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BAND GAP DETERMINATION USING POST OFFICE.

Aim:

To find the band gap of the material of the given thermistor using post office box.

Apparatus Required:

Thermistor, thermometer, post office box, power supply, galvanometer, insulating coil and glass beakers.

Principle and Formulae:

(i) Wheatstone's Principle for balancing a network $\frac{P}{Q} = \frac{R}{S}$.

Of the four resistances, if three resistances are known and one is unknown, the unknown resistance can be calculated.

(ii). The band gap for semiconductor given by,

$$E_g = 2k\left(\frac{2.303 \log_{10} R}{1/T}\right)$$

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Experiment

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OBSERVATION TABLE →

Temp of Thermistor T = T + 273	$\frac{1}{T}$	Resistance in			Resistance of the thermistor $R_T = (P/Q) \times R$	
		P	Q	R		
K	K^{-1}	ohm (Ω)			ohm (Ω)	ohm (Ω)
305	0.00327869	10	10	946	946	6.85
310	0.00327581	10	10	740	740	6.60
318	0.00314465	10	10	528	528	6.26
328	0.00304878	10	10	400	400	5.99
333	0.00300300	10	10	360	360	5.88
343	0.00291545	10	10	300	300	5.70
353	0.00283286	10	10	259	259	5.55
358	0.00279330	10	10	200	200	5.29
363	0.00275482	10	10	179	179	5.18
371	0.00269542	10	10	173	173	5.15

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CALCULATION:

- Ln R_T values.

1) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 946$
$= 6.85$

2) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 740$
$= 6.60$

3) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 528$
$\Rightarrow 6.26$

4) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 400$
$= 5.99$

5) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 360$
$= 5.88$

6) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 300$
$= 5.70$

7) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 259$
$= 5.55$

8) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 200$
$= 5.29.$

9) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \log_{10} 179$
$= 5.18$

10) $2.303 \log_{10} R_T$
$\Rightarrow 2.303 \times \log_{10} 173$
$= 5.15$

Band gap $E_g = 2k \times$ slope of the graph

$= \frac{2 \times 1.38 \times 10^{-23}}{1.602 \times 10^{-19}} \times 3205$

$= 5.521 \times 10^{-4}$ eV or 0.5521eV

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where K = Boltzmann constant
= 1.38×10^{-23} J/K
R_T = Resistance at T K.

OBSERVATION FROM GRAPH →

From the graph plotted between $2.303 \log_{10} R_T$ and $1/T$, we can calculate the slope to be $(dy/dx) = 3205$

Band gap (E_g) = 2K x slope of the graph
= $2K \times (dy/dx)$

where K = Boltzmann const.

RESULT →

The band gap of the material of the given thermistor is found to be 0.5521 eV.

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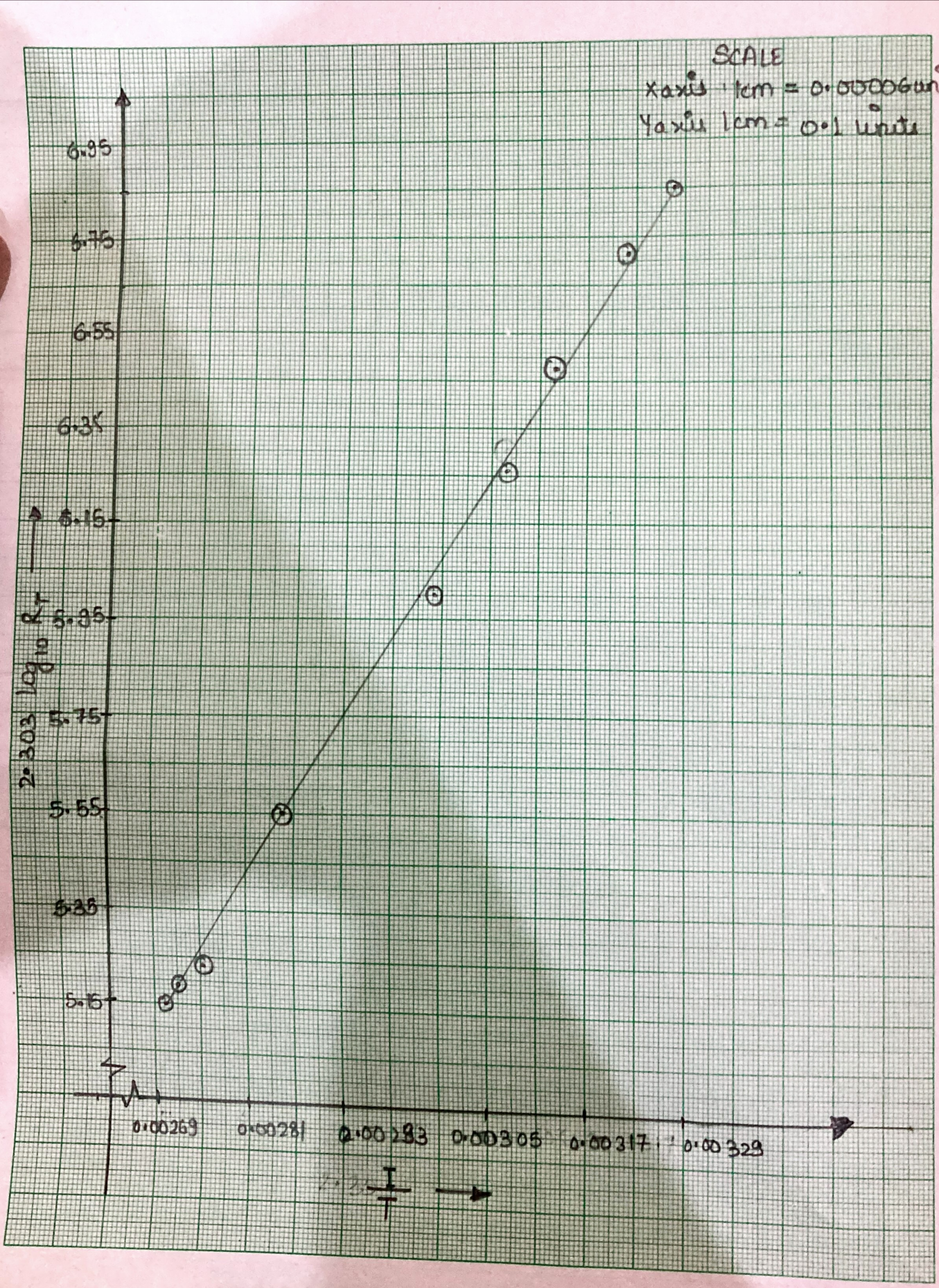
SCALE
X axis 1cm = 0.00006 units
Y axis 1cm = 0.1 units
6.95
6.75
6.55
6.35
6.15
5.95
5.75
5.55
5.35
5.15
2.303 log10 Lt
0.00269
0.00281
0.00293
0.00305
0.00317
0.00329
1/T