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Experiment No :- 1

Aim of the experiment — To determine the thermal conductivity of a bad conductor by Lee's disc method.

Apparatus Required —

(1) Lee's apparatus.
(2) Thermometer.
(3) Rubber tube.
(4) weight bar.
(5) Travelling microscope.
(6) Stop watch.

Theory — when steam is passed through the steam chest, heat is conducted from D to C through the test material from where it is dissipated to the environment.

In the steady state :

Rate of heat conduction = Rate of loss of heat by that disc.

$$\therefore \frac{K A(\theta_1 - \theta_2)}{x} = mc\left(-\frac{d\theta}{dt}\right)_{\theta=\theta_2}$$

$$K = \frac{m c x}{A(\theta_1 - \theta_2)} \left(-\frac{d\theta}{dt}\right)_{\theta=\theta_2}$$

where, λ = thermal condutivity of the test material.
A = Area of the test material.
θ_1 = steady temp. recorded by T_1.
θ_2 = steady temp. recorded by T_2.
c = specific heat capacity of the material.
namely copper has 385 $J\,Kg^{-1}\,K^{-1}$
x = Thickness of the test material.
m = mass of the lower disc.

observation —

Thickness of the test material by screw gauze L.C = 0.01 mm.

S.No	MSR	V.C.	V.C X L.C	Total	mean
1.	1.2	7	0.07		
2.	1.2	7	0.07	3.80	1.26
3.	1.2	6	0.06		

Thickness of the test material:
= 1.26 mm
= 0.00126 m

Radius of disc,

$L.C = 0.01 cm$

S.No	MSR	V.C	V.C × L.C	Total	mean
1.	11.1	6	11.16		
2.	11.1	9	11.19	33.52	11.17
3.	11.1	7	11.17		

Radius of disc $= \frac{D}{2} = \frac{11.17}{2}$ cm

$= 5.58$ cm

$= 0.0558$ m

So, $\lambda = \frac{m c x}{A(\theta_1 - \theta_2)} \left(\frac{AB}{BC}\right)$

$= \frac{0.88 \times 385 \times 0.0012 \times 1.40}{0.00949 \times 22.5}$

$= \frac{338.8 \times 0.00163}{0.213525} = 2.66$

Result — $\boxed{\text{Thermal conductivity of test material} = 2.66\, m^{-1} K^{-1}}$

Experiment No:- 2

Aim of the Experiment —

To calibrate a platinum resistance thermometer and use it to measure unknown temperature of tap water.

Apparatus Required —

(i) platinum resistance thermometer.
(ii) P.O box
(iii) Rheostat
(iv) meter bridge wire
(v) Galvanometer
(vi) cell
(vii) connecting wire
(viii) plug key.

Theory —

platinum resistance thermometal is based on the change of resistance with change in temp.

A platinum resistance thermometer consists of a pure platinum wire would in a

Double spiral to avoid induction effect, the wire is would on a micaplates, the ends of the wire is connected to terminals PP to compensate for the resistance of the lead wire, two identical coils wire exactly of same length of as lead wire placed by their sides.

R_t = Resistance of a coil at t°c.

R_o = Resistance of a coil at 0°c.

The resistance of the wire change with temp. according to Eqn,

$$R_t = R_o\,(1 + \alpha t)$$

where α is const called temp. cofficient of metal.

The unknown temp. is given by relation

$$t_p = \frac{R_1 - R_o}{R_t - R_o} \times \Theta \quad \text{—— (i)}$$

where Θ is the boiling point of water in celsius and is given by,

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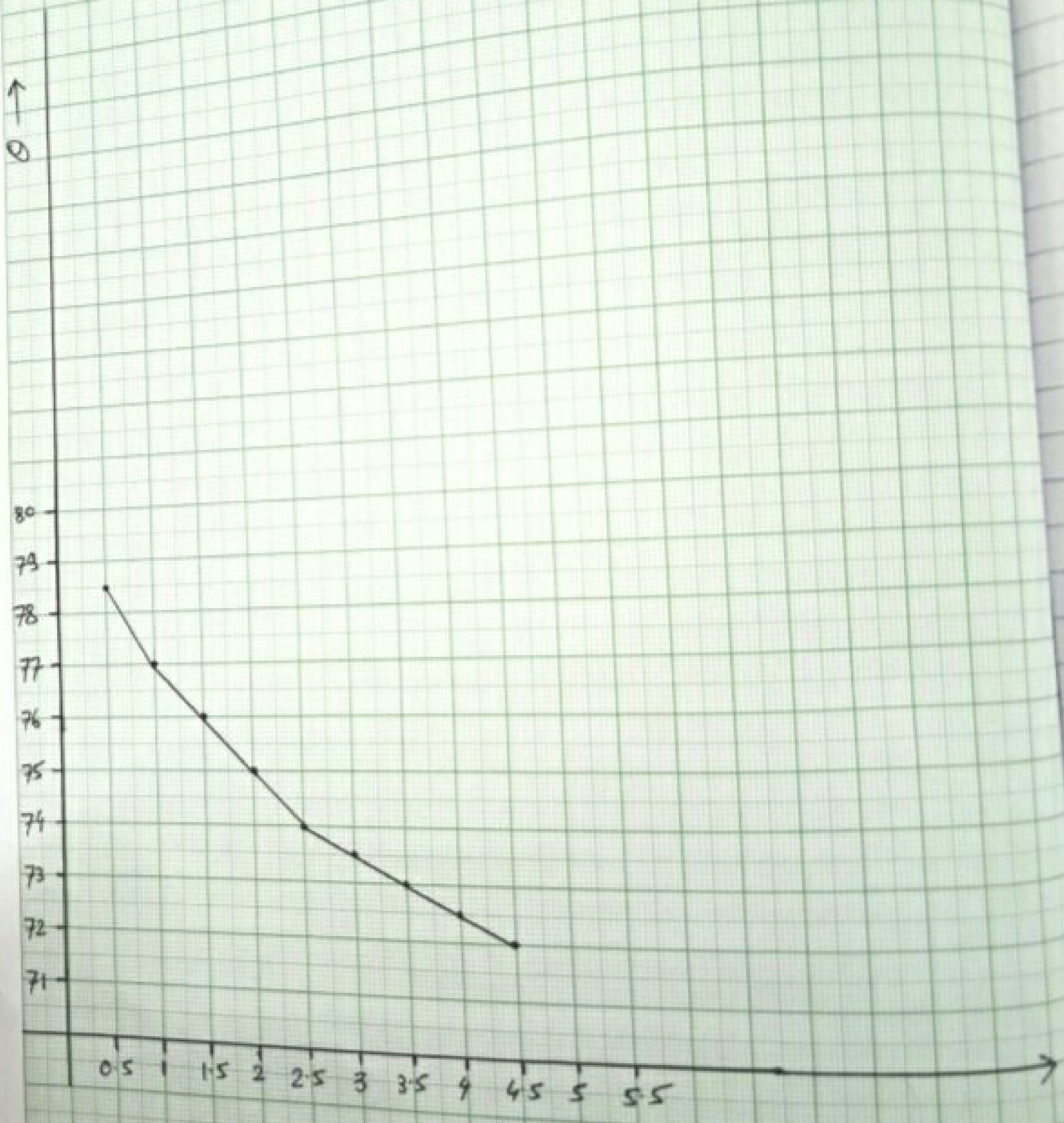

↑
θ
80
79
78
77
76
75
74
73
72
71
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
t →

where;
$$\theta = (100-37)(76-H)$$
H = ferrometer reading in cm.

This temp. is called platinum scale temp. It differs from the actual temp. because the exact temperature for relation is;

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

The received correction is given by;

$$t = t_p = S\left(\frac{t}{100} - 1\right)\frac{t}{100} \quad \text{—— (2)}$$

where 'S' is a const. for pt. its Value = 1.5

observation ——

l_0 = Distance of electrical mid-point = 42.3cm
H = farrometer reading = 69.95cm

r = Resistance per unit length of wire = 0.012

Thus;
$$\theta = (100 - 0.037)(76 - H)$$
$$= (100 - 0.037)(6.05)$$
$$\theta = 97.76°C.$$

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Temp. of bath	$R\Omega$	l (cm)	Lo (cm)	H - L - Lo	Rt = R+2r
0°C (Bath melting at 1°C)	11	50	50	50	11
$\theta = 100 - 0.37(76 \cdot H)$ (Bath boiling H_2O)	11	50	50	2	11.04
Bath of unknown temp.	11	50.2	50	0.5	11.01

calculation —

t_p = platinum scale temp.

$$= \left(\frac{R_t - R_0}{R_\theta - R_0} \right) \times \theta$$

$$t - t_p = S\left(\frac{t}{100} - 1 \right) \times \frac{t}{100}$$

$r = 1.5$ (for platinum)

calculated 't' from t_p is:

$t_p = 24.421$°C

1^{st} appear;

$$\text{correction} = 1.5\left(\frac{24.44}{100}\right) \times \frac{24.44}{100}$$
$$= -0.277 \simeq -0.28$$

Temp. of top water $= 24.17°c$
corrected temp. for first appear $= 24.44 - 0.28$
$= 24.16°c$

2^{nd} appear;

$$\text{correction} = 1.5\left(\frac{24.16-1}{100}\right) \times \frac{24.16}{100}$$

correction temp. after 2^{nd} appear $= 24.44 - 0.028$
$= 24.16°c$

$$t_p = \frac{R_t - R_o}{R_0 - R_o} \times Q$$

$$t = t_P = S\left(\frac{t}{100} - 1\right) \times \frac{7}{100}$$

where S = constant.

for platinum $= 1.5$

calculation of t_p;
Pt scale temp. $= \left(\frac{R_t - R_o}{R_Q - R_o}\right) Q$

$$= \left(\frac{11.01 - 11}{11.04 - 11} \right) \times 97.76$$

$\therefore t_p = 24.44^\circ c$

Result —

$\boxed{\text{Temperature of tap water} = 27.04^\circ c}$

Experiment No :- 3

Aim of the experiment —

To determine the coefficient of the thermal conductivity of copper by Searle's appuratus.

Apparatus Required —

(1) Searle's thermal conductivity apparatus.
(2) Boiler
(3) Two thermometers (0-110°c)
(4) Two thermometer (0-50°c)
(5) Stop watch
(6) vernier callipers
(7) Beaker.

Theory —

one end of a cylindrical (AB) copper bar is maintained at a steady high temp. by passing steam in the steam chest C and the other end is cooled by circulating cold water ~~the~~ through the copper spiral tubings would closely over the end.

In the steady state of the bar, i.e when temp. of each point becomes constant, the quantity of heat flowing any normal section per second is,

$$Q = \frac{KA(\theta_1 - \theta_2)}{d} \quad \text{--- (1)}$$

If a mass m of water energy from the copper spiral in t seconds and θ_3°C and θ_4°C are the steady temperature of the in flowing and outflowing waters then the quantity of heat absorbed by water per second is,

$$\boxed{\frac{m(\theta_4 - \theta_3)}{t}}$$

Hence, $\frac{KA(\theta_1 - \theta_2)}{d} = \frac{m(\theta_4 - \theta_3)}{t}$

$$\therefore K = \frac{m(\theta_4 - \theta_3)\,d}{A(\theta_1 - \theta_2)\,t} \quad \text{--- (2)}$$

Area of cross-section (A) =

$$\frac{\pi D^2}{4} = \frac{22}{7} \times \frac{(2.55)^2}{4}$$

$$= 5.11\,cm^2$$

Distance (d) between two thermometer T_1 and T_2 :

$$d = \frac{10.6 + 10.7 + 10.8 + 10.2 + 10.3 + 10.4}{6} = 10.5 \text{ cm.}$$

To find the mass (m) of water collected in 't' sec

S.No	mass of empty beaker (gm)	mass of beaker + water	mass of water collected (m)	time of collection in seconds.
I	96.57	242.002	145.432	120

Hence, from thermometer readings, we have :

$$\theta_1 - \theta_2 = \frac{78.5 - 51.5 + 78.4 - 51.5}{2} = 27^\circ C$$

$$\theta_4 - \theta_3 = \frac{38.5 - 2.84 + 38.6 - 28.5}{2}$$

calculation —

$$K = \frac{m(\theta_4 - \theta_3)d}{A(\theta_1 - \theta_2)t} = \frac{145.432 \times 10.1 \times 10.50}{5.11 \times 27 \times 120}$$

$= 0.9315$ cal / sec / cm / °c

$= 0.9315 \times 420$

$= 391.2$ $wm^{-1} K^{-1}$

Result — $K = 0.931$ cal / sec / cm / °c

Standard value of K (cu) = 0.918 cal / sec / cm / °c

% error = 1.4

Experiment No :— 4

Aim of the Experiment —

To determine the plank's constant i.e 'h'

Apparatus —

(1) photo - cell and filter

(2) 1·5V or 2V cell with key

(3) 1KΩ Rheostat

(4) milli - voltmeter [1500 mV (DC), pre ferably FET - met hy]

(5) micrometer [50 μA]

(6) mercury bulb or milky bulb (at least 100 watt).

Theory —

Einstein photoelectric equation is

$$h\nu = h\nu_0 + \frac{1}{2} m v^2$$

or,

$$h\nu = h\nu_0 + eV_s$$

where, e = electric charge.

Expt. No.

Date

Vs = stopping potential for electron.

The potential (−ve) on anode of the cell which is just sufficient to stop photo electron emission,

we have i,

$$V_s = \frac{h\nu}{e} - \frac{h\nu_0}{e}$$

comparing it with the Equation of a straight line, viz.

$$\boxed{y = mx + c}$$

we have, $m = \tan\theta = \frac{h}{e}$

$$\therefore \boxed{h = e\tan\theta}$$

circuit diagram —

The compound are arranged as shown in the accompanying figure. the diffrent points are explained below.

A·K — Anode and cathode of photocell.

Filter — coloured glass, wich filter out only a

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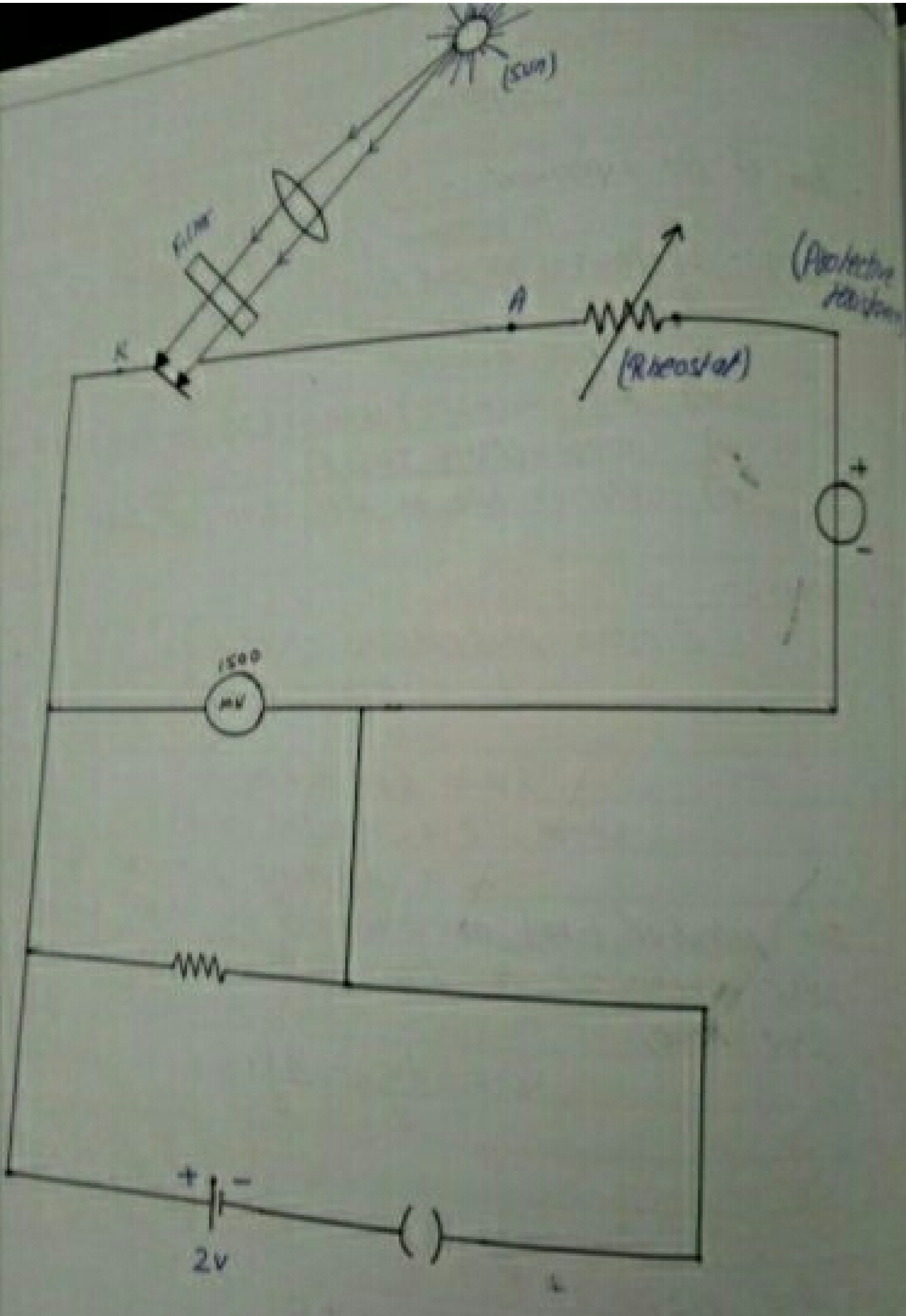
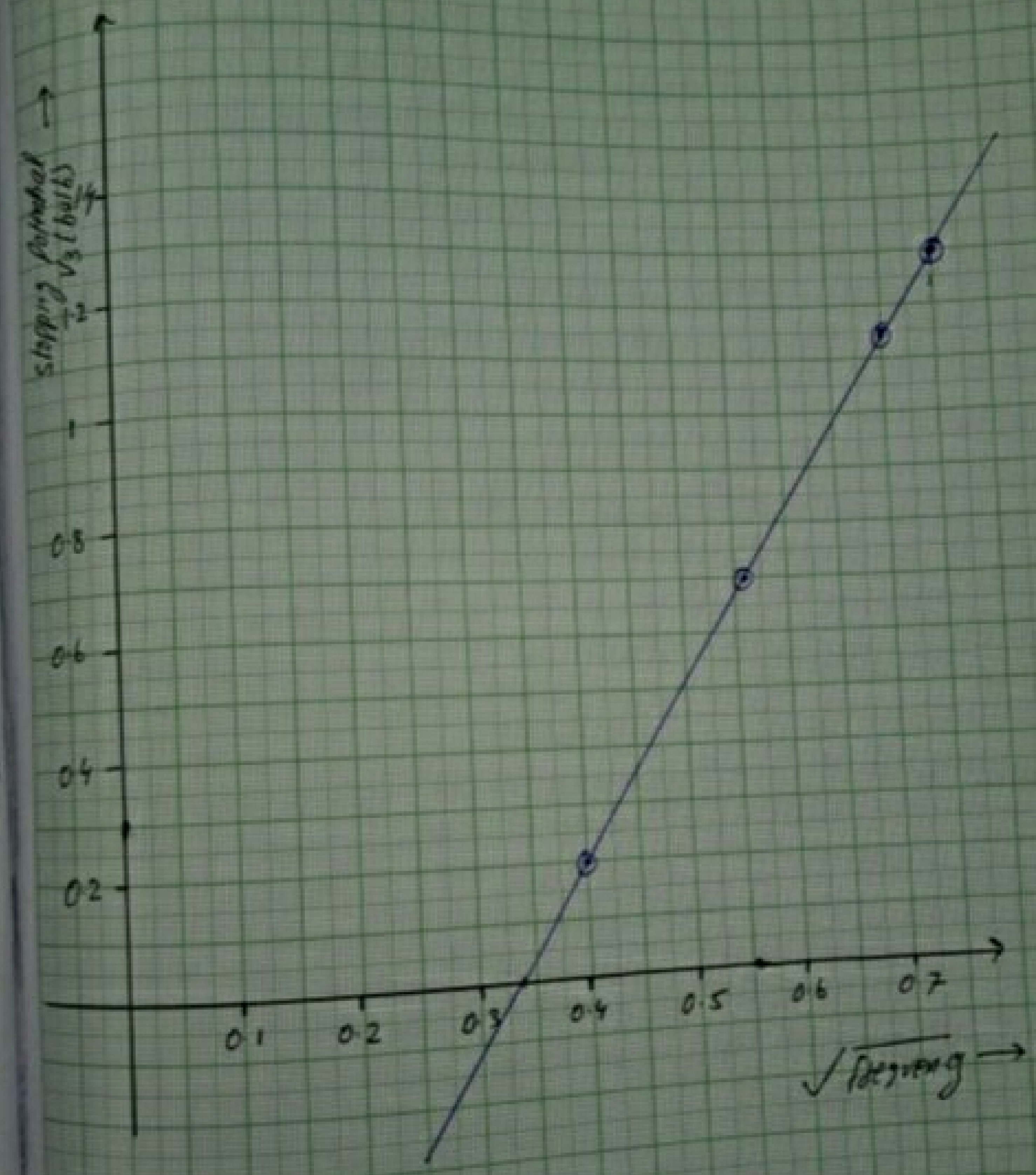

(Sun)
Film
K
A
(Rheostat)
(Protective resistance)
+
-
1500
mV
2v


stopping potential
0.2
0.4
0.6
0.8
1
1.2
1.4
0.1
0.2
0.3
0.4
0.5
0.6
0.7

single colour(d) of light.

S — Mercury lamp milky bulb (100 watt)

Lens — convex of short focal length to condense the incident light.

protective Resistance — 10 KΩ resistance box or potentiometer, its value remaining high at start and zero finally.

3500 MV → D.C this must be of 20KΩ / volt2 of high sensitivity.

μA → D.c preferably 0 – 50 μA to 100 μA.

observation —

Data for stopping potential.

λ(Å) with source	mv-reading (volt)	Deflection in μA
5893(Blue)	0.0	50
	0.2	50

Fillter – 1 →

[similarly for other fillter]

plot graphs between deflections in WA (on y – axis) and on x – reading in Volt (on x-axis). for sodium light and for light from all the fillter on the same paper.

for each colour of light V_0 is determined from the graph where the curve touches the x – axis.

From the wave length λ, calculation should be made of frequency ν by the relation.

$$c = \nu \cdot \lambda$$

where $c = 3 \times 10^{10}$ cm / sec (velocity of light)

Calculation —

From the graph,

$$\tan\theta = \frac{1.42 \times 10^{5}}{0.7 - 0.34} \quad \{\tan\theta = h/e\}$$

$$= 4 \times 10^{-15}$$

$$\therefore h = e \tan\theta$$
$$= 1.6 \times 10^{-19} \times 4 \times 10^{-15}$$

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$= 6.4 \times 10^{-34}$ JS

Threshold frequency = $\boxed{0.34 \times 10^{5}\ sec^{-1}}$.