PAGE NO. ....

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Experiment - 1

OBJECT

Determination of ~~[illegible]~~ STEFEN'S CONSTANT using BLACK BODY RADIATION

2. **APPARATUS:** (उपकरण) EM–122 दो ट्रेनिंग बोर्ड, प्रकाशिकी व्यवस्था के साथ स्टैण्ड, एक इलेक्ट्रिक बल्ब, एक फोटोवोल्टेक सेल,

The apparatus consists of New Tech Type EM – 122 two training boards, one optical arrangement with stands (02 No), one electric bulb fixed inside an enclosure, and one photo voltaic cell. The big training board consists of a variable A.C. supply source, socket for bulb and two digital A.C. meters one digital A.C. voltmeter, the other A.C. mA and one DC 2000mV. The small training board consists of variable power supply source, socket for bulb and two meters – one digital voltmeter and one digital milliammeter.

एक बड़ा ट्रेनिंग बोर्ड जिसमें परिवर्तित AC पावर सप्लाई, सॉकेट

The set up is self contained No other item is required to perform the experiment.

और दो डिजीटल AC मीटर एक डिजीटल AC वोल्टमीटर, दूसरा AC mA और एक DC 2000mV.

3. **THEORY:**

(थ्योरी या सिद्धान्त)

Formula used to determine Stefan's constant by B B method is read as

स्टीफन नियतांक को कृष्णिका द्वारा ज्ञात करने का सूत्र

$$\sigma = 2.43 \times 10^{-4} \text{ (V/T)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

where $V = V_O + V_{CC}$

V_O = is work function of material found from intercept of graph between V_{oc} and T.

V_0 = धातु का कार्यफलन जो कि ग्राफ के इंटरसेप्ट (अवरोधन) V_{oc} और T के मध्य से प्राप्त होता है

फोटो वोल्टिक सैल खुला परिपथ वोल्टेज जो कृष्णिका के उत्सर्जित

V_{CC} = Photo voltaic cell open circuit voltage corresponding to energy of the photons emitted by the black body. फोटोन के अनुसार है।

Graph plotted between open circuit voltage V_{OC} of photo voltaic cell and the absolute temperature T of the black body is a straight line and its equation can be given by $V_{OC} = mT - V_O$, thus when this line is extrapolated it cut V_{OC} axis on negative side. The intercept thus obtained is V_O. यह ग्राफ V_{OC} और कृष्णिका के निरपेक्ष ताप के मध्य सीधी लाइन प्राप्त होती जो समीकरण $V_{OC} = mT - V_0$ यह लाइन जब V_{OC} के ऋणात्मक खण्ड में कट करती है तो यह प्राप्त होगा।

FINDING TEMPERATURE OF BLACK BODY:

Temperature of the black body is obtained from resistance measurement using Ohm's law. Circuit diagram shown in Fig. (1) is employed using relation $R_t = V_t / I_t$ ……………………….. (2)

Method is crude but the temperature range is so wide that these resistance measurements will be quite useful to get good estimates of the filament temperature T. Variation in filament resistance with temperature is given by $R_t = R_O(1 + \alpha t + \beta t^2 + \gamma t^3)$.

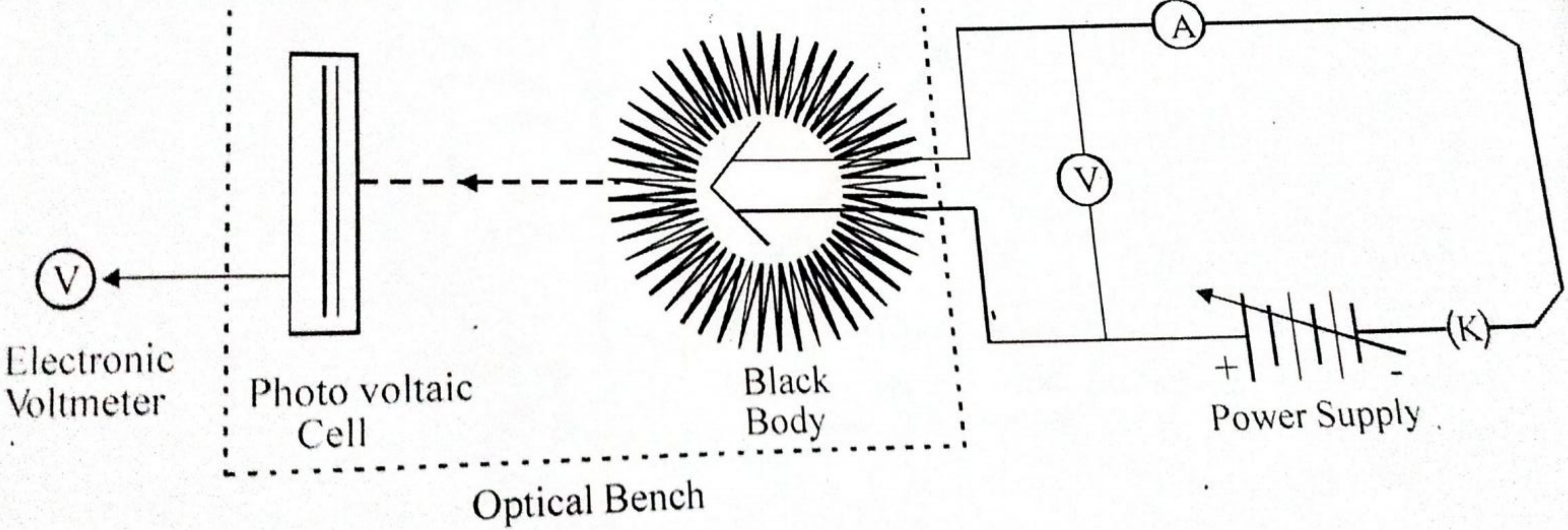
R_O is the resistance at 0^OC will be so low that small error in resistance measurement would lead to large error in T. The draper point (The temperature at which filament of the bulb just starts showing a dull red glow) is 800^OK or $t = 530^OC$ and trial shows that it is reproducible well within 20%.

Further measurement of draper point resistance Rd at draper temperature need no extra devices. Thus if Vd is the draper voltage, Id is the draper point current then Rd = Vd / Id and experimentally it has been seen that R_0 is related to Rd as $R_0 = Rd / 3.9$ where 3.9 is the slope of the line when Log P (power radiated by the black body) is plotted against Log T (temperature of black body).

For tungsten filament $\alpha = 5.21 \times 10^{-3} /^OC^2$, $\beta = 7.2 \times 10^{-7} /OC$, and $\gamma = 6.0 \times 10^{-12} /^OC^3$.

Compute R_t/R_O for different t values i.e., t = 100, 200, 400, 800, 1200, 1600, 1800, 2000, 2200 and 2400°C.

Plot R_t/R_O against 't' or T(= t + 270) and draw a smooth curve. This graph in turn helps to find temperature of the black body at any illumination of the bulb by calculating its resistance R_t using relation (2). Simultaneously measuring V_{OC} for different temperature of the black body, plot graph between V_{OC} and T, extrapolate the line so obtained; and measure intercept to get V_O. Add V_O to all V_{OC} values measured on electronic meter to get V. Find average V/T to calculate Stefan's constant using relation (1).



SCHEMATIC DIAGRAM
Fig. (1)

OBSERVATIONS:

छोटे ट्रेनिंग बोर्ड हेतु

First Part with Small Training Board

प्रेक्षण सारणी (1) ड्रेपर प्रतिरोध फिलामेन्ट का

O.T. No. (1) for draper resistance measurement of filament:

Sr. No.	V_d (Volts)	I_d (Amp)	$R_d = \frac{V_d}{I_d}$ (Ohms)	Average R_d (Ohms)	$R_0 = \frac{R_d}{3.9}$ (Ohms)
1.	13.4	0.0792	169.19		
2.	13.2	0.0776	170.10		
3.	14.9	0.083	179.51	171.95	44.08
4.	13.2	0.0781	169.01		

प्रेक्षण सारणी - (2)

O.T. No. (2) for graph between $\frac{R_t}{R_0}$ (computed) against T:

$R_t/R_0 = 1 + \alpha t + \beta t^2 + \gamma t^3$ $\alpha = 5.21 \times 10^{-3}$ $\beta = 7.2 \times 10^{-7}$ $\gamma = 6.0 \times 10^{-12}$	2.0708	3.199	4.386	5.63	6.93	8.30
Temperature $t^{\circ}C$	200	400	600	800	1000	1200
$T = t^{\circ}C + 270$ K	470 $\simeq$ 500	670 $\simeq$700	870 $\simeq$900	1070 $\simeq$1100	1270 $\simeq$1300	1470 $\simeq$1500

$\frac{R_t}{R_0}$	9.72	11.2	12.74	14.35	16.01	17.73	18.62
$t^{\circ}C$	1400	1600	1800	2000	2200	2400	2500
T K	1670 $\simeq$1700	1870 $\simeq$1900	2070 $\simeq$2100	2270 $\simeq$2300	2470 $\simeq$ 2500	2670 $\simeq$ 2700	2770 $\simeq$ 2800

II Part with Big Training Board बड़े ट्रेनिंग बोर्ड हेतु

Meters (1) 2000mV DC (2) 200V AC (3) 2000mA AC

O.T. No. (3) for graph between V_{OC} and temperature T:
प्रेक्षण सारणी (3)

For measuring V_{OC}

Sr. No.	Temperature of black body					V_{OC} (Volts)
	V_t (Volts)	I_t (Amp)	$R_t = \frac{V_t}{I_t}$ (Ohms)	$\frac{R_t}{R_0}$	T from graph (K)	
1.	50.8	0.122	416.39	9.44	1660	0.168
2.	70.4	0.154	457.14	10.37	1780	0.197
3.	90.4	0.183	493.98	11.20	1900	0.213
4.	110.6	0.213	519.24	11.77	1980	0.225
5.	130.4	0.239	545.60	12.37	2040	0.232
6.	150.4	0.267	563.29	12.77	2100	0.237
7.	170.8	0.293	582.93	13.22	2160	0.242
8.	190.8	0.320	596.25	13.52	2190	0.245

O.T. No. (4) for average value of $\frac{V}{T}$: From Graph

$V_0 = 0.1875V$

कृष्णिका का तापमान

Sr. No.	Temp. of black body TK	V_{OC} Volt	$V = V_O + V_{OC}$ $V_0 = 0.1875$ Volt Volt	$\frac{V}{T}$ VK^{-1}	Average $\frac{V}{T}$ VK^{-1}
1.	1660	0.168	0.1875 +0.168 = 0.3555	0.2141×10^{-3}	
2.	1780	0.197	0.1875+0.197 = 0.3845	0.2160×10^{-3}	
3.	1900	0.213	0.1875 + 0.213= 0.4005	0.2107×10^{-3}	
4.	1980	0.225	0.1875+0.225 = 0.4125	0.2083×10^{-3}	
5.	2040	0.232	0.1875+0.232 = 0.4195	0.2056×10^{-3}	0.2052×10^{-3}
6.	2100	0.237	0.1875+0.237 = 0.4245	0.2014×10^{-3}	$= 2.052 \times 10^{-4}$
7.	2160	0.242	0.1875+0.242 = 0.4295	0.1884×10^{-3}	
8.	2190	0.245	0.1875+0.245 = 0.4325	0.1974×10^{-3}	

रिजल्ट परिणाम)

$\sigma = 2.43 \times 10^{-4} \times \frac{V}{T}$ (स्टीफन नियतांक)

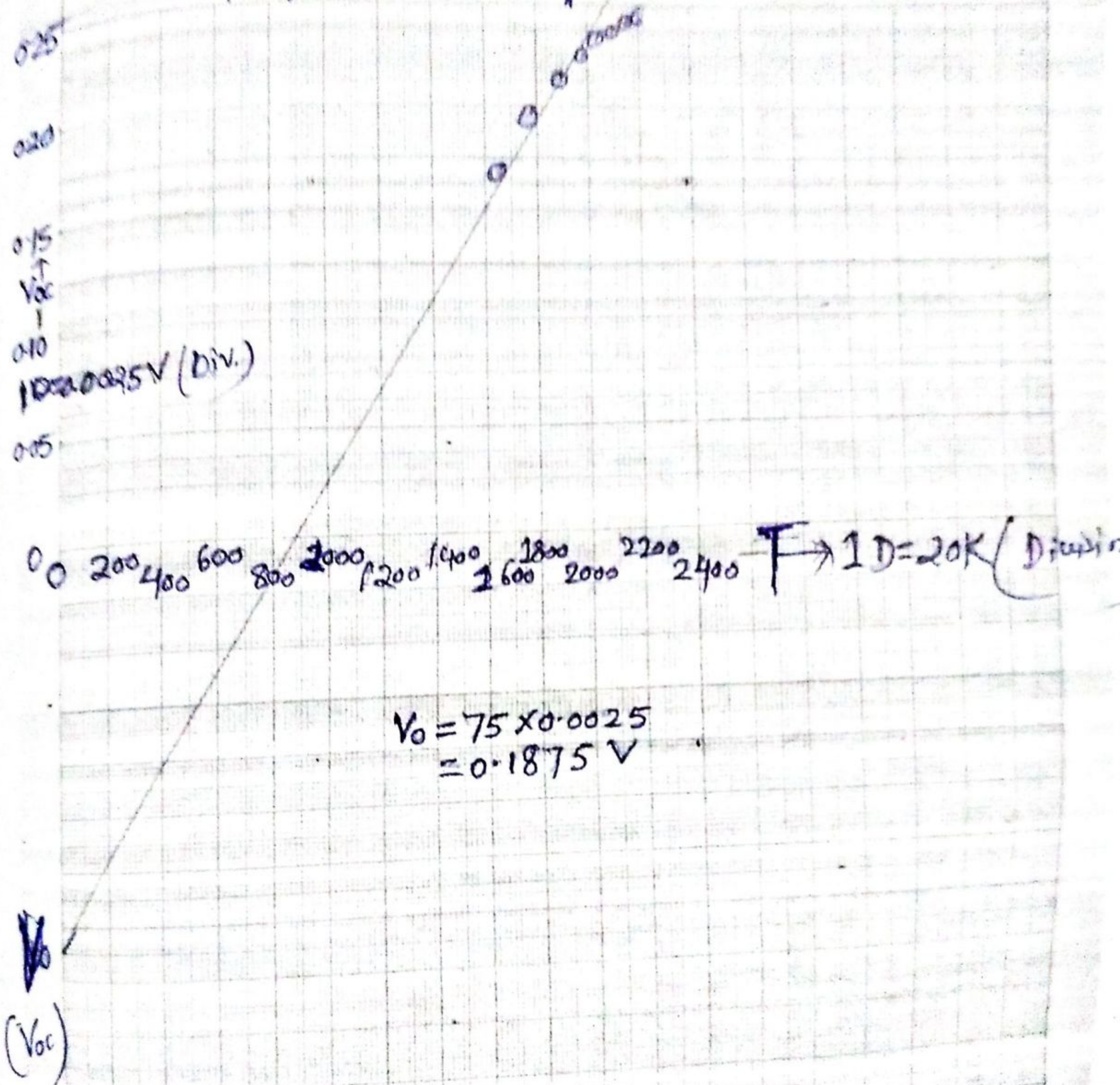
$= 2.43 \times 10^{-4} \times 2.052 \times 10^{-4}$

$4.986 \times 10^{-8}\ wm^{-2}K^{4}$ ← (प्रेक्टिकल वेल्यू)

Standard value = $5.67 \times 10^{-8}\ wm^{-2}K^{4}$

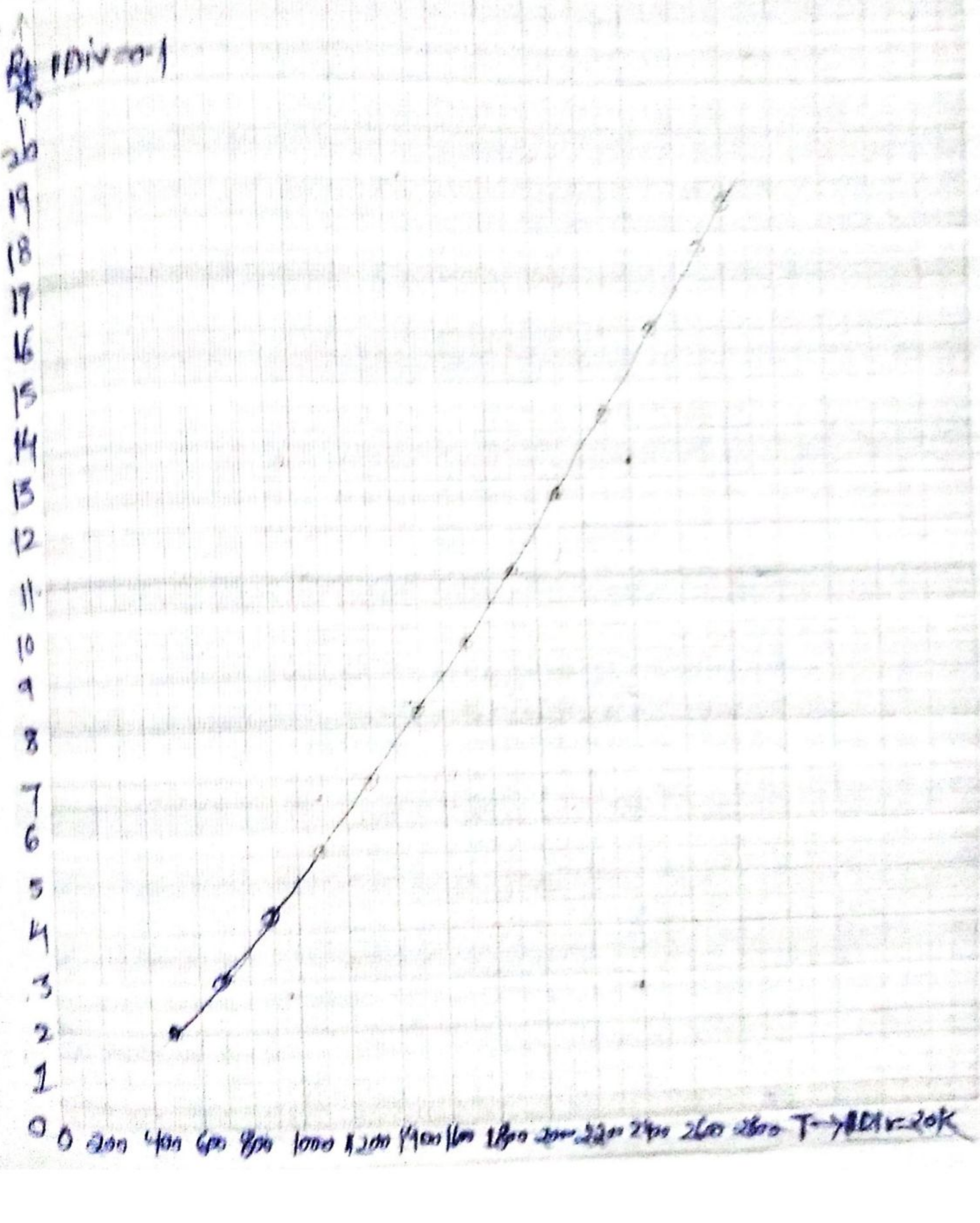
स्टेण्डर्ड वेल्यू –

Graph between T & Voc



$V_0 = 75 \times 0.0025$
$= 0.1875\ V$

Graph between T & $\frac{R_t}{R_0}$



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(a) Experiment (2)

OBJECT → STUDY of variation of total thermal radiation with temperature.

APPARATUS:

The Electronic Training Board New Tech Type DM – 104 on total thermal radiation with temperature.

THEORY:

According to Stefan's Law the net amount of heat radiated per second per unit area from the surface of the black body is given as E = σ T4 and if the temperature of the surrounding of the black body is T0 then above law is read as

$$E = \sigma (T^4 - T_0^4)$$

Where T is the temperature of the black body & σ is Stefan's constant.

It has been seen that even if the body is not black, the total power emitted by the body is given approximately by.

$$P = AE$$

$$= A \sigma (T^4 - T_0^4)$$

i.e. $P \alpha T^4$

Where A is a constant depending upon the material and area of the body.

Thus the graph plotted between P and T^4 is a straight line. For a bulb connected with battery, electric power P = V I should be equal to the radiated power P in steady state. Where it has been assumed that the energy loss due to conduction through connecting wires and gas in the bulb is taken negligible compared to radiation loss.

Filament temperature is determined using relation

$$R_t = R_o\,(1 + \alpha t + \beta t^2 + \gamma t^3)$$

$$\text{Or } \frac{R_t}{R_0} = 1 + \alpha t + \beta t^2 + \gamma t^3 \;\ldots\ldots\ldots\ldots\ldots (1)$$

where $\alpha = 5.21 \text{ X } 10^{-3}$, $\beta = 7.2 \text{ X } 10^{-7}$, $\gamma = 6.0 \times 10^{-12}$

$$R_0 = \frac{R_d}{3.9} \;\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where R_d is the resistance of the filament at draper point. Draper point is the temperature at which filament just glows.

Calculate R_t/R_0 at temperatures 200°C, 400°C , 600°C .... 2400°C respectively. Plot a smooth graph between R_t/R_0 and T. It is given in Fig. (1). This graph helps to find temperature of the filament of the bulb at arbitrary value of power to the bulb.

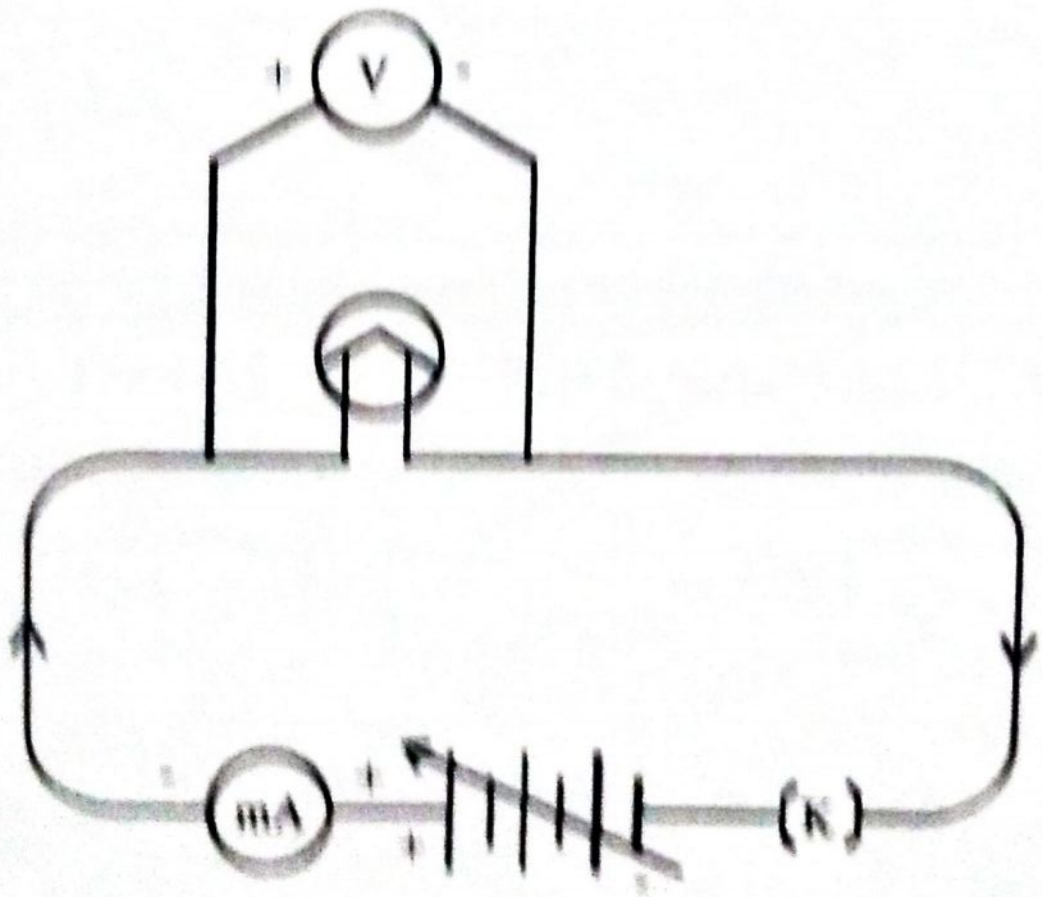


Fig. 3. EXPERIMENTAL CIRCUIT

O.T. No. (1) For R_0

S. No.	V_d Volt	I_d mA	$R_d = \frac{V_d}{I_d}$ Ohms	Av R_d Ohms	$R_0 = \frac{R_d}{3.9}$ Ohms
1	.60	152	3.947		
2	.58	150	3.866		
3	.57	149	3.825	3.874Ω	0.993
4	.58	150	3.866		
5	.58	150	3.866		

O.T. No. (2)

Sr. No.	Observations		Computations				
	Voltage across filament V (Volts)	Current in filament I (mA)	$R_t = \frac{V}{I}$ Ohms	$\frac{R_t}{R_0}$	T from Graph	P = VI	T^4
1	2.44	276	8.840	8.902	1580	0.673	6.23×10^{12}
2	2.86	299	9.565	9.632	1680	0.855	7.96×10^{12}
3	3.03	308	9.837	9.906	1740	0.933	9.16×10^{12}
4	3.42	328	10.426	10.499	1800	1.121	10.49×10^{12}
5	4.06	358	11.340	11.419	1920	1.453	13.58×10^{12}
6	4.68	386	12.124	12.209	2020	1.806	16.64×10^{12}
7	5.15	404	12.747	12.836	2100	2.080	19.44×10^{12}
8	5.54	420	13.190	13.282	2160	2.326	21.76×10^{12}
9	6.02	438	13.744	13.840	2240	2.636	25.17×10^{12}
10	6.50	455	14.285	14.385	2300	2.957	27.98×10^{12}
11	7.02	473	14.841	14.945	2360	3.320	31.02×10^{12}
12	7.54	492	15.325	15.433	2420	3.709	34.29×10^{12}
13	8.18	512	15.976	16.088	2480	4.188	37.82×10^{12}

CALCULATIONS:

$\frac{R_t}{R_0} = 1 + \alpha t + \beta t^2 + \gamma t^3$ .... (1)

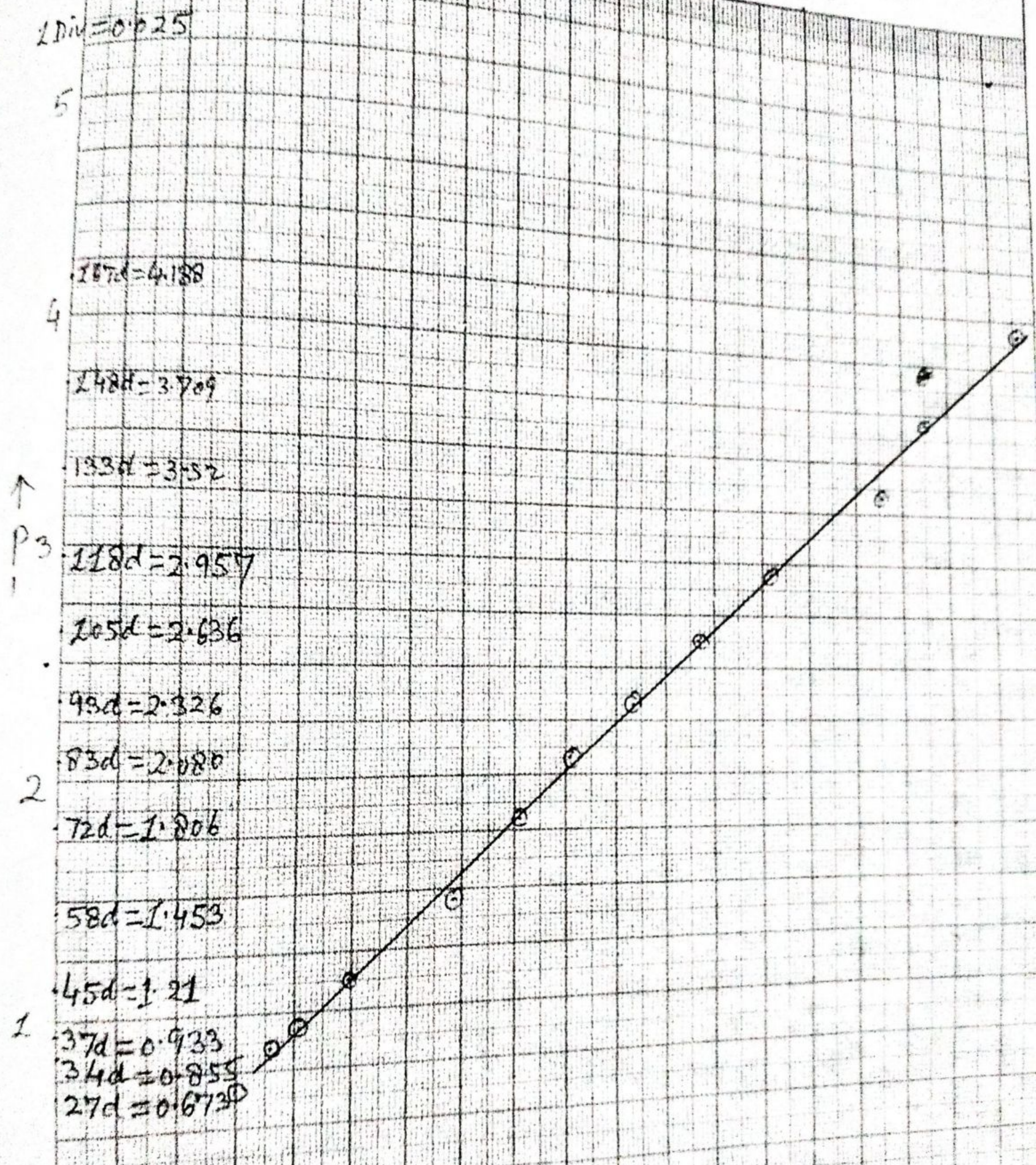
$R_0 = \frac{R_d}{3.9}$ .... (2)

$\alpha = 5.21 \times 10^{-3}$, $\beta = 7.2 \times 10^{-7}$, $\gamma = 6.0 \times 10^{-12}$

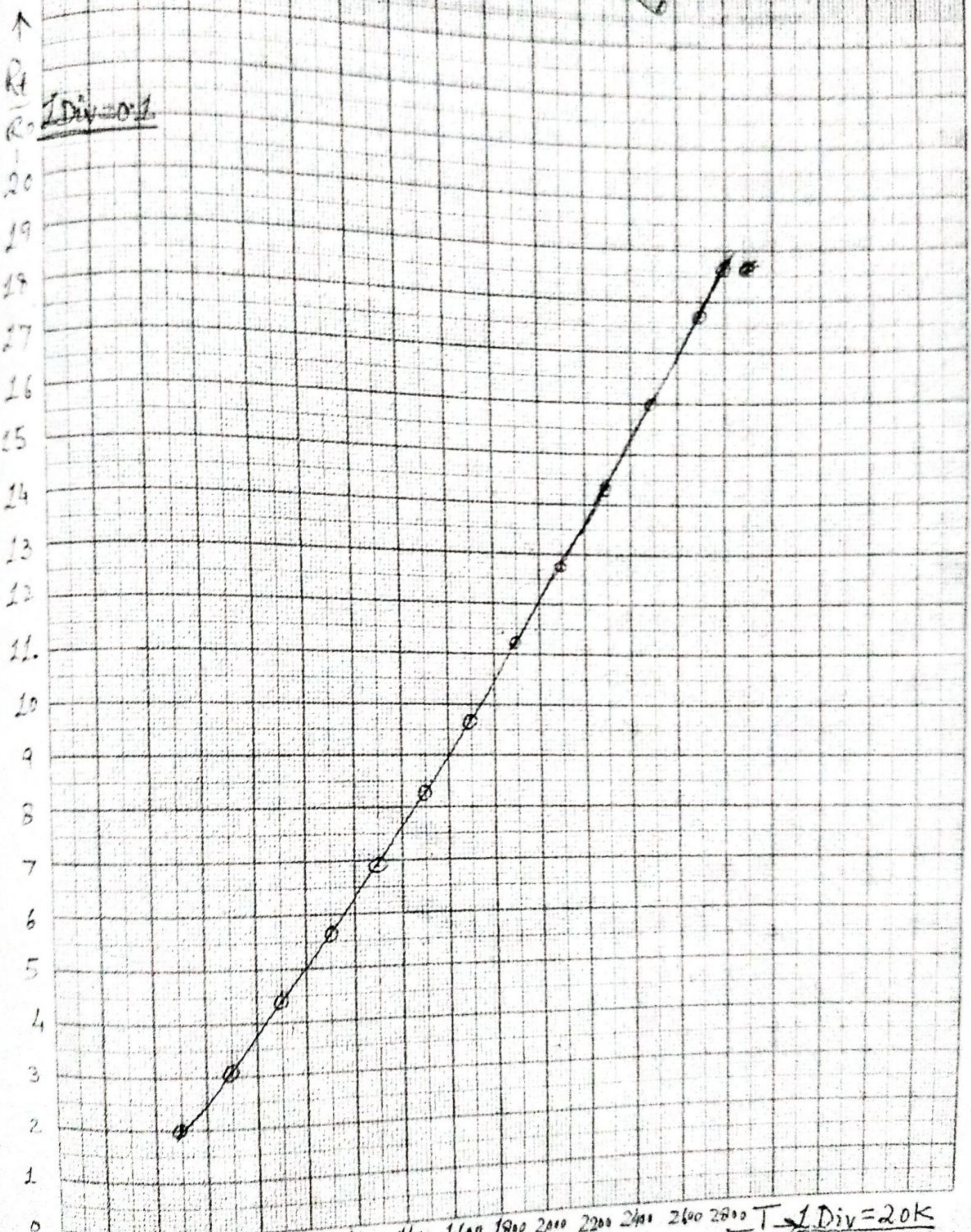
calculations are done for different temperatures in place of 273 approximately 270 has been taken. On calculations we get:

S. No.	Temperature in 0c	Temperature in K	$\frac{R_t}{R_0}$
1	200	470 ≃ 500	2.07
2	400	670 ≃ 700	3.19
3	600	870 ≃ 900	4.38
4	800	1070 ≃ 1100	5.63
5	1000	1270 ≃ 1300	6.93
6	1200	1470 ≃ 1500	8.30
7	1400	1670 ≃ 1700	9.72
8	1600	1870 ≃ 1900	11.20
9	1800	2070 ≃ 2100	12.74
10	2000	2270 ≃ 2300	14.35
11	2200	2470 ≃ 2500	16.01
12	2400	2670 ≃ 2700	17.73
13	2500	2770 ≃ 2800	18.62

Graph between P & T^4



Graph between T & $\frac{R_t}{R_0}$



Experiment-(3)

To determine the temperature Coefficient of resistance for platinum, using platinum Resistance thermometer

APPARATUS: उपकरण → न्यू टेक टाइप NTI- 433 कैलेंडर ग्रिफ्थ सेतु, डिजीटल गैल्वनोमीटर, IC रेगुलेट पाव बैट

New Tech Type NTI - 433 consists of a Callender and Griffith's Bridge. It consists of Digital Galvanometer, IC regulated power supply for battery, key/switch and a wire wound potentiometer used as rheostat, P & Q ratio resistances of 5Ω each and a small resistances r = 0.2Ω,0.5Ω to be connected in series with compensating leads of Platinum resistance thermometer.

विभवमापी, वायर, P & Q अनुपात प्रतिरोध 5Ω प्रत्येक, छोटा प्रतिरो

Extra Items:- Platinum resistance thermometer with stand, beaker, Hypsometer, thermometer and connecting leads. r = 0.2Ω, 0.5Ω सीरीज जुड़ा हुआ प्लेटिन प्रतिरोध थर्मामीटर

THEORY:

It is based on the principle that the resistance of pure metals increases with temperature. The variation in resistance with temperature for a specimen of pure platinum over a large temperature range is given by

$$R_t = R_o (1 + \alpha t + \beta t^2) \qquad (1)$$

Where α and β are constants which may be found by measuring R_t at three different temperatures.
But over small ranges the relation may be taken as

$$R_t = R_0 (1 + \alpha t) \qquad (2)$$

Where α is temperature coefficient of resistance.

R_t is resistance of platinum coil at temperature t. R_0 is resistance of platinum coil at 0° C. Let R_1 is resistance of platinum coil at temperature t_1 and R_2 is resistance of platinum coil at temperature t_2.

Than using relation (2):

$$R_1 = R_0 (1+\alpha t_1) \qquad (3)$$

And $R_2 = R_0 (1+\alpha t_2)$ (4)

Dividing relation (4) by (3) : $\frac{R_2}{R_1} = \frac{R_0\,(1+\alpha t_2)}{R_0(1+\alpha t_1)}$

Or $\quad \frac{R_2}{R_1} = \frac{1+\alpha t_2}{1+\alpha t_1}$

Or $\quad R_2 (1 + \alpha t_1) = R_1 (1+\alpha t_2)$

Or $\quad R_2 + \alpha R_2 t_1 = R_1 + R_1 t_2$

Or $\quad R_2 - R_1 = \alpha (R_1 t_2 - R_2 t_1)$

Or $\quad \alpha = \frac{R_2 - R_1}{R_1 t_2 - R_2 t_1}$ per °C. (5)

Using this formula the temperature coefficient of resistance can be calculated.

प्रतिरोध प्रति लम्बाई इकाई कैलेण्डर एण्ड ग्रिफिथ सेतु /
Formula for resistance per unit length (ρ) of Callender and Griffith's bridge:

$$\rho = \frac{r}{2x'} = \ldots\ldots\ldots\ldots \text{ Ohm / cm}$$

यह सन्तुलित तार की लम्बाई विद्युत मध्य बिन्दु
Where x' is balancing length of wire from electrical middle point

छोटा प्रतिरोध कम्पेनसेटिंग लीड के साथ श्रेणी क्रम में

r - is small resistance in series with compensating leads (C_1C_2)

Formula for R_1 and R_2:

$R_t = R \pm 2\rho x$ .... Ohms

Where R resistance of coil (R)

x = balancing length from electrical middle point.

सन्तुलित लम्बाई ON दायीं तरफ

+ ve is taken when balancing length is ON right hand side of electrical mid point

सन्तुलित लम्बाई ON बायीं तरफ विद्युत मध्य बिन्दु

-ve is taken when balancing length is ON left hand side of electrical mid point

PROCEDURE:

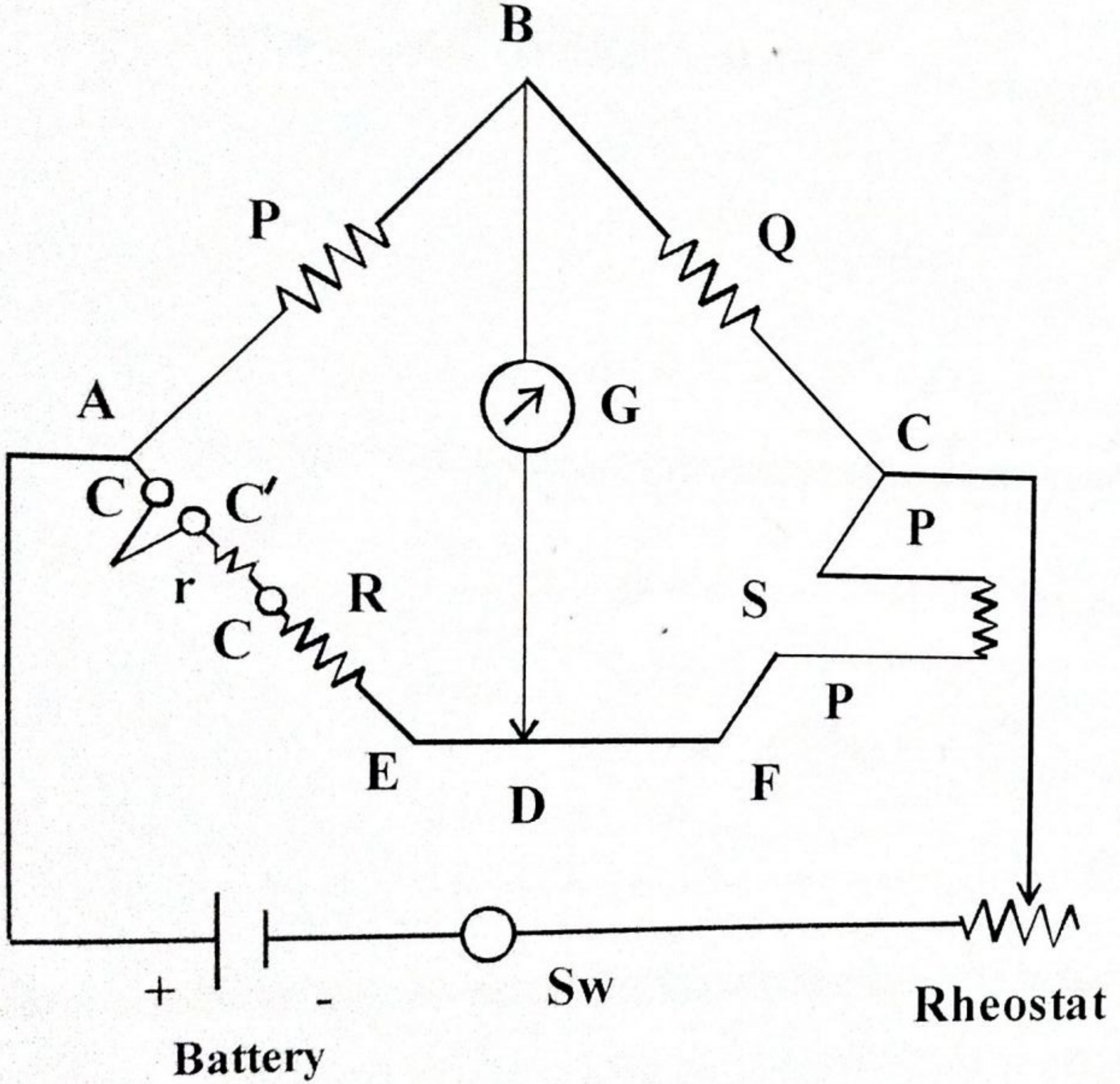
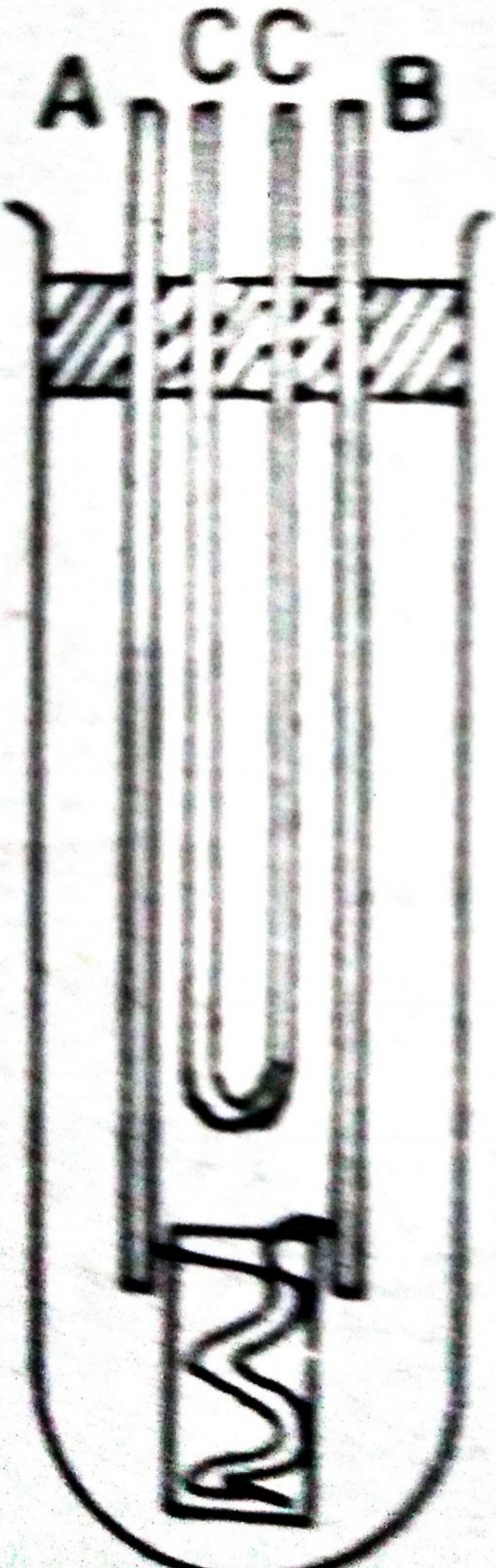


Fig (1) Callendar & Griffith's Bridge Principle


CC
A
B

SAMPLE OBSERVATIONS:

[a] Determination of electric middle point : OT - 1

SR No.	Resistance introduced in moving coil resistance (R) Ω	Position of balance point cm.	Electric middle point cm.	Mean electric middle point cm.
1	0	20	20	20
2	0	20	20	
3	0	20	20	

[b] Determination of ρ: OT – 2

r = 0.2 ohm.

SR No.	Resistance introduced in moving coil resistance (r) Ω	Distance between electric middle point and null point x' cm.	$\rho = \frac{r}{2x'}$ ohm / cm.	Mean ρ ohm / cm.
1	0	20 – 16 = 4	$\frac{.2}{2 \times 4} = .025$	$\frac{.086}{3} = .028$
2	0	20 – 16.5 = 3.5	$\frac{.2}{2 \times 3.5} = .028$	
3	0	20 – 17 = 3	$\frac{.2}{2 \times 3} = .033$	

[c] Determination of R_1 and R_2 : OT - 3

OT for R_1

Temp. of platinum resistance thermometer	S. No.	Resistance R introduced in moving coil resistance Ω	Distance of null point from electric middle point X Cm.	Resistance of Platinum Resistance Thermometer Ω	Mean resistance Ω
$t_1 = 20^{\circ}C$	1.	$R_1 = 3$	20 – 14 = 6	$R_1 = 3 - 2 \times .028 \times 6 = 2.664$	$R_1 = \frac{2.664+2.692+2.692}{3} = 2.682$
	2.	$R_1 = 3$	20 – 14.5 = 5.5	$R_1 = 3 - 2 \times .028 \times 5.5 = 2.692$	
	3.	$R_1 = 3$	20 – 14.5 = 5.5	$R_1 = 3 - 2 \times .028 \times 5.5 = 2.692$	
$t_2 = 60^{\circ}C$	1.	$R_2 = 3$	23 – 20 = 3	$R_2 = 3+2 \times .028 \times 3 = 3.168$	$R_2 = \frac{3.168 + 3.196 + 3.196}{3} = 3.186$
	2.	$R_2 = 3$	23.5 – 20 = 3.5	$R_2 = 3+2 \times .028 \times 3.5 = 3.196$	
	3.	$R_2 = 3$	23.5 – 20 = 3.5	$R_2 = 3+2 \times .028 \times 3.5 = 3.196$	

Temperature coefficient is given by:

$$\alpha = \frac{R_2 - R_1}{R_1 t_2 - R_2 t_1}$$

$$= \frac{3.186 - 2.682}{2.682 \ x \ 60 - 3.186 \ x \ 20}$$

$$= \frac{.504}{160.920 - 63.720}$$

$$= \frac{.504}{97.200} = .0051 \text{ Per } {}^{o}C$$

$$= 51 \ x \ 10^{-4} \text{ Per } {}^{o}C$$

Standard value = $37 \ x \ 10^{-4}$ Per ^{o}C

(Experiment 4)

Aim :- To determine the planck constant with the help of photocell.

Apparatus :- Photocell, woodenbox to photo cell, blue, green and orange filter etc.

Theory :- It is well known that light has dual nature when light properties progates from one point to another, it behave like an electromagnetic wave but when it interacts with matter, it behave like a particle or quanta known as photon :- $e = h\nu$
where h = plank's constant
Now, from einstein photo cell electric equation

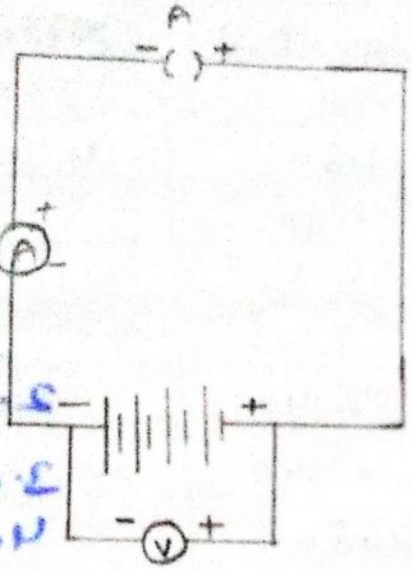
$$\frac{1}{2}mv^2 = e\vartheta_0 = h\nu - h\nu_0$$

$$\vartheta_0 = V_0 = (h/e)\,\nu - \left(\frac{h}{e}\right)\nu_0 \quad \text{--- (1)}$$

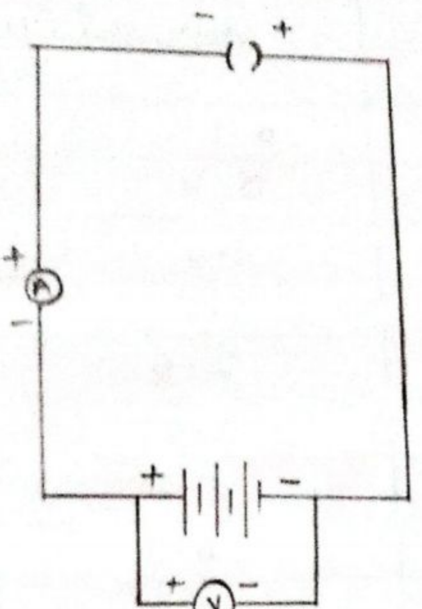
Hense :- m = mass of electron
ϑ_0 = threshold frequency
$\nu - V_0$ = velocity of photoelectron
e = electric charge

slope of equation (1) $h = e\tan\theta$
make connection according to figure with light source and align filter property.
first place blue filter at has stand S. I. the light of photocell falls on the lamp while passing throught the blue filter.

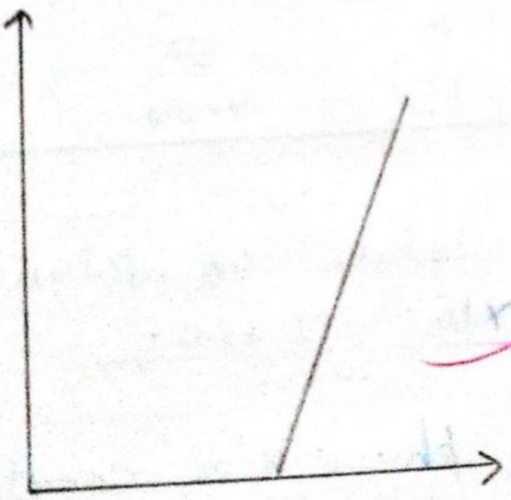
photocell.

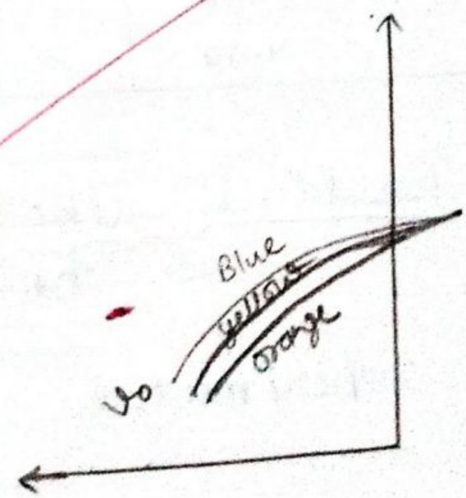


forward bias.



Reverse bias





(b)

The current in ammeter doubles 400 μA for blue filter.
Now increase the voltage gradually & note down the corresponding reading of current in μA.
Similarly note down reading of V and I for R.B. Repeat the steps for green and orange light.

Observation Table :-

Blue filter. :-

S.No.	Forward Bias voltage (V)	current (μA)	Reverse Bias voltage (mV)	current (μA)
1	0	480	0	480
2	0.1	490	20	440
3	0.2	500	40	420
4			60	400
5			80	390
6			100	380
7			120	350
8			140	330
9			180	300
10			200	280
11			220	250
12			240	200

		260	
13		280	180
14		300	150
15		320	120
16			90
17		320	50
18		340	70
19		360	0

Green filter :-

	forward Bias		Reversebias	
	voltage(v)	current (μA)	voltage(v)	current (μA)
1	0	360	0	360
2	0.1	430	20	250
3	0.2	500	40	340
4			60	330
5			80	310
6			100	300
7			120	280
8			140	260
9			160	240
10			180	220
11			200	180
12			220	160
13			240	130
14			280	100
15			280	70
16			300	40
17			320	0

orange filter :-

	Forward Bias voltage (V)	current (μA)	Reverse Bias voltage (mV)	current (μA)
1.	0	280	0	280
2.	1	360	20	270
3.	2	430	40	260
4.	3	500	60	250
5.			80	240
6.			100	280
7			120	220
8.			140	210
9.			160	190
10			180	170
11.			200	140
12			220	120
13			240	100
14			260	70
15			280	40
16			300	0

<u>Calculation :-</u> $e = 1.6 \times 10^{-19} C$, $c = 3 \times 10^{8} m/sec.$

wavelength of orange fillter $\lambda_o = 5400 \times 10^{-8} cm.$
wavelength of blue fillter $\lambda_B = 5100 \times 10^{-8} cm.$
wavelength of green fillter $\lambda_a = 5200 \times 10^{-8} cm.$
frequency of blue fillter $(\nu_B) = \frac{c}{\lambda_B} = 58.8 \times 10^{13} sec^{-1}$
frequency of green fillter $(\nu_a) = \frac{c}{\lambda_a} = 57.6 \times 10^{13} sec^{-1}$
frequency of orange fillter $(\nu_o) = \frac{c}{\lambda_o} = 55.5 \times 10^{-13} sec^{-1}$

from graph, slope of straight line between stopping potential and frequency $\tan\theta = h/e$

$$h = e \tan\theta$$

$$\tan\theta = \frac{40 \times 10^{-3}}{1.2 \times 10^{13}} = 33.83 \times 10^{-16}$$

Now, $h = e \tan\theta \Rightarrow \tan\theta = \frac{40 \times 10^{-3}}{1.2 \times 10^{13}} = 33.33 \times 10^{-16}$

Now, $h = e \tan\theta = 1.6 \times 10^{-19} \times 83.33 \times 10^{-16}$

$$h = 5.33 \times 10^{-34} \text{ J-sec.}$$

percentage error $= \frac{\text{practical value} - \text{standard value}}{\text{practical value}} \times 100$

$$= \frac{1.29}{662} \times 100\%$$

$$= 0.1948 \times 100\% \Rightarrow 19.48\%$$

300 | 0

Result :-

Theoretical value of planck's constant is 6.62×10^{-34} J-sec.

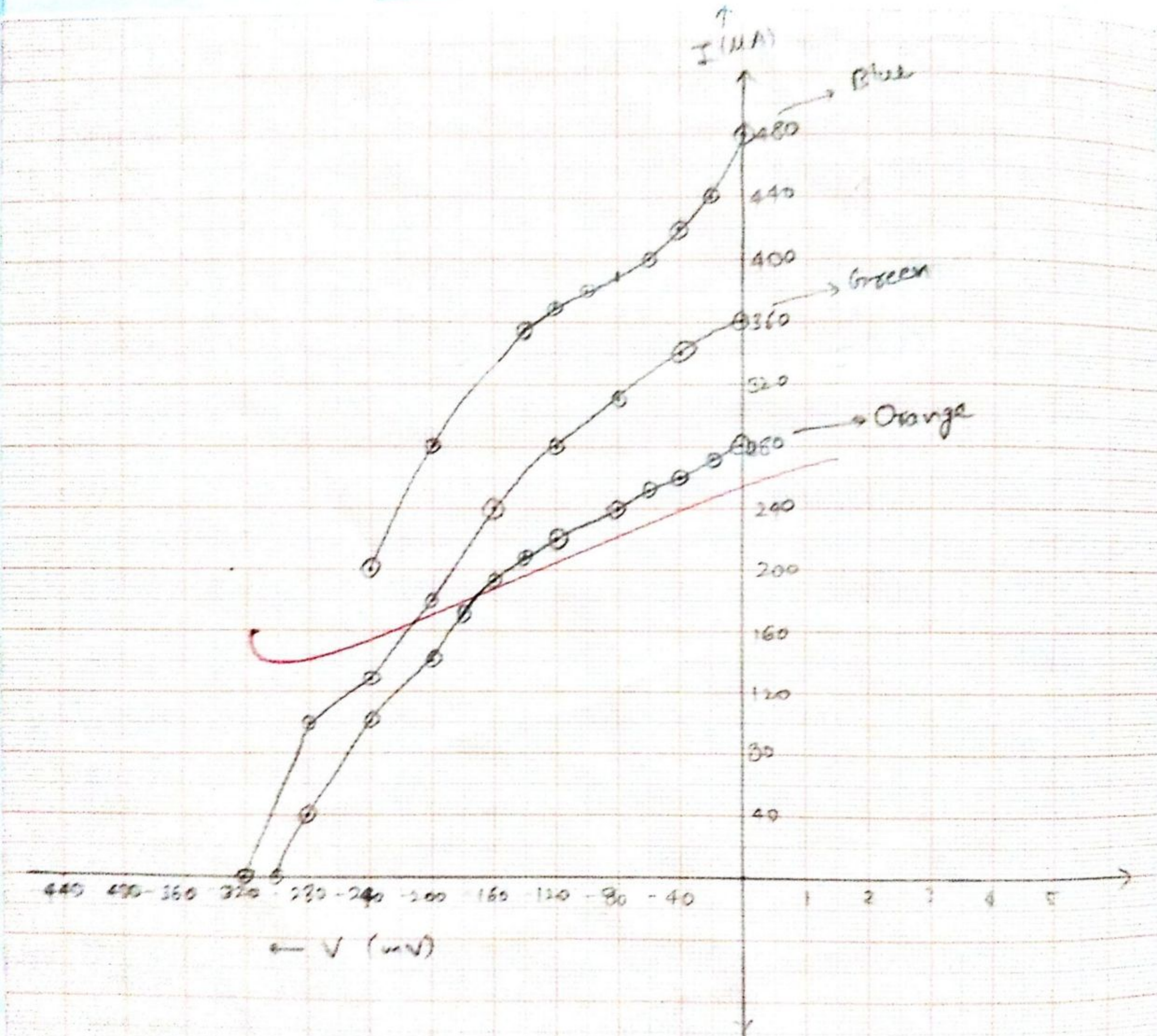
practical value of planck's constant is $= 5.23 \times 10^{-34}$ Joule·sec.

Teacher's Signature ______________

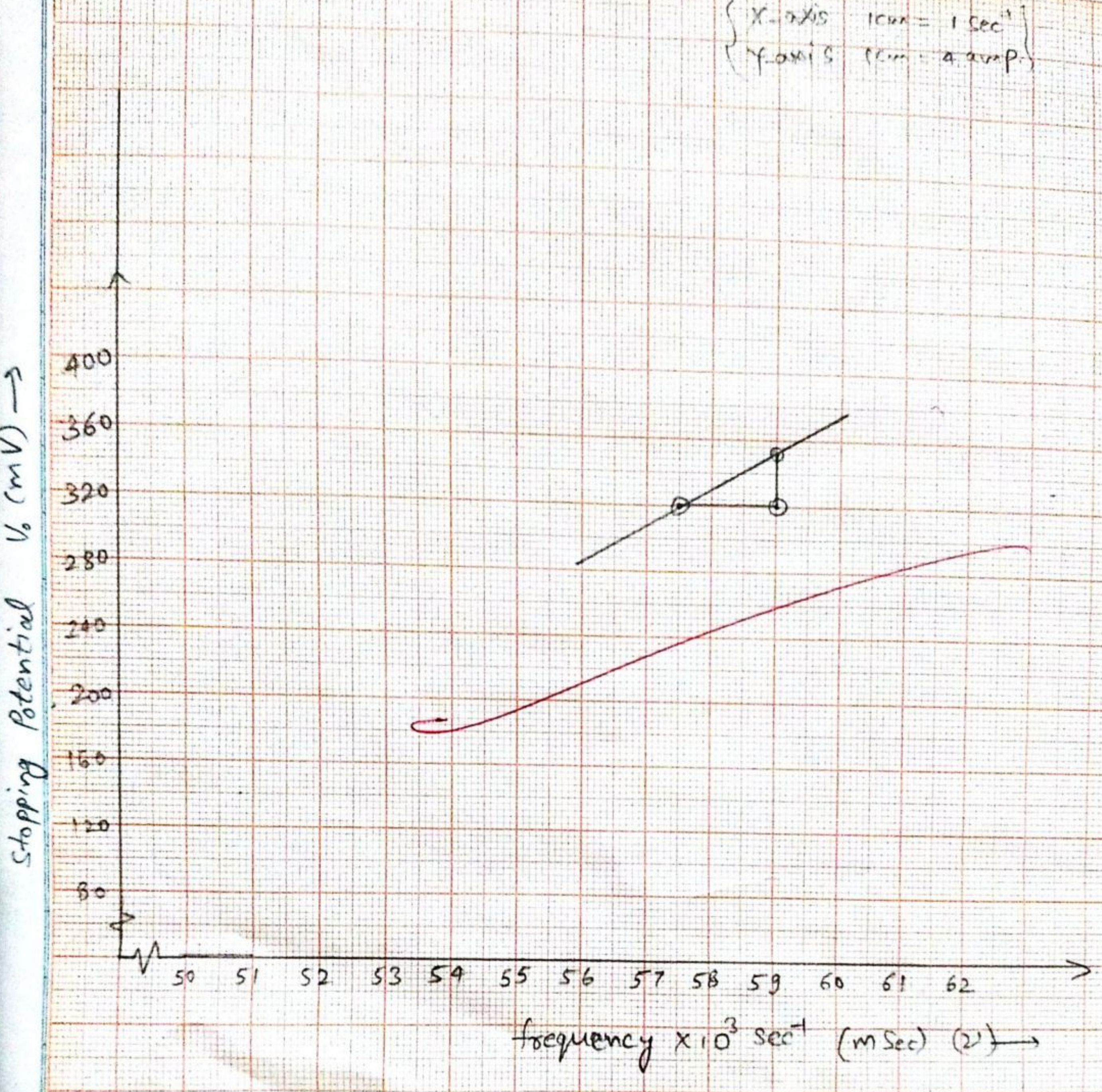
percentage error = 19.48 %

filter	frequency (sec^{-1})	stopping potential V_0 (mV)
Blue	360	53.3×10^{13}
Green	320	57.6×10^{13}
orange	300	55.5×10^{13}

for Reverse.



I (μA)
Blue
Green
Orange
480
440
400
360
320
280
240
200
160
120
80
40
440
400
360
320
280
240
200
160
120
80
40
1
2
3
4
5
← V (mV)


X-axis 1cm = 1 sec⁻¹
Y-axis 1cm = 4 amp.
Stopping Potential V₀ (mV) →
400
360
320
280
240
200
160
120
80
50
51
52
53
54
55
56
57
58
59
60
61
62
frequency × 10³ sec⁻¹ (m Sec) (ν) →

DATE ....

Experiment - 5

DETERMINATION OF THERMAL Conductivity of Bad Conductor by LEE Method.

APPARATUS:
New Tech Type DM – 103 experimental setup is required for performing the experiment. The setup consists of Lee's apparatus, two thermometers, steam boiler, two bad conductor discs one of ebonite and other card board.

THEORY:
The thermal Conductivity of ebonite or card board disc or plate G is –

$$K = \frac{msd}{(\theta_1 - \theta_2)\,\pi\, r_0^2} \cdot \frac{d\theta}{dt} \left(\frac{r + 2t}{2r + 2t}\right)$$

Where

m – Mass of brass disc.

s – specific heat of the material of disc D.

r – Radius of brass disc D.

t – Thickness of the brass plate.

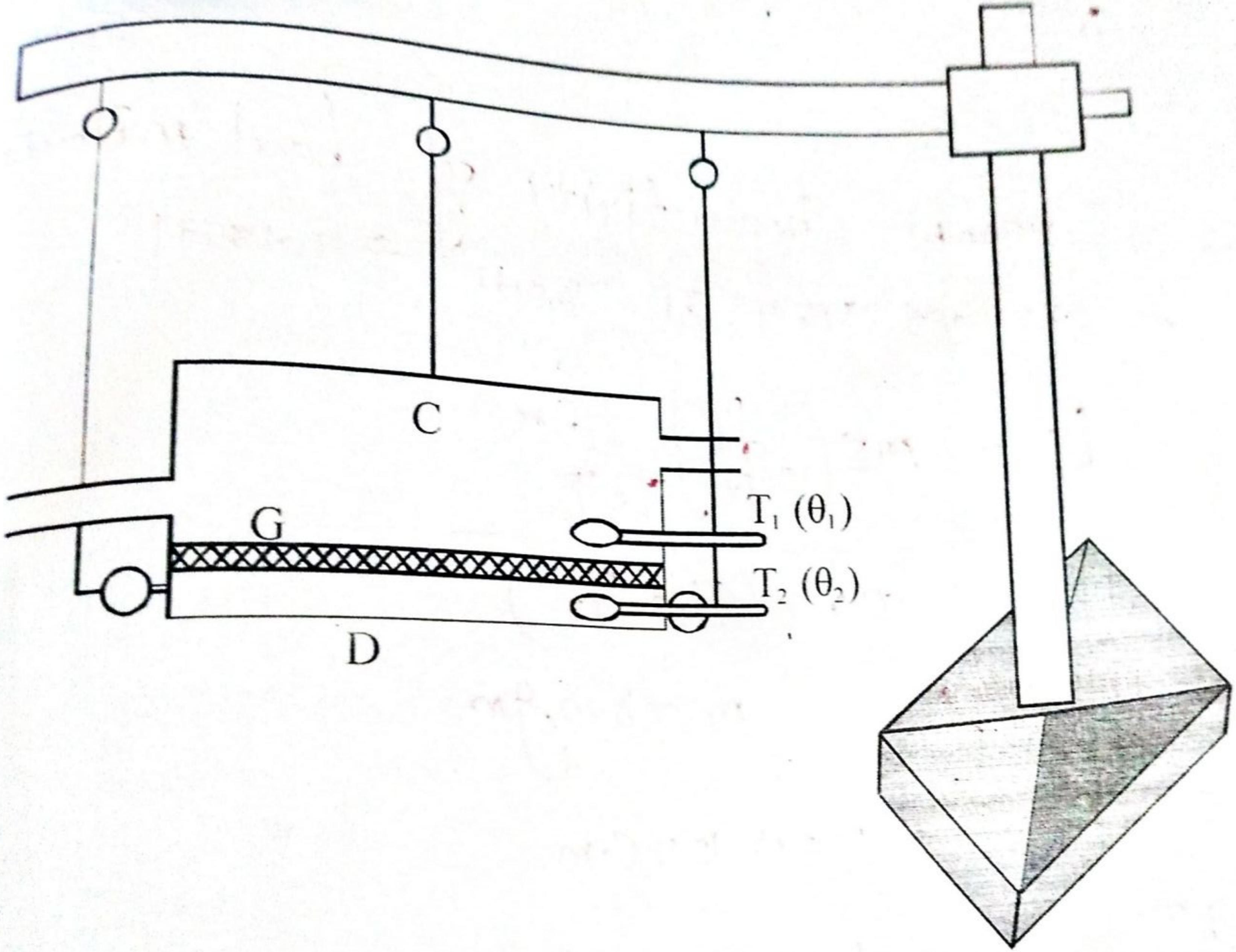
r_0 – Radius of ebonite or bad conductor plate.

d – Thickness of the card board plate.

θ_1 – Temperature of the hot surface of card board plate.

θ_2 – Temperature of the cold surface of card board plate.

$\frac{d\theta}{dt}$ - Rate of fall of temperature at temp. θ_2^0 C



FIGURE

OBSERVATION TABLE

OBSERVATION प्रेक्षण

(1) SPECIFIC HEAT OF SUBSTANCE (पदार्थ की विशिष्ट ऊष्मा) or material of disc ~~[illegible]~~ D = 0.11 Cal/g °C

(2) MASS OF DISC D = 800 gm
चकती D का द्रव्यमान

(3) RADIUS OF DISC C (चकती C की त्रिज्या)

S.N.	Main Scale M.S.	Vernier Scale V.S.	TOTAL Reading T.R.	MEAN
1.	11.1	8	11.18	11.18
2.	11.1	9	11.19	
3.	11.1	7	11.17	

(2) THICKNESS OF DISC C (चकती C की मोटाई)

S.N.	main Scale	Circular ~~[illegible]~~ Scale वृत्तीय स्केल	कुल मान Total Reading	Mean (माध्य)
1.	11	43	11.43	11.43
2.	11	42	11.42	
3.	11	44	11.44	

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(3) ~~कुचालक चक~~

THICKNESS INSULATING DISC (G)

(कुचालक चकती की मोटाई (G)) (कुल मान)

S.N.	M.S.	Circular scale Reading (वृत्तीय स्केल)	Total Reading
1	1	23	1.23
2	1	25	1.25
3	1	24	1.24

$\boxed{\text{Mean (माध्य)} = 1.24 \text{ mm}}$

(4)

<u>तापमापी T_1 का स्थायी ताप</u>

(Constant temperature of thermometer) T_1 = 98°C

तापमापी T_2 का स्थायी ताप

(Constant temperature of thermometer T_2) = 78°C

क्रम संख्या S.N.	तापमान Temperature	समय Time (sec)
1	83°	0
2	82°	33
3	81°	66
4	80°	99
5	79°	132
6	78°	165
7	77°	200
8	76°	200
9	75°	295
10	74°	340
11	73°	385

CALCULATION

$$K = \frac{Ms\left(\frac{dT}{dt}\right)_{T=T_2} \cdot x}{\pi r^2 (T_1 - T_2)}$$

$S = 0.11\ cal/g^{\circ}C$ $\quad$ $m = 800\ gm$

$r = 5.59\ c.m.$ $\quad$ $x = 0.124\ c.m.$

$\frac{dT}{dt} = 0.029^{\circ}C/sec.$ $\quad$ $T_1 = 98^{\circ}C$ $\quad$ $T_2 = 78^{\circ}C$

$$\boxed{K = \frac{800 \times 0.11 \times 0.029 \times 0.124}{3.14 \times 5.59^2 \times (98-78)}}$$

$$\boxed{K = 1.6 \times 10^{-4}\ cal/sec, cm^{\circ}C}$$

परिणाम (Result) = $K = 1.6 \times 10^{-4}$ Cal/Sec. Cm °C

Percentage error = $\frac{\text{प्रमाणित मान} - \text{प्रायोगिक मान}}{\text{प्रमाणित मान}} \times 100\%$

प्रतिशत त्रुटि

$= \frac{1.5 \times 10^{-4} - 1.27 \times 10^{-4}}{1.5 \times 10^{-4}} \times 100\%$

$= 1\%$

cm.-s-°C

PRECAUTIONS:

(1) The steam chamber C and D should be nickel polished so that the emissivity of both be same.

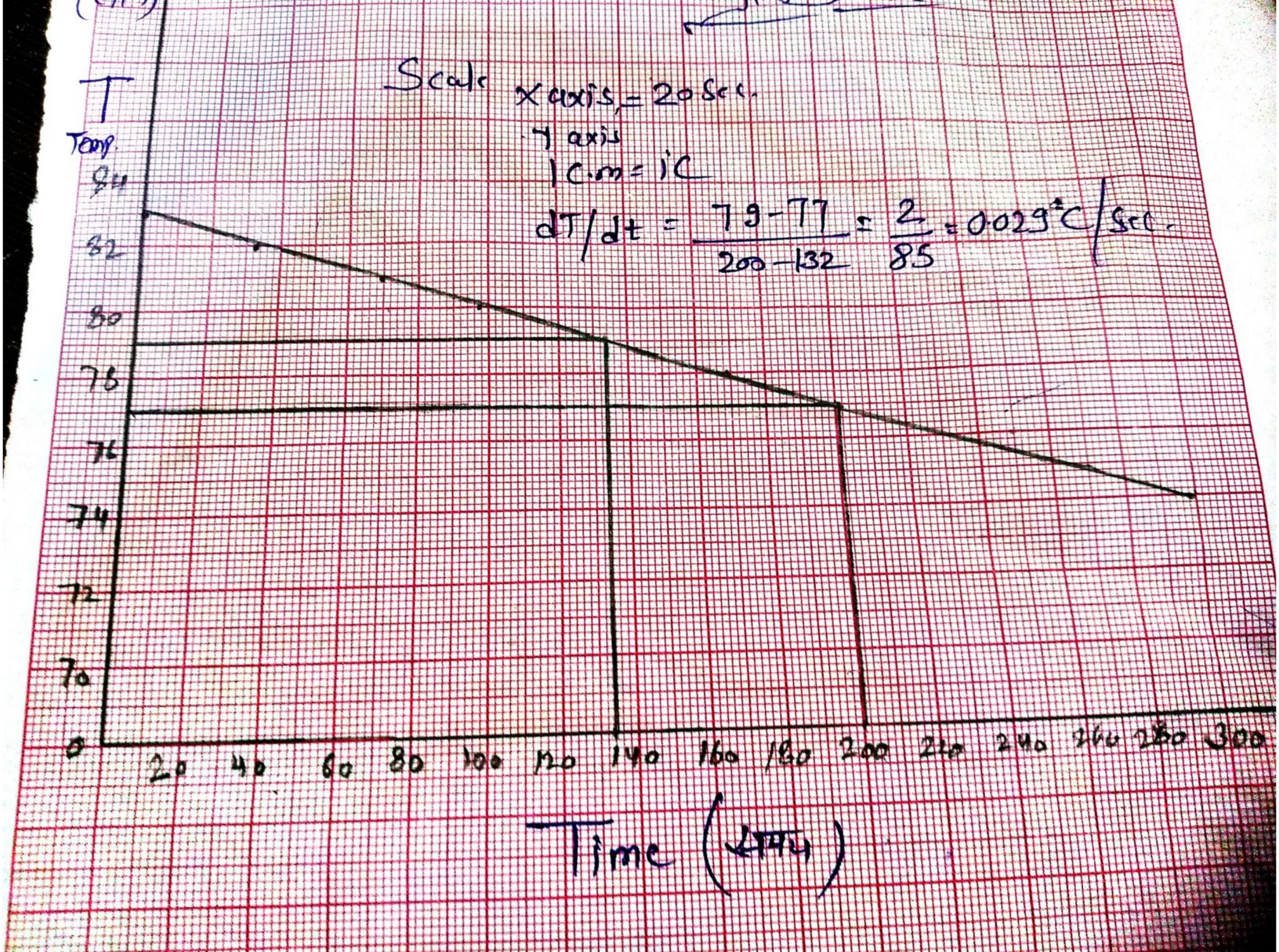
(2) Temperature θ_1 and θ_2 should be noted in steady state.

(3) Thermometer T_1 and T_2 should properly placed.

Operating Instructions for New Tech Type DM – 103

(4) Thickness of plate G should be measured at different places of card board plate.

(5) For calculating on removing card board plate the brass plate should be heated to a temp. nearly 10°C higher than θ_2 in steady state by placing it directly in contact with steam chamber.



T
Temp.
84
82
80
78
76
74
72
70
0
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Time
Scale x axis = 20 sec.
y axis
1 c.m = 1C
dT/dt = (79-77)/(200-132) = 2/85 = 0.029°C/sec.