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Experiment-5

Aim-: To find the thermal conductivity of a poor conductor by Lee's method.

Apparatus-: copper disc apparatus, two celsius thermometer, steam boiler, stopwatch, specimen in the form of circular disc, screw gauge and vernier calipers.

Formula/ Theory:-

The coefficient of thermal conductivity K is given by

$$K = \frac{msd}{\pi r^2(\theta_1 - \theta_2)}\left(\frac{d\theta}{dt}\right)_{\theta=\theta_2}$$

where m: mass of disc
s: specific heat of material of the disc
r: radius of specimin disc
d: thickness of specimen B.
θ_2: steady temperature at thermometer T_2
θ_1: steady temperature at thermometer T_1

$$\left(\frac{d\theta}{dt}\right)_{\theta=\theta_2} = \text{slope at the tangent}$$

Observations

Steady temperature at $\theta_1 = 96°C$
Steady temperature at $\theta_2 = 92°C$

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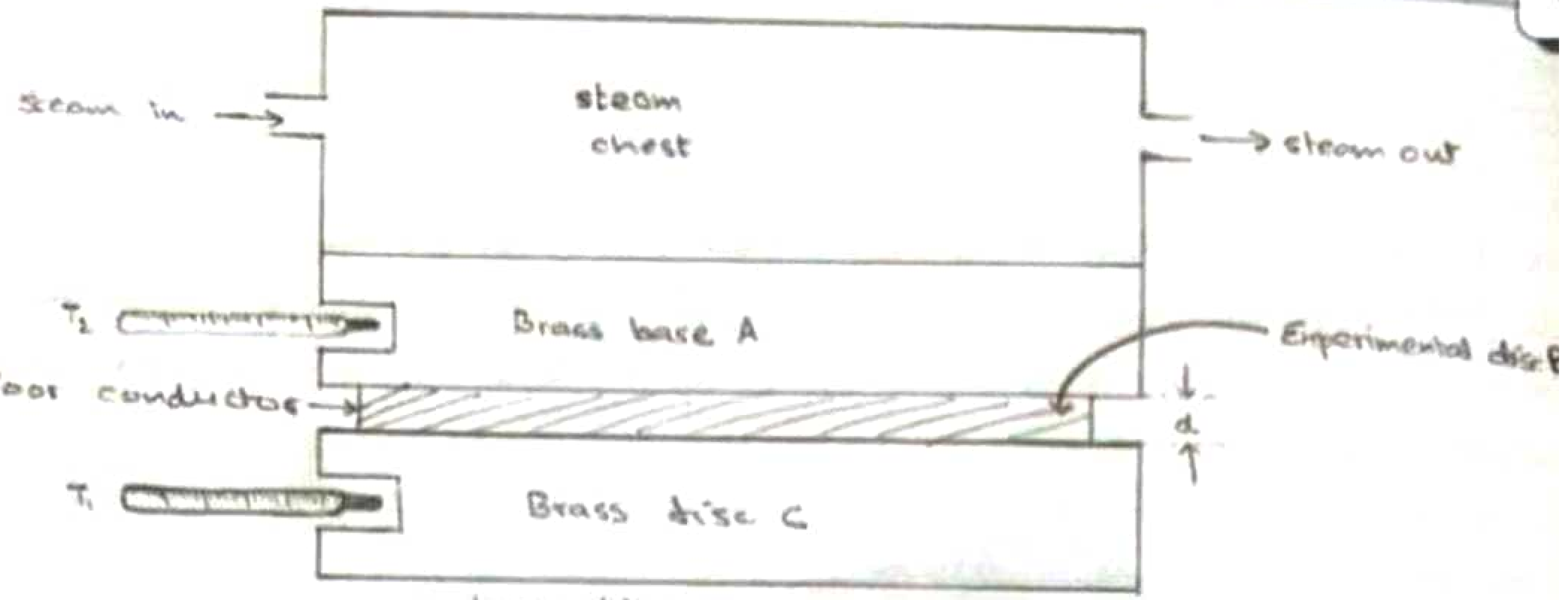
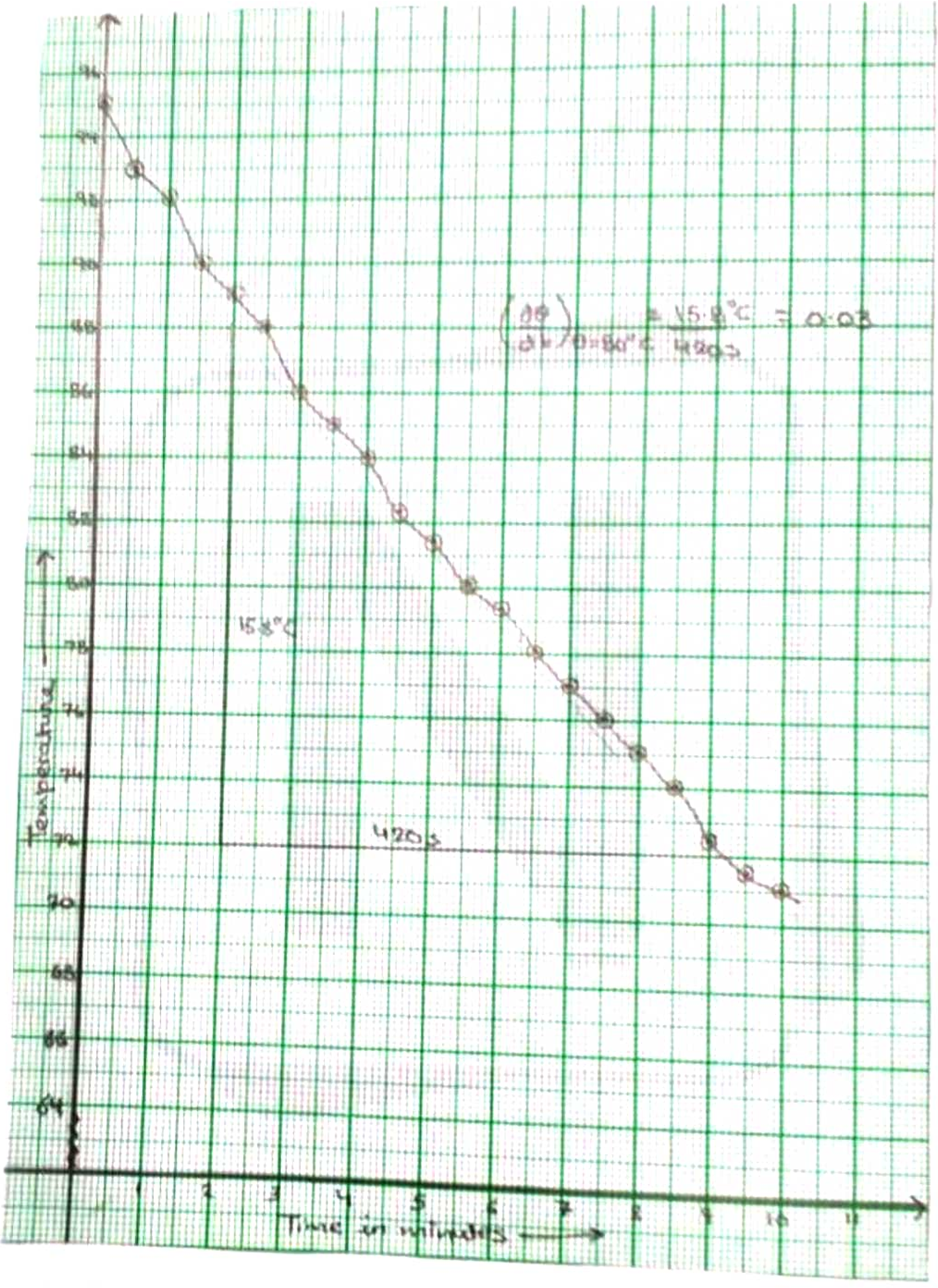


Lee's discs arrangement.

For finding $\left(\frac{d\theta}{dt}\right)_{\theta=\theta_2}$

Time (t) is seconds	Temperature (θ) in °C
30	95
30	93
30	92
30	90
30	89
30	88
30	86
30	85
30	84
30	82
30	81.5
30	80
30	79.5
30	78
30	77
30	76
30	75
30	74
30	72.5
30	71.5



$\left(\frac{d\theta}{dt}\right)_{\theta=80°C} = \frac{15.8°C}{420s} = 0.03$
15.8°C
420 s
Temperature
Time in minutes
1
2
3
4
5
6
7
8
9
10
11
64
66
68
70
72

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Mass of disc B = 39.840g

specific heat of the material of disc (s) = 0.11 cal/g °C

Radius of the experimental disc (r) = $\frac{9.9 + 5/100}{2}$ = 4.975cm

Thickness of the experimental disc = $0.2 + \frac{3}{100}$ = 0.03cm

Result :- The thermal conductivity of a poor conductor by Lee's method = 0.03 cal/cm °C sec

Precautions :-

(1) Readings for d and r of the experimental disc should be taken before slanting experiment.

(2) The steady temperature should be obtained very accurately.

(3) The graph temperature ~~varies~~ versus time is plotted by choosing a paper scale.

(4) The slope is determined at $\theta = \theta_2$ carefully.

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Experiment-6

AIM -: To study the hall effect and to calculate.
(i) the concⁿ of charge carriers, n and
(ii) the hall coefficient R_H.

THEORY -:
A current carrying conductor (semi-conductor) is placed in the magnetic field perpendicular to the direction of current, a voltage is developed across the conductor in a direction perpendicular to both the current and magnetic field. The effect is known as Hall effect.

This effect is very useful in determining :-
- The nature of charge carriers.
- Carrier concentration or the density of charge carrier.
- Mobility of charge carriers.

Expression of Hall voltage and Hall coefficient.
The accumulation of positive and negative charge on the opposite faces result in the development of voltage across the two ends called Hall voltage (V_H). The corresponding Hall electric field is denoted by E_H.

The force due to the electric field on a current carrier of charge is eE_H. while the force due to transverse magnetic field is eV_B where V is drift velocity of current carrier.

OBSERVATIONS

width of specimen, ω = 4mm

thickness of specimen, d = 0.5 mm

B = 380 gauss

S.No	Current (in mA)	Hall Voltage (in V)	Hall coefficient(R_H)
1.	1.28	0.031	0.1376×10^{-7}
2	2.19	0.112	0.290×10^{-7}
3.	3.56	0.114	0.1819×10^{-7}
4.	4.60	0.151	0.1865×10^{-7}
5.	5.71	0.090	0.1890×10^{-7}

Mean $R_H = 0.197 \times 10^{-7}$

$$R_H = \frac{V_H \times \omega}{I \times B}$$

Carrier Concentration :

$$n = \frac{1}{eR_H} = 3.172 \times 10^{26}$$

where $e = 1.6 \times 10^{-19}$ C

The two forces being oppositively directed for equilibrium condition:

$$eE_H = eV_B \quad \Rightarrow \quad \boxed{E_H = VB}$$

if w width and d is thickness of specimen, $A = wd$

$$I = neAv = nwdev$$

$$V_H = E_H d = vB \times \frac{I}{nwev} = \frac{BI}{nwe}$$

$$\boxed{V_H = \frac{BI}{new}}$$

PROCEDURE :-

1. Connect one pair of contact of specimen on the opposite face to the current sources and other pair to the milli-voltmeter/multimeter.
2. Switch ON the power supply of electromagnet and measure the magnetic flux density at the centre b/w the pole faces by placing the tip of hall probe there. Now do not change the current in the electromagnet.

(3) Place the specimen at the center between the pole faces ~~...~~ such that the magnetic field is perpendicular in the strip.

(4) Pass the current (mA) from the current source through the specimen and measure the resulting Hall voltage in the multimeter/millimeter. Enter these values in obs. table.

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(5) Increase the current through the specimen gradually and measure the corresponding Hall voltages.

(6) The entire process can be repeated for different values of magnetic flux density. Find the mean at difference R_H.

RESULT:-

The hall coefficient is found to be 0.197×10^{-7} & charge concentration is 3.172×10^{26}.

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