

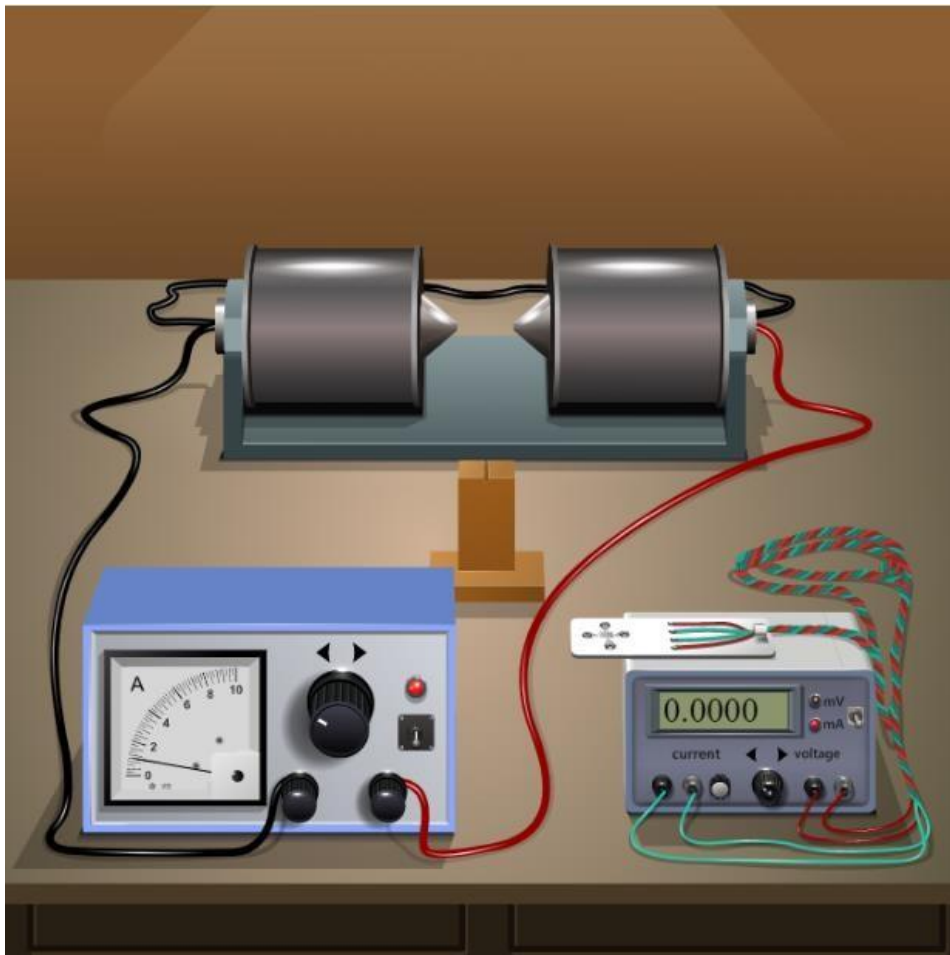
Hall Effect

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Aim: To calculate the carrier concentration by fixed hall current and plotting a graph of hall voltage and magnetic field.

Apparatus: Two solenoids, Constant current supply, four probe, Digital gauss meter, Hall effect apparatus (which consist of Constant Current Generator (CCG), digital milli voltmeter and Hall probe).

Diagram:



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Observation Table:

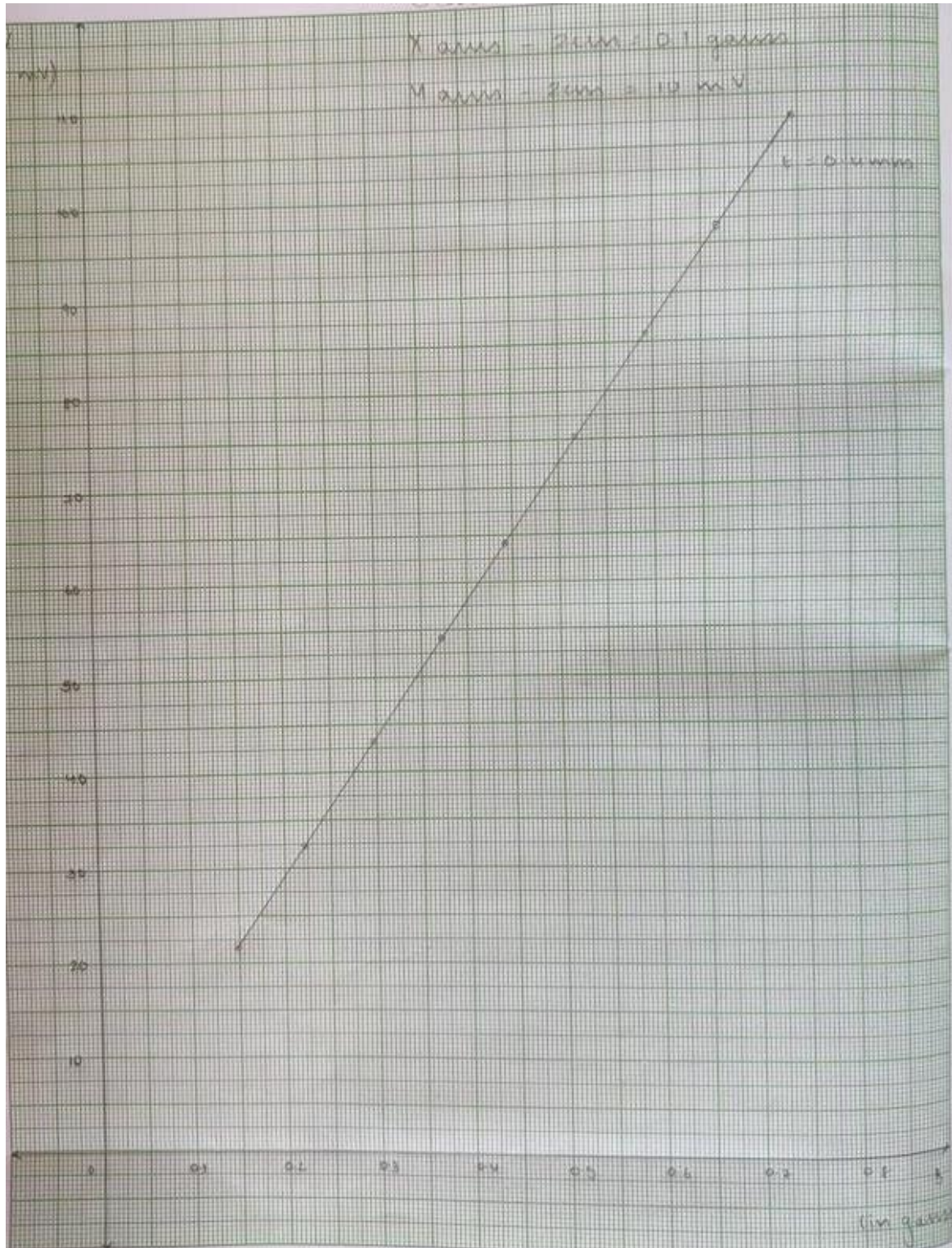
Material: Germanium

Magnetic field $B = 0.447 \text{ gauss} = \underline{44.7 * 10^{-6} \text{ tesla}}$

Thickness $t = 0.4 \text{ mm}$		Thickness $t = 0.8 \text{ mm}$	
$I_H \text{ mA}$	$V_H \text{ mV}$	$I_H \text{ mA}$	$V_H \text{ mV}$
1	0.1482	1	21.567
1.5	0.2223	1.5	32.350
2	0.2964	2	43.133
2.5	0.3706	2.5	53.917
4	0.4447	4	64.700
3.5	0.5188	3.5	75.484
4	0.5929	4	86.267
4.5	0.6670	4.5	97.050
5	0.7411	5	107.834

Graph:

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



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

Calculations:

Handwritten calculations for carrier concentration n :

Points: $(x_1, y_1) = (0.1482, 21.567)$ and $(x_2, y_2) = (0.7411, 107.834)$.

Slope calculation:

$$\frac{(107.834 - 21.567) \times 10^{-3}}{(0.7411 - 0.1482) \times 10^{-4}} = \text{slope.}$$

Slope value:

$$\therefore \text{slope} = 1455.001.$$

Carrier concentration calculation:

$$n = \frac{I_H}{q \times t \times \text{slope}} = \frac{3 \times 10^{-3}}{1.6 \times 10^{-19} \times 0.4 \times 10^{-3} \times 1455.001}$$

Final result:

$$n = \boxed{3.22 \times 10^{16}}$$

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

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

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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	32.350
2	0.2964	43.133
2.5	0.3706	53.917
4	0.4447	64.700
3.5	0.5188	75.484
4	0.5929	86.267
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