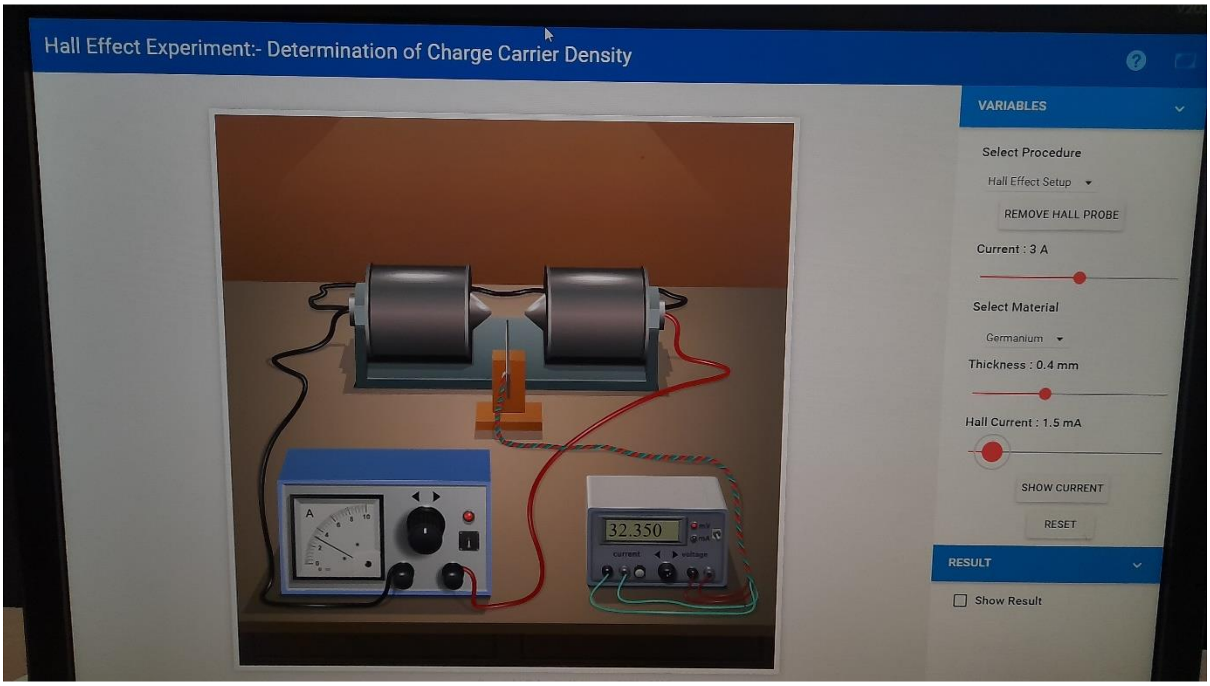
Name: Meet Gala
Roll No: 16010121051
Branch: Comps
Batch: A3

Aim:-

1. To determine Hall Voltage developed across the sample material
2. To calculate the Hall coefficient and carrier concentration of sample material.

Apparatus:- Two solenoids ,constant current supply , four probe , digital gauss meter , Hall effect Apparatus , digital millivoltmeter , hall probe.

Diagram:-



Observation Table:

Material: Germanium

Magnetic field B = 0.447 gauss = 0.0000447 tesla

Thickness t = 0.4 mm		Thickness t = 0.8 mm	
I_H mA	V_H mV	I_H mA	V_H mV
1	21.567	1	10.7
1.5	32.350	1.5	16.17
2	43.13	2	21.5
2.5	53.91	2.5	26.9
3	64.7	4	32.3
3.5	75.4	3.5	37.7
4	86.2	4	43.13
4.5	97.05	4.5	48.5
5	107.8	5	53.9

Hall Coefficient – 0.0194
Carrier Coefficient – 3.22165e+20

Calculations:-

Formula: carrier concentration $n = \frac{B}{q \times t \times slope}$

Calculations:

① for $t = 0.4\ mm = 0.4 \times 10^{-3}\ m$

Slope $(s_1) = \frac{32.350 - 21.567}{0.5} = 21.556$

$n_1 = \frac{B}{q \times t \times s_1}$

$B = 4.47 \times 10^{-5}\ T$, $q = 1.6 \times 10^{-19}\ C$

$n_1 = \frac{4.47 \times 10^{-5}}{1.6 \times 10^{-19} \times 10^{?} \times 10^{-3} \times 21.555} = 3.24 \times 10^{16}$

② For $t = 0.8\ mm = 0.8 \times 10^{-3}\ m$

Slope $= \frac{16.175 - 10.783}{1.5 - 1} = 10.784$

$n_2 = \frac{B}{q \times t \times S_2}$

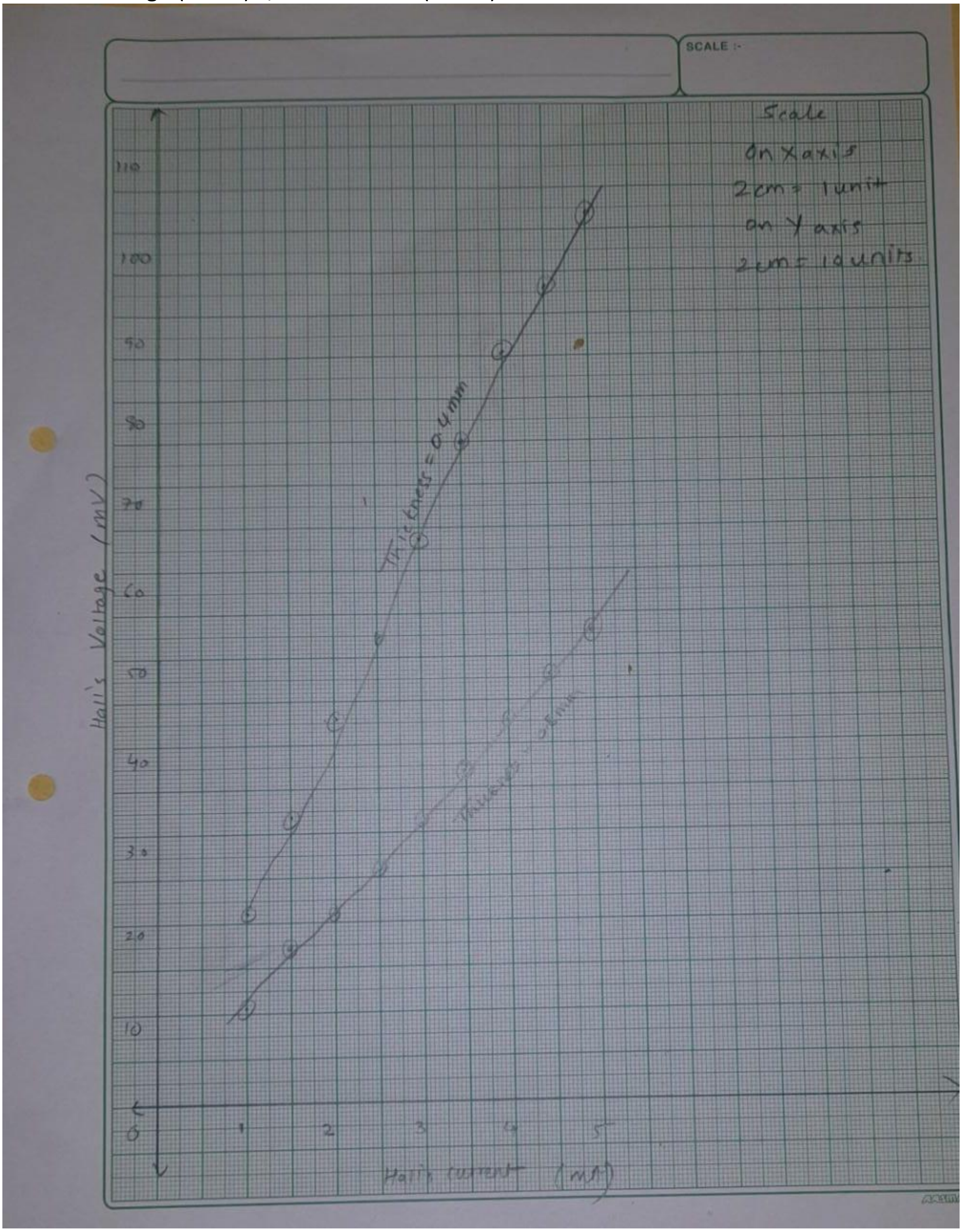
$B = 4.47 \times 10^{-5}\ T$ $q = 1.6 \times 10^{-19}\ C$

$n_2 = \frac{4.47 \times 10^{-5}}{1.6 \times 10^{-19} \times 0.8 \times 10^{-3} \times 10.789} = 3.24 \times 10^{16}$

$\therefore n_2 = 3.24 \times 10^{16}$

Graph:

Plot Hall voltage (Y-axis) v/s Hall current (X-axis) for different thicknesses



Result:- The value of n is 3.24×10^{16} for thickness 0.4mm and 0.8mm

Home Assignment:

Keep Hall current (I_H) fixed at 3 mA. Vary Magnet current in steps of 0.5 A and note Hall voltage. Plot graph of Hall voltage (Y-axis) v/s Magnetic field* for any one thickness. Calculate carrier concentration using the formula: $n = \frac{I_H}{q \times t \times slope}$

*Find magnetic field for different magnet currents by selecting "Magnetic field v/s Current" from the "Select Procedure" drop-down menu of the simulator.

Observation table for Home Assignment:
Material: Germanium

Hall current: 3 mA

Thickness t = 0.4 OR 0.8 mm		
I ampere (magnet current)	B gauss	V_H mV
1	0.1482	21.567
1.5	0.2223	32.325
2	0.2964	43.133
2.5	0.3706	53.917
3	0.4447	64.700
3.5	0.5188	75.484
4	0.5929	86.267
4.5	0.6670	97.050
5	0.7411	107.834

Calculation :-

Home Assignment

Calculation:

For $t = 0.4 mm = 0.4 \times 10^{-3} m$

$$\text{Slope} = \frac{32.350 - 21.567}{0.2223 - 0.1482} = 145.519$$

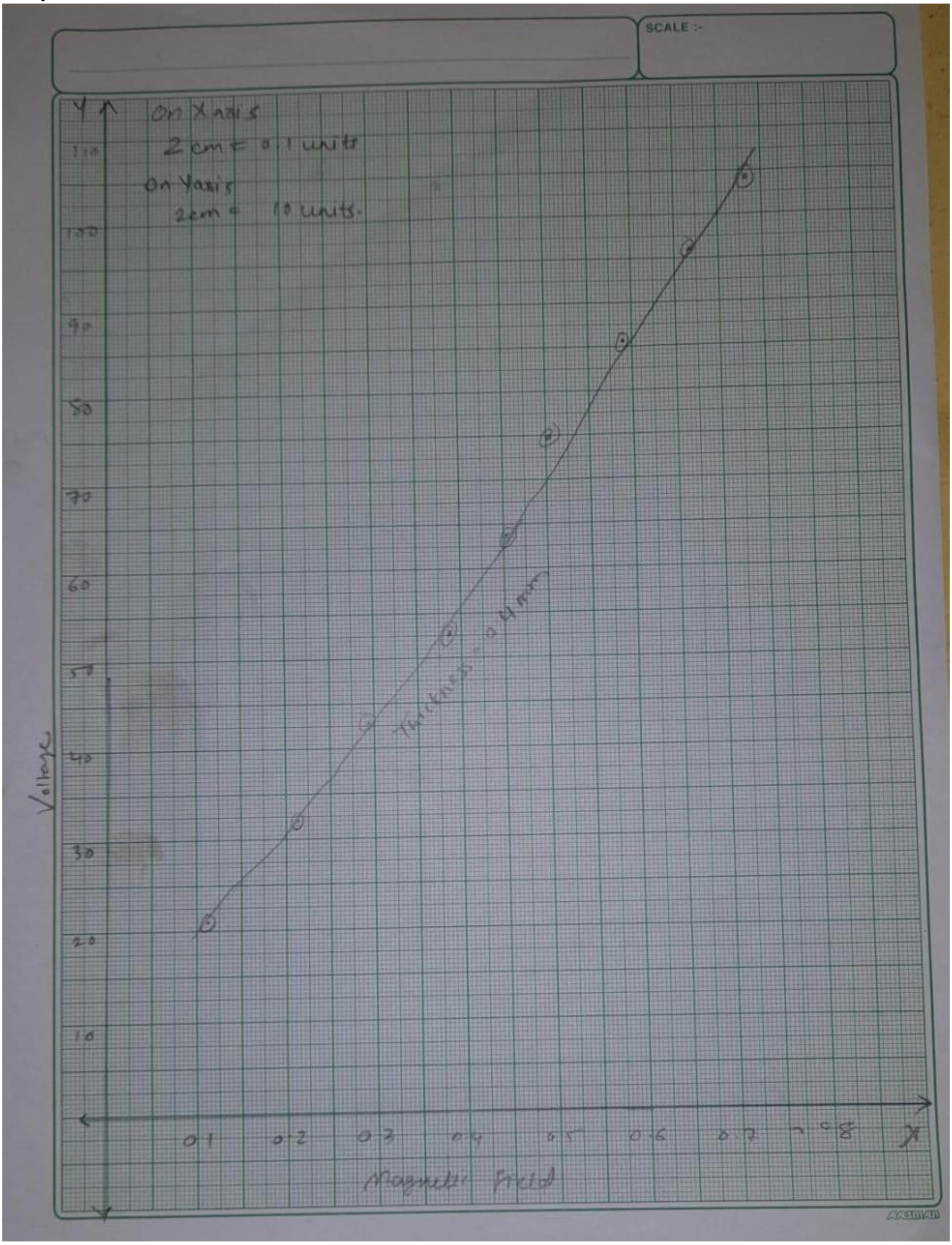
$$n = \frac{I_H}{q \times t \times \text{slope}}$$

$I_H = 3 mA = 3 \times 10^{-3} A$, $q = 1.6 \times 10^{-19} C$

$$n = \frac{3 \times 10^{-3}}{1.6 \times 10^{-19} \times 0.4 \times 10^{-3} \times 145.519}$$

$$n = 3.22 \times 10^{17}$$

Graph:-


SCALE :-
On X axis
2 cm = 0.1 units
On Y axis
2cm = 10 units.
Voltage
Magnetic Field
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
10
20
30
40
60
70
80
90
110
X
Y