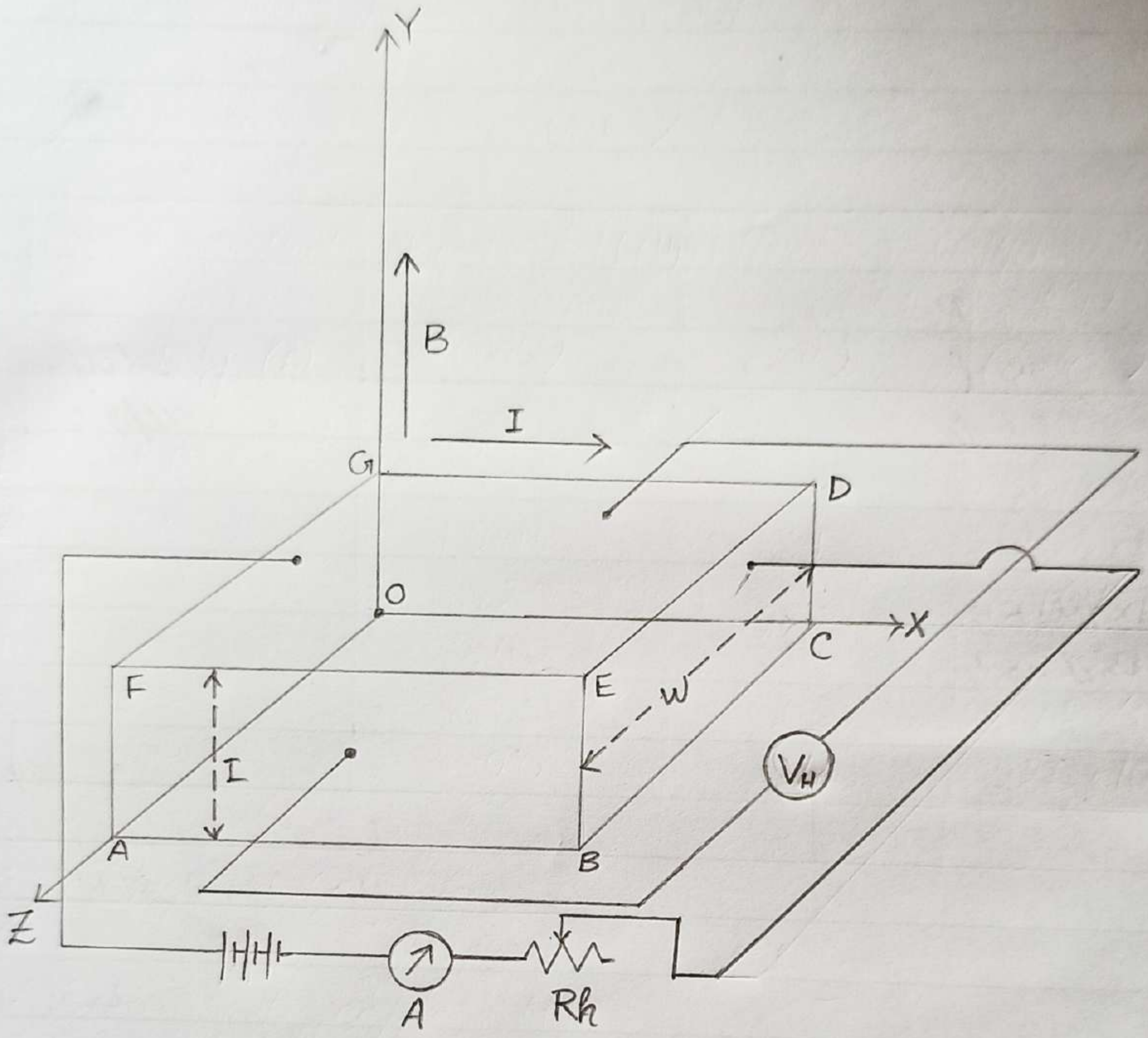

HALL EFFECT SETUP

Determination of Hall Coefficient and carrier type for a Semi-conducting material.

AIM: To determine the hall coefficient of the given n-type or p-type semiconductor.

APPARATUS REQUIRED:
Hall probe (n type or p type), Hall effect setup, Electromagnet, constant current power supply, gauss meter etc.

FORMULAE:

i) Hall coefficient (R_H) = $\dfrac{V_H \cdot t}{IH} \times 10^8 \, cm^3 C^{-1}$

where: V_H = Hall voltage (volt)
t = thickness of sample (c
I = current (Ampere)
H = Magnetic field (Gauss)

ii) Carrier density (n) = $\dfrac{1}{R_H \cdot q} \, cm^{-3}$

where: R_H = Hall Coefficient ($cm^3 C^{-1}$)
q = charge of electron or ho (C)

iii) Carrier mobility (μ) = $R_H \cdot \sigma \; cm^2 V^{-1} s^{-1}$

where: R_H = Hall Coefficient ($cm^3 C$
σ = Conductivity ($C V^{-1} s^{-1} cm^{-1}$)

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MEASUREMENT OF HALL COEFFICIENT :-

Current in Hall effect setup (I_H) = 2 mA

	Current in constant current power supply (A)	Magnetic field (H) (Gauss)	Hall Voltage (V_H) (millivolts)	Hall Coefficient (R_H) = $\frac{V_H \times t}{I_H} \times 10^8$ ($cm^3 C^{-1}$)
1.	1.0	1320	12.5	$\frac{12.5 \times 0.05}{2 \times 1320} \times 10^8 = 2.3674 \times 10^4$
2.	1.5	1940	18.1	$\frac{18.1 \times 0.05}{2 \times 1940} \times 10^8 = 2.3325 \times 10^4$
3.	2.0	2620	23.2	$\frac{23.1 \times 0.05}{2 \times 2620} \times 10^8 = 2.2137 \times 10^4$
4.	2.5	3040	27.4	$\frac{27.4 \times 0.05}{2 \times 3040} \times 10^8 = 2.2533 \times 10^4$
5.	3.0	3600	31.2	$\frac{31.2 \times 0.05}{2 \times 3600} \times 10^8 = 2.1667 \times 10^4$
6.	3.5	4390	35.6	$\frac{35.6 \times 0.05}{2 \times 4390} \times 10^8 = 2.0273 \times 10^4$

Observations and Calculations :-

1. Thickness of the sample (t) = 0.05 cm
2. Resistivity of the sample (ρ) = 10 $VC^{-1}s\,cm$
3. Conductivity of the sample (σ) = 0.1 $CV^{-1}s^{-1}cm^{-1}$
4. The charge of electron or hole (q) = 1.6×10^{-19} C

Calculation :-

$$R_{H_1} = \frac{12.5 \times 0.05}{2 \times 1320} \times 10^8 = \frac{0.625}{2640} \times 10^8 = 2.3674 \times 10^4 \ cm^3C^{-1}$$

$$R_{H_2} = \frac{18.1 \times 0.05}{2 \times 1940} \times 10^8 = \frac{0.905}{3880} \times 10^8 = 2.3325 \times 10^4 \ cm^3C^{-1}$$

$$R_{H_3} = \frac{23.1 \times 0.05}{2 \times 2620} \times 10^8 = \frac{1.155}{5240} \times 10^8 = 2.2137 \times 10^4 \ cm^3C^{-1}$$

$$R_{H_4} = \frac{27.4 \times 0.05}{2 \times 3040} \times 10^8 = \frac{1.37}{6080} \times 10^8 = 2.2533 \times 10^4 \ cm^3C^{-1}$$

$$R_{H_5} = \frac{31.2 \times 0.05}{2 \times 3600} \times 10^8 = \frac{1.56}{7200} \times 10^8 = 2.1667 \times 10^4 \ cm^3C^{-1}$$

$$R_{H_6} = \frac{35.6 \times 0.05}{2 \times 4390} \times 10^8 = \frac{1.78}{8780} \times 10^8 = 2.0273 \times 10^4 \ cm^3C^{-1}$$

5. Hall coefficient of sample (mean) $= R_H = \frac{V_H \times t}{IH} \times 10^8 \ cm^3C^{-1}$

$$= \frac{(2.3674 + 2.3325 + 2.2137 + 2.2533 + 2.1667 + 2.0273) \times 10^4}{6}$$

$$= 2.2268 \times 10^4 \ cm^3C^{-1}$$

6. The carrier density of sample $= n = \frac{1}{R_H \cdot q} = \frac{1}{2.2268 \times 10^4 \times 1.6 \times 10^{-19}}$

$= 2.8067 \times 10^{14}$ carriers/cm^3

7. Carrier mobility of sample $= R_H \cdot \sigma = 2.2268 \times 10^4 \times 0.1$

$= 2226.8 \ cm^2$/Volt sec

PRINCIPLE :

Hall effect : When a current carrying conductor is placed in a transverse magnetic field, a potential difference is developed across the conductor in a direction perpendicular to the direction of both current and magnetic field.

RESULT :

1. The Hall coefficient of the given semi-conducting material (R_H) $= 2.2268 \times 10^4 \ cm^3 C^{-1}$

2. The carrier density (n) $= 2.8067 \times 10^{14}$ carriers / cm^3

3. The carrier mobility $= 2226.8 \ cm^2$/volt sec.

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