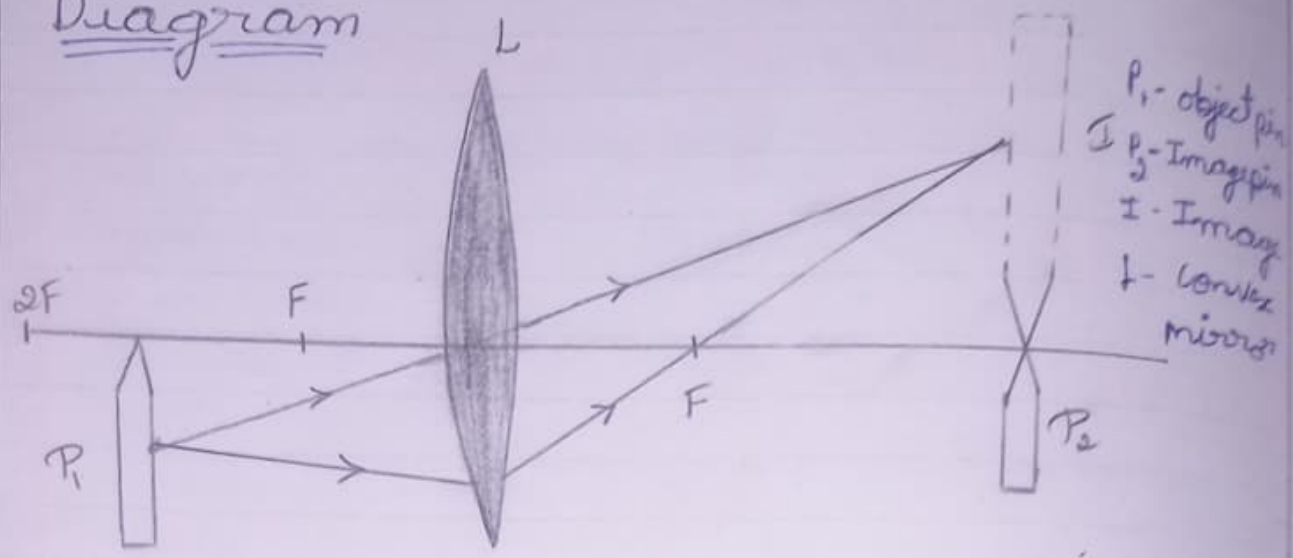
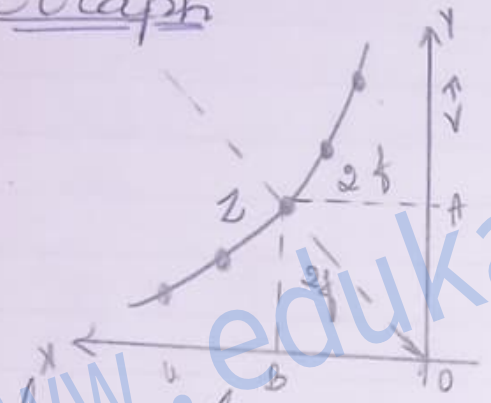
Diagram



Graph



observation.

Tabular column

Trial no	object distance u in cm	Image distance v in cm
1	26	37
2	27	34
3	28	33·2
4	29	31·3
5	30	30·5

Date

Expt. No. 1 Page No. 1

Focal length of convex lens.

Aim: Determination of the focal length of a convex lens by plotting a graph of u/v

Apparatus: optical bench, two sharp edge pins convex lens by plotting a graph u/v

Principle: 1) The object distance must be greater than focal length of the convex lens to get real & inverted image

2) when object distance is equal to twice the focal length of the convex lens, then the image distance will be equal to twice the focal length.

Formula:

Focal length of the convex lens

$$f = \frac{OA \times OB}{H}$$

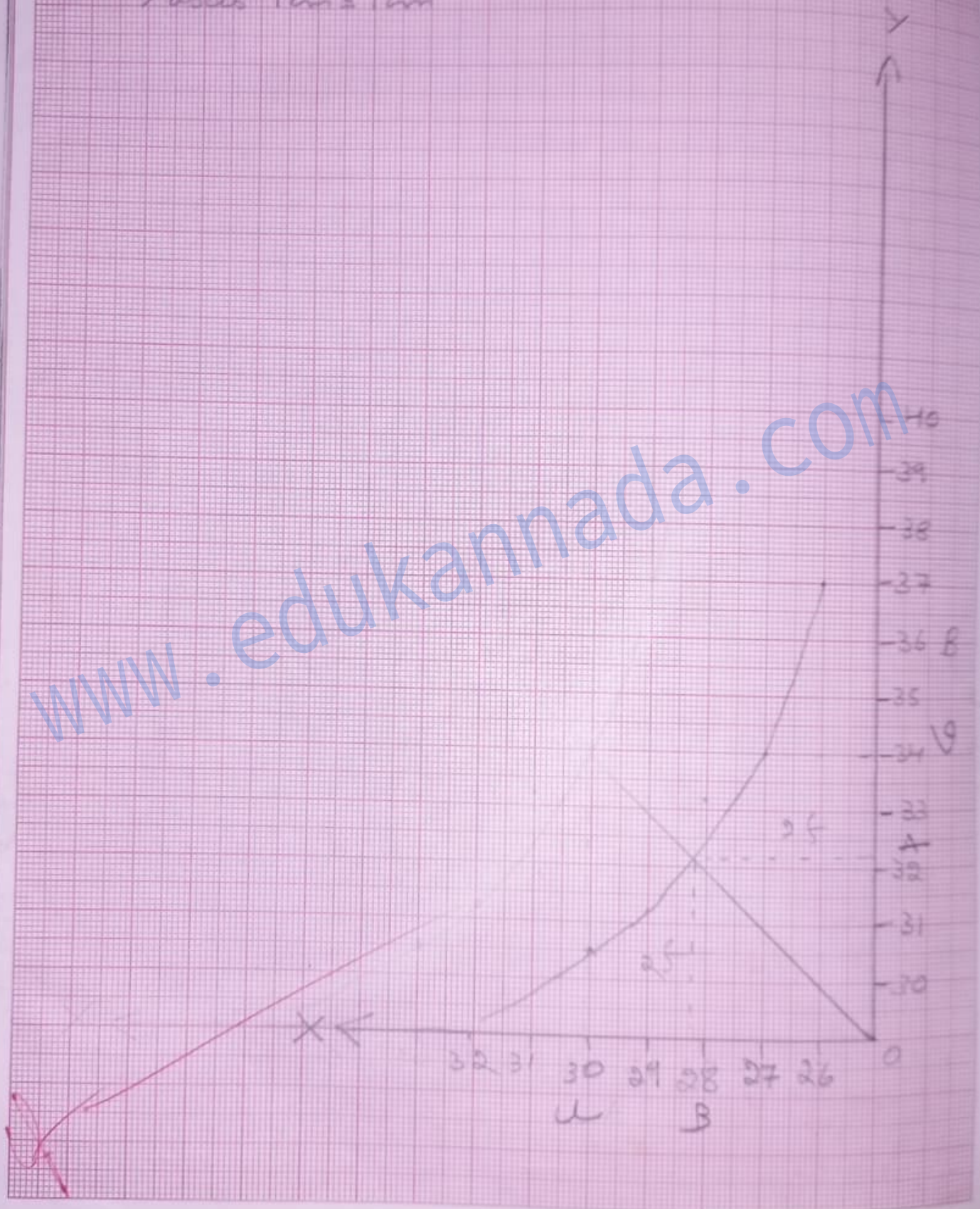
where OA - image distance
OB - object distance.

Teacher's Signature : _____

Scale

X axis 1cm = 1cm

Y axis 1cm = 1cm



Procedure :

1] The given convex lens is moved forward and backward to obtain the sharp image of the distant tree on the white sheet of paper kept vertically behind the lens. The distance between the lens and white sheet of paper is measured. This is the approximate focal length f of the lens.

2] The upright mounted with convex lens, object pin P_1 & image pin P_2 are placed on one side of the optical bench as shown in the figure.

3] The heights of the object pin P_1 & image pin P_2 are adjusted such that their tips lie on the principal axis of the lens.

4] The position of the object pin P_1 is adjusted such that it will be at a distance u which is greater than f of the lens.

5] Seeing the inverted and enlarged image of the object pin P_1, the position of the image pin P_2 is adjusted so that its tip coincides with the tip of the image without parallax. Then the distance between the convex lens and image pin P_2 becomes image distance v.

Teacher's Signature : _____

Calculation

$$f = \frac{\sigma A + \sigma B}{H}$$

$$= \frac{32.2 + 28.2}{H}$$

$$= \frac{60.4}{H}$$

$$= 15.1$$

6] Experiment is repeated for differed value of u and reading are tabulated

7] A graph is plotted between u & v taking u on x-axis & v on Y-axis. The angular bisector OZ is drawn and $\angle AOB$ are measured

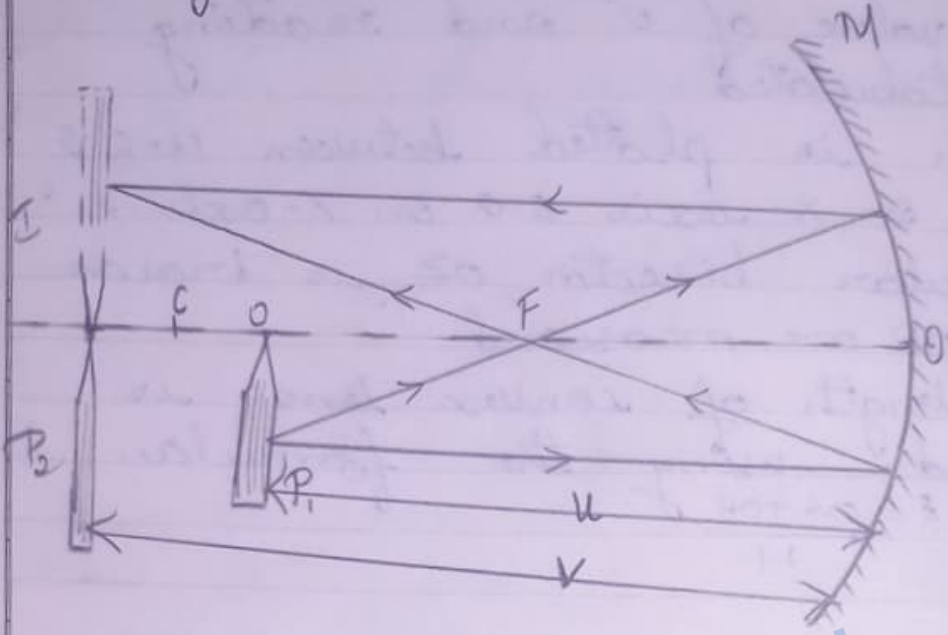
8] Focal length of convex lens is calculated using the formula.

$$f = \frac{OA + OB}{4}$$

Result :- The focal length of the convex lens $f = 15.1$ cm

Teacher's Signature : _____

Diagram



P_1 - object pin
P_2 - Image pin
I - Image
M - concave mirror

Observation

Tabular column

Trial no	object distance u in cm	Image distance v in cm	$f = \frac{uv}{u+v}$ in cm
1	26	29	16.98
2	29	37.5	16.55
3	28	41	16.6
4	27	45	16.8

mean f = 16.718 cm

Date

Expt. No. 2 Page No. 11

Experiment No - 2

Focal length of concave mirror

Aim :- Determination of the focal length of a concave mirror by u-v method.

Apparatus :- optical bench, two sharp edge spirit concave mirror of focal length less than 20cm, three uprights with clamps and metre scale.

Principle :- 1) Focal length is the distance between the pole & principle focus of the mirror

2) The object distance must be greater than the focal length of the concave mirror to get a real & inverted image.

Formula :- Focal length of concave mirror

$$f = \frac{uv}{u+v}$$

Teacher's Signature : _____

calculation:

Trial 1 = $\frac{uv}{u+v}$

$= \frac{26 \times 49}{26+49}$

$= 16.98\,cm$

Trial 2 = $\frac{uv}{u+v}$

$= \frac{29 \times 37.5}{29+37.5}$

$= 16.35\,cm$

Trial 3 = $\frac{uv}{u+v}$

$= \frac{28 \times 41}{28+41}$

$= 16.63\,cm$

Trial 4 = $\frac{uv}{u+v}$

$= \frac{27 \times 45}{27+45}$

$= 16.87\,cm$

Procedure :-

1] The given concave mirror is moved forward and backward to obtain the sharp image of the distant object on the white sheet of paper kept vertically before the mirror. Then the distance between the mirror and the sheet of white paper gives the approximate focal length f of the concave mirror.

2] The uprights mounted with concave mirror, object pin P_1 and image pin P_2 are placed on one side of the optical bench as shown in the figure.

3] The heights of the object pin P_1 and image pin P_2 are adjusted such that their tips lie on the principal axis of the mirror

-or-

4] The position of the object pin P_1 is adjusted such that it will be at a distance u which is greater than f

5] Seeing the inverted and enlarged image of the object pin P_1 from the other side of the optical bench, the position of the image pin P_2 is adjusted so that

its tip coincides with the tip of the image without parallax. Then the distance between the concave mirror and image pin P_2 become image distance v

6] The focal length f of the concave mirror is calculated using the formula.

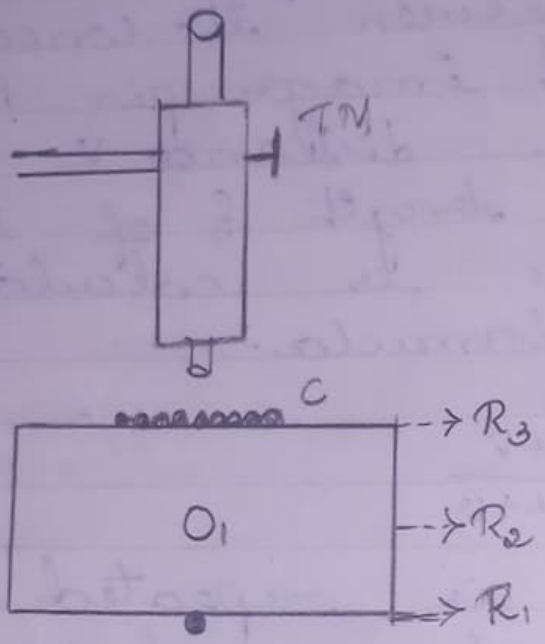
$$f = \frac{uv}{u+v}$$

7] Experiment is repeated for differed value of u and readings are tabulated and average focal length is found.

Result :- The focal length of the concave mirror $f = 16.70$ cm

Teacher's Signature : _____

Diagram



TM- travelling microscope
G_1- Glass slab
O - ink mark
I - Virtual image of the ink
C - chalk powder

Observation.

1] Value of 1MSD, S = 0.05 cm

2] Number of division on the Vernier, N = 50

3] Least count of the travelling microscope

$$LC = \frac{S}{N} = 0.001 \text{ cm}$$

Tabular column

Trial No	Reading R_1 in cm	Reading R_2 in cm	Reading R_3 in cm	Refractive index of glass $\mu_g = \frac{R_3 - R_1}{R_3 - R_2}$
1	H.397	H.891	5.891	1.49
2	H.393	4.894	5.892	1.50
3	H.39	H.888	5.891	1.49

Experiment No - 3

Refractive Index of glass

Aim :- Determination of the refractive index of glass using a glass slab and travelling microscope

Apparatus:- Travelling microscope
glass slab.

Principle :- The refractive index of the glass with respect to air is the ratio of depth of the apparent depth.

$$\text{Refractive index} = \frac{\text{real depth}}{\text{apparent depth}}$$

Formula:-

1. Refractive index of the glass with respect to air.

$$n_g = \frac{R_3 - R_1}{R_3 - R_2}$$

R_1 - Reading of the microscope when focused on the ink mark through air

calculation

Trial 1

$R_1 = MSR + (CVD \times LC)$
$= 1.35 + (17 \times 0.001)$
$= 1.35 + 0.017$
$= 1.397$ cm

$R_2 = MSR + (CVD \times LC)$
$= 1.85 + (11 \times 0.001)$
$= 1.85 + 0.011$
$= 1.891$ cm

$R_3 = MSR + (CVD \times LC)$
$= 5.85 + (18 \times 0.001)$
$= 5.85 + (0.018)$
$= 5.878$ cm

$ng = \frac{R_3 - R_1}{R_3 - R_2} = \frac{5.878 - 1.397}{5.878 - 1.891}$

$= 1.19$

Trial 2

$R_1 = MSR + (CVD \times LC)$
$= 1.35 + (43 \times 0.001)$
$= 1.35 + (0.043)$
$= 1.393$ cm

$R_2 = MSR + (CVD \times LC)$
$= 1.85 + (44 \times 0.001)$
$= 1.85 + (0.044)$
$= 1.894$ cm

$R_3 = MSR + (CVD \times LC)$
$= 5.85 + (42 \times 0.001)$
$= 5.85 + 0.042$
$= 5.892$ cm

$ng = \frac{R_3 - R_1}{R_3 - R_2} = \frac{5.892 - 1.393}{5.892 - 1.894}$

1.50

Trial 3

R_2 - Reading of the microscope when focused on the ink mark through glass slab

R_3 - Reading of the microscope when focused on the chalk dust on the upper surface of the glass slab.

2] Total reading of TM, R = MSR + (CVD × LC)

Procedure:-

1] The least count of the travelling microscope is calculated.

2] A sheet of white paper is placed on the base of travelling microscope and ink mark is made on it.

3] The microscope is adjusted to focus on the ink mark on the paper, MSR and CVD are noted in vertical scale and reading R_1 is calculated using formula R = MSR + (CVD × LC)

4] Glass slab is equal placed on the paper and the microscope is raised to focus on the ink mark through glass slab and corresponding reading R_2 is found.

5] chalk dust is sprinkled on

$R_1 = MSR + (CVD \times LC)$

$= 4.35 + (40 \times 0.001)$

$= 4.35 + 0.040$

$= 4.39\ cm$

$R_2 = MSR + (CVD \times LC)$

$= 4.85 + (38 \times 0.001)$

$= 4.85 + 0.038$

$= 4.888\ cm$

$R_3 = MSR + (CVD \times LC)$

$= 5.85 + (41 \times 0.001)$

$= 5.85 + 0.041$

$= 5.891\ cm$

$ng = \frac{R_3 - R_1}{R_3 - R_2} = \frac{5.891 - 4.39}{5.891 - 4.888}$

$= 1.49$

the upper surface of the glass slab and microscope is again raised to focus on the chalk dust and corresponding reading R_3 is found

6] Refractive index of glass is calculated using the formula

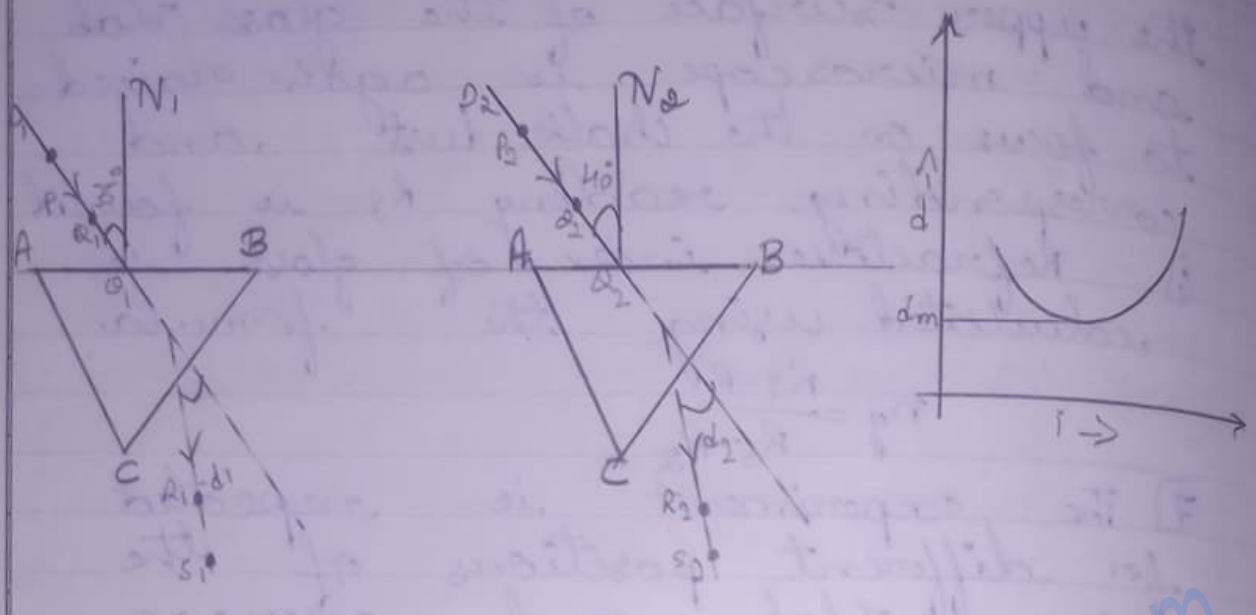
$$n_g = \frac{R_3 - R_1}{R_3 - R_2}$$

7] The experiment is repeated for different positions of the glass slab and average refractive index is found.

Result: The refractive index of glass = 1.49 ≈ 1.5

Teacher's Signature : _____

Diagram



observation

Trial No	Angle of incidence(i) in degree	Angle of deviation (d) in degree
1	35	45
2	40	40
3	45	38
4	50	35
5	55	36
6	60	40

Date

Expt. No. H Page No. 10

Experiment no - H

Angle of Minimum deviation:

Aim: Determination of angle of minimum deviation for a glass prism by plotting a graph between the angle of deviation and angle of incidence

Apparatus: Drawing board, triangular glass prism, drawing pins and white paper sheet.

Principle: The angle of deviation is the angle between the incident ray & the emergent ray at minimum deviation, the light ray passes through the prism symmetrically.

Hence angle of incidence = angle of emergence

Procedure:

1) A straight line is drawn on the sheet of white paper fixed on the drawing board.
2) The points O_1, O_2, O_3, O_4 & O_5 are marked

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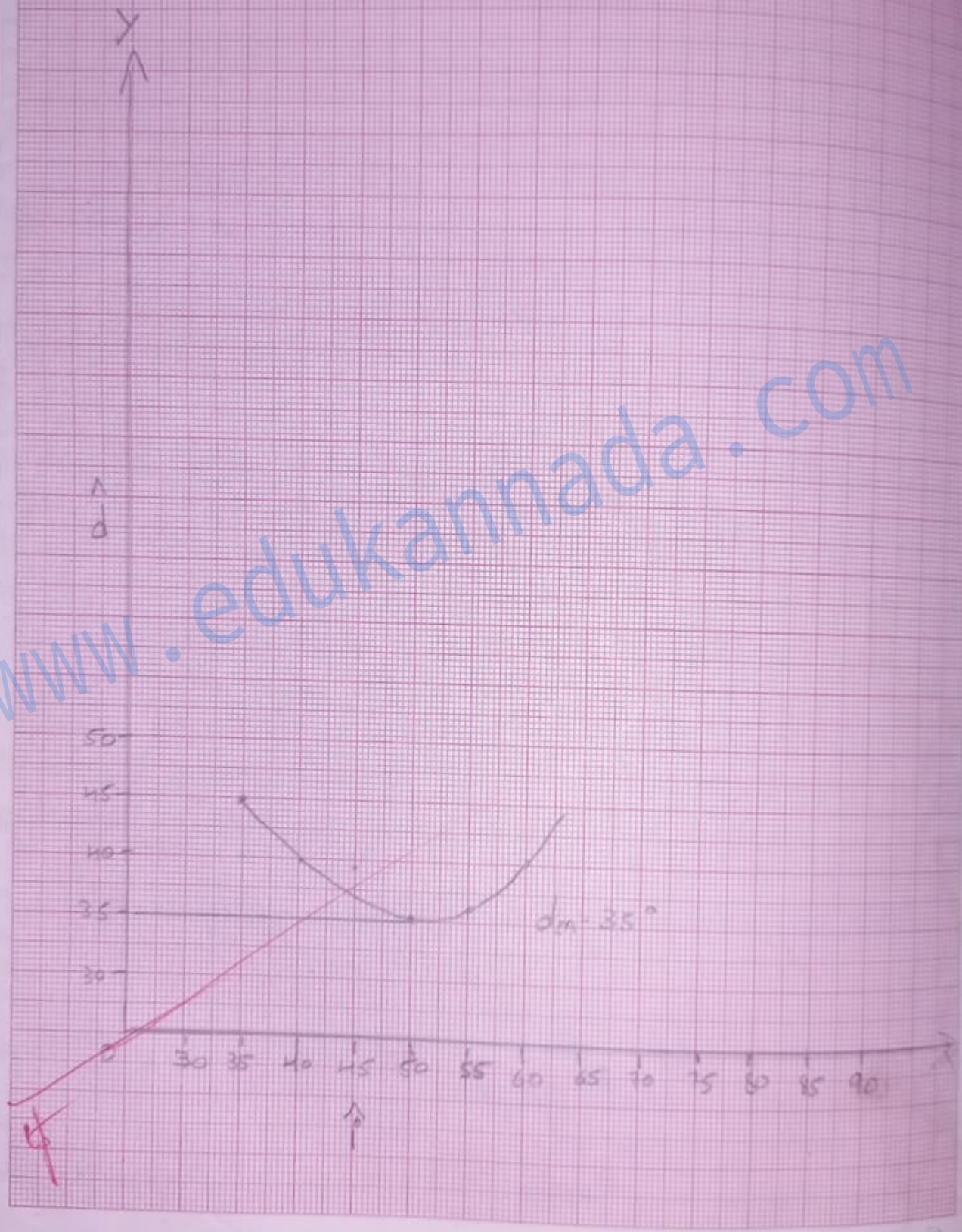
Scale: X axis 1cm = 5°
Y axis 1cm = 5°



on XY at distances of about 10cm apart

2] The points O_1 O_2, O_3, O_4 & O_5 are marked on XY

3] A normal N_1O_1 is drawn to XY at O_1 and a straight line O_1O_2 is drawn to represent ray of incidence which makes an angle of 35° with N_1O_1

4] The prism ABC is placed on the paper as shown in the figure and its boundary is drawn.

5] Two pins P_1 and O_1 are vertically fixed about 5cm apart on the ray of incidence O_1O_2

6] While seeing the image of pins P_1 and O_1 through BC two more pins R_1 and S_1 are fixed on the side of BC so that images of tips of pins P_1 & O_1 R_1 and S_1 will be collinear

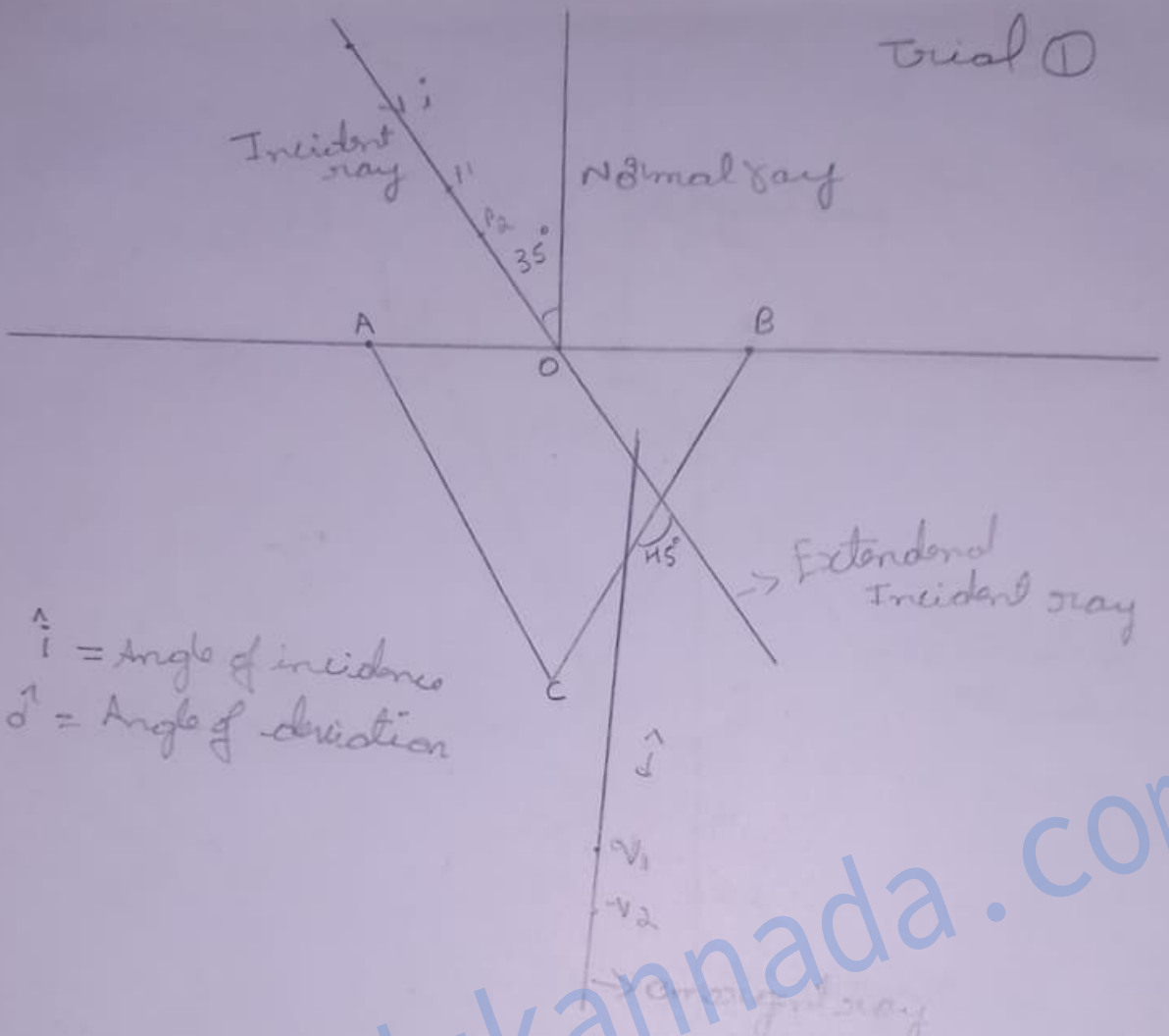
7] Pins are removed and their pricks are encircled. A straight line is drawn through pin pricks on R_1 & S_1 to obtain ray of emergence

8] Rays of incidence and emergence are extended as shown in the figure to find angle of deviation

9] Experiment is repeated for different value of angle of incident 40°, 45°, 50°, 55°, 60° and reading are tabulated

Teacher's Signature : _____

Trial ①



Date .....

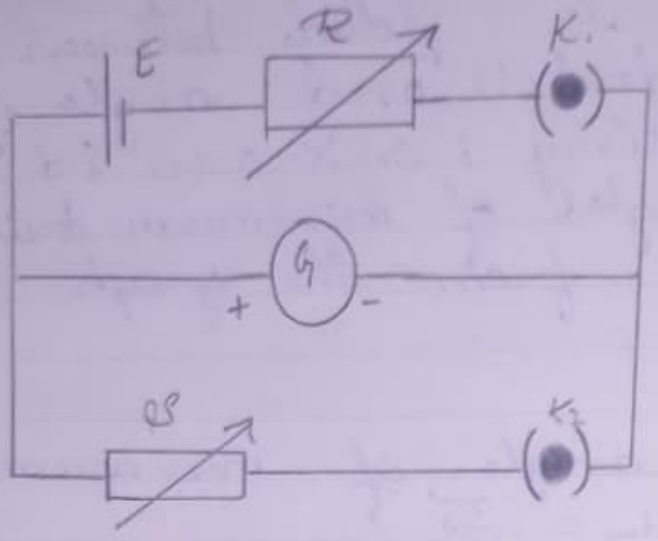
Expt. No. 4 Page No. 12

10] A graph is plotted between angle of incident (i) and angle of deviation (d) taking i on X-axis & d on Y-axis. The angle of minimum deviation d_m is found from the graph.

Result :- The angle of minimum deviation d_m = 35°

Teacher's Signature : _____

Circuit diagram



E - cell
K_1 & K_2 - Keys
G - Galvanometer
R & S - Resistance box

observation:

Emf of the battery E = 1.8 V

Tabular column

Trial No	Resistance R in Ω	Deflection θ in Div	S for θ/2 in Ω	$G = \frac{RS}{R-S}$ in Ω	$K = \frac{E}{(R+G)\theta}$ in A/Div
1	6900	16	100	101.47	0.00016
2	6H00	18	100	101.58	0.00053
3	6000	20	100	101.69	0.00017

Date

Expt. No. 5 Page No. 13

Experiment no : 5

Figure of Merit of Galvanometer

Aim :- Determination of the resistance of a galvanometer by half-deflection method and to find its figure of merit.

Apparatus :- Pointer galvanometer, cell, resistance box & two keys

Principle :- Deflection in a galvanometer is directly proportional to the current through the galvanometer

$$I = K\theta$$

where K is called of merit of the galvanometer.

Formula :- Figure of merit of the galvanometer

$$K = \frac{E}{(R+G_1)\theta}$$

where E - emf of the cell

G_1 - Galvanometer resistance

Teacher's Signature : _____

Calculation

Trial 1

$$C_1 = \frac{RS}{R-S} = \frac{6900(100)}{6900-100} = 101.47$$

$$K = \frac{E}{(R+C_1)\theta} = \frac{1.8}{(6900+101.47)16} = 0.00016$$

Trial 2

$$C_1 = \frac{RS}{R-S} \quad \frac{6400(100)}{6400-100} = 101.58$$

$$K = \frac{E}{(R+C_1)\theta} = \frac{1.8}{(6400+101.58)18} = 0.00153$$

Trial 3

$$C_1 = \frac{RS}{R-S} = \frac{6000(100)}{6000-100} = 101.69$$

$$K = \frac{E}{(R+C_1)\theta} = \frac{1.8}{(6000+101.58)20} = 0.00147$$

Date .....

Expt. No. 5 Page No. 14

Procedure :-

1] The connections are made as shown in the circuit diagram.

2] Key K_2 is opened and key K_1 closed. The suitable resistance R is unplugged to get even defelection θ in the galvanometer.

3] K_2 is closed and suitable resistance S is unplugged so that deflection becomes $\theta/2$. Then the resistance of the galvanometer G_r is calculated using the formula.

$$G_r = \frac{RS}{R-S}$$

4] The experiment is repeated for different values of θ and average value of G_r is found.

5] The emf E of the cell is measured using a voltmeter.

6] The figure of merit of the galvano-meter is calculated in each case using the formula $K = \frac{E}{(R+G_r)\theta}$

7] Experiment is repeated for different value of R and value of K is found.

Result :- The resistance of the galvanometer = 10.58 Ω

Teacher's Signature : _____

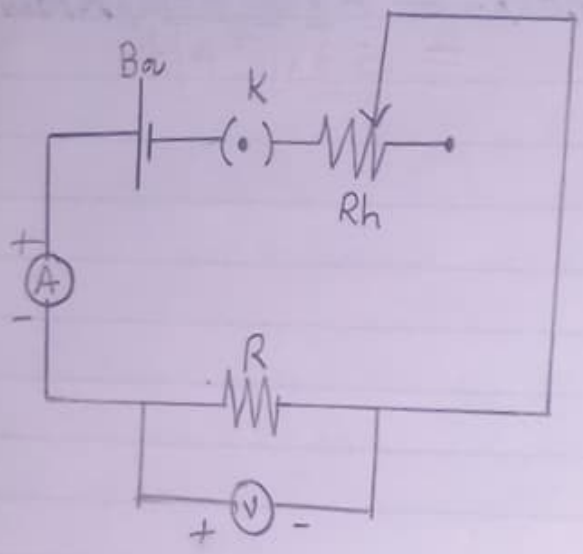
Date .....

Expt. No. 5 Page No. 15

The figure of merit of the given galvanometer = 0.000153 A/div
= 15.3×10^{-6} A/div

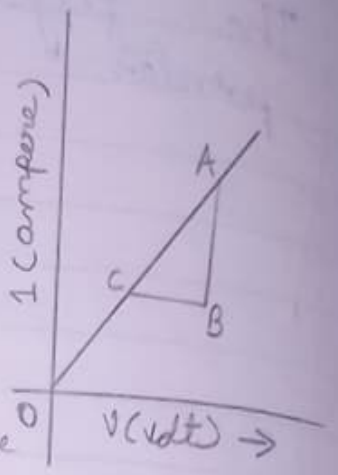
Teacher's Signature : _____

circuit diagram



Ba - Battery
K - Key
Rh - Rheostat
V - Voltmeter
A - Ammeter
R - Resistance wire

Graph



observation

length of the wire l = 0.44 m

Tabular Column

Trial No.	I in Ampere	V in Volt
1	0.1	0.2
2	0.2	0.4
3	0.3	0.6
4	0.4	0.8
5	0.5	1.0
6	—	—

Date

Expt. No. 6 Page No. 16

Experiment no: 6

Resitance per unit length of wire

Aim:- Determination of resistance per unit length of a given wire by plotting a graph of current verses potential difference.

Apparatus:- A wire of unknown resistance; battery, voltmeter, ammeter, plug key and rheostat & meter scale.

Principle:- Ohm's law: The electric current flowing through a conductor is directly proportional to the potential difference across the ends of the conductor when temperature & other physical condition remain constant.

Formula:

1] Resistance of the wire $R = 1/m$

where R - Resistance of wire

m - Slope of the graph of current versus potential difference

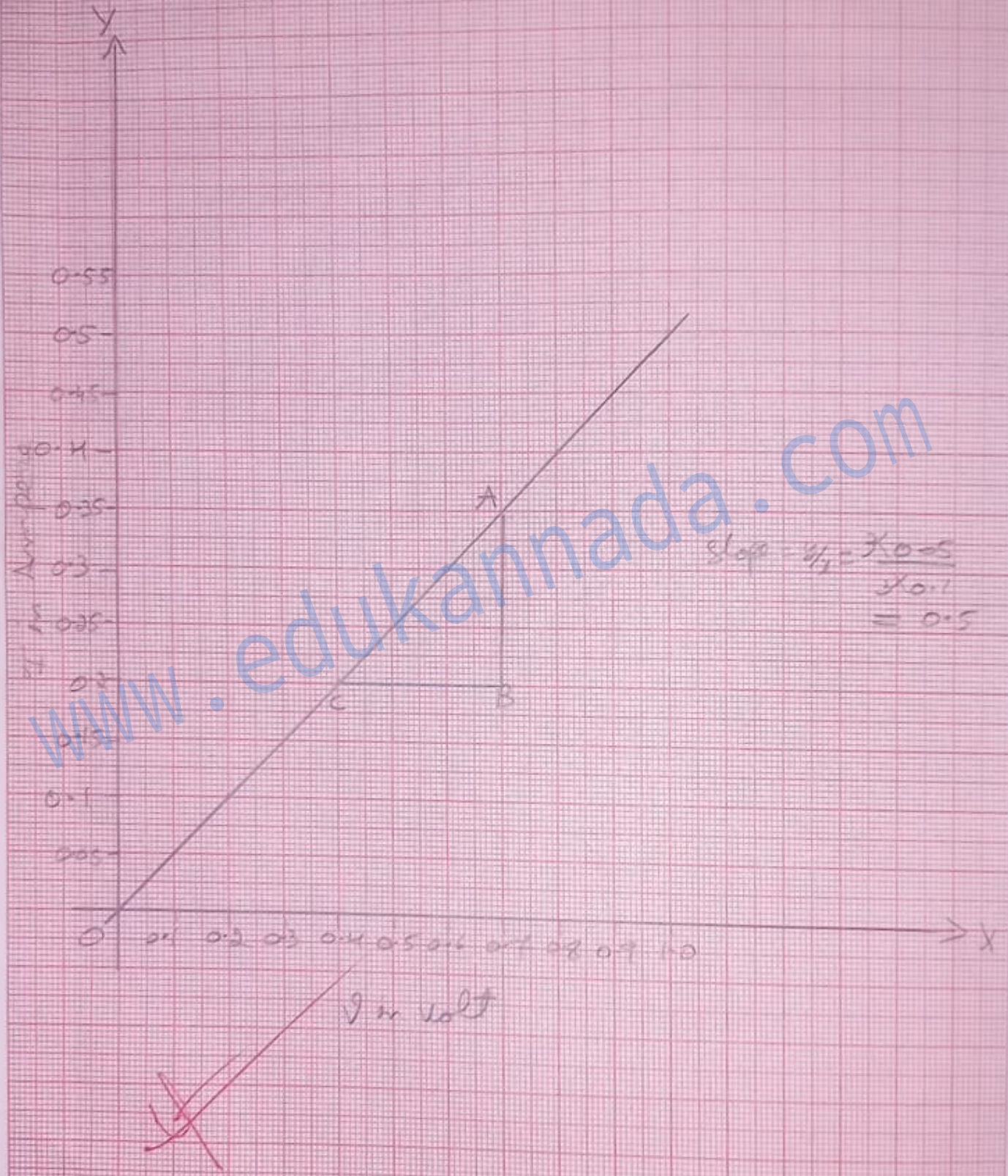
2] Resistance per unit length $= R/L$

where L - the length of the experiment law

Teacher's Signature : _____

Scale x-axis 1cm = 0.1 volt

y-axis 1cm = 0.05 Amp



$$\text{Slope} = \frac{y_2}{x_{0.1}} = \frac{x_{0.05}}{x_{0.1}} = 0.5$$

calculation

Resistance of the wire $R = V_m = CB/AB = 2\,\Omega$

Resistance of per unit length $R/L = 4.54\,\Omega m^{-1}$

$R = V_m = V_{0.5} = 2\,\Omega$

Resistance per length of the wire

$= R/L = \frac{2}{0.44} = 4.54\,\Omega m^{-1}$

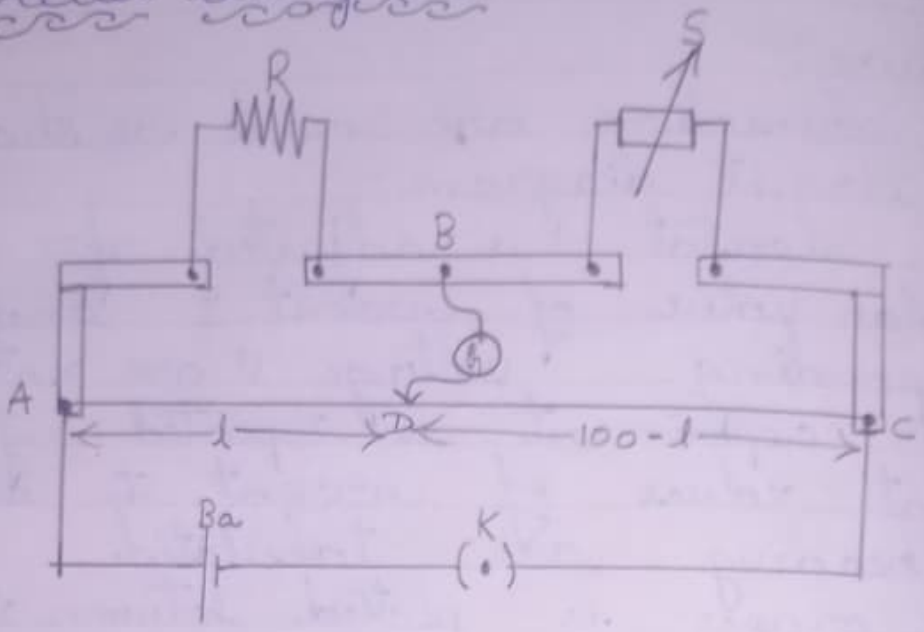
Procedure:-

1) The connections are made as shown in the circuit diagram.
2) The rheostat is adjusted for a particular value of current I and the corresponding voltage V are noted
3) The experiment is repeated for different values of current I and the reading are tabulated
4) A graph is plotted between V and I taking V on x-axis & I on y-axis. The slope m of the graph is found.
5) The reciprocal of the slope is calculated which gives the resistance R of the wire
6) The length of the resistance wire is measured
7) Then the resistance per unit length of the wire R/L is calculated.

Result:- Resistance per unit length of given wire 4.54 Ωm^{-1}

Teacher's Signature : _____

circuit diagram



observation

1] Radius of the experimental wire $r = 0.23 \pm \_\_ m$

2] length of the experimental wire $l = 0.44 \pm \_\_ m$

Tabular column

Trial no	Resistance S in Ω	Balancing length l in cm	(100 − l) in cm	$R = \frac{Sl}{(100-l)}$ Ω
1	2	45.9	54.1	1.69
2	4	31.1	68.9	1.80
3	6	25.1	74.9	2.01
4	8	20.2	79.8	2.02
5	10	7	83	2.04

Mean R = 1.92 Ω

Date

Expt. No. 7 Page No. 18

Experiment no: 7

Resistivity of the Material of the wire

Aim:- Determination of resistance of a given wire using meter bridge and hence to find resistivity of the material of the wire.

Apparatus:- Meter bridge, experimental wire, plug key, resistance box, jockey, galvanometer & battery,

Principle:- 1) Wheatstone's bridge is balanced when current through the galvanometer is zero.

2) If P, Q, R & S represent the resistance of four arms of wheatstone's bridge then $P/Q = R/S$

Formula:- 1) Resistance of the wire

$$R = \frac{Sl}{(100-l)}$$

S = Standard resistance

2) Resistivity of material of the wire

$$\rho = \pi r^2 R/L$$

Teacher's Signature :

calculation

Trial 1:- $\frac{Sl}{100-l} = \frac{2 \times 45.1}{54.1} = 1.69$

Trial 2:- $\frac{Sl}{100-l} = \frac{4 \times 31.1}{68.9} = 1.80$

Trial 3:- $\frac{Sl}{100-l} = \frac{6 \times 25.1}{74.9} = 2.01$

Trial 4:- $\frac{Sl}{100-l} = \frac{8 \times 20.2}{79.8} = 2.02$

Trial 5:- $\frac{Sl}{100-l} = \frac{10 \times 17}{83} = 2.04$

$$\rho = \frac{\pi r^2 R}{L} = \frac{3.14 \times (0.23 \times 10^{-3})^2 \times 2.06}{0.44}$$

$$= \frac{0.34217 \times 10^{-6}}{0.44}$$

$$= 0.7776 \times 10^{-6} \Omega m$$

Date .....

Expt. No. 7 Page No. 19

Procedure :-

1] The connections are made as shown in the circuit diagram

2] A suitable standard resistance S is unplugged in the resistance box.

3] The circuit is checked for opposite deflections by placing the jockey at the two ends of wire AC alternately

4] The jockey is moved on the wire from the end A towards C till the galvanometer shows zero deflection.

5] The balancing length l is measured. The resistance of the wire is calculated using $R = \frac{Sl}{(100-l)}$

6] The experiment is repeated for different value of S & average value of R_s is calculated

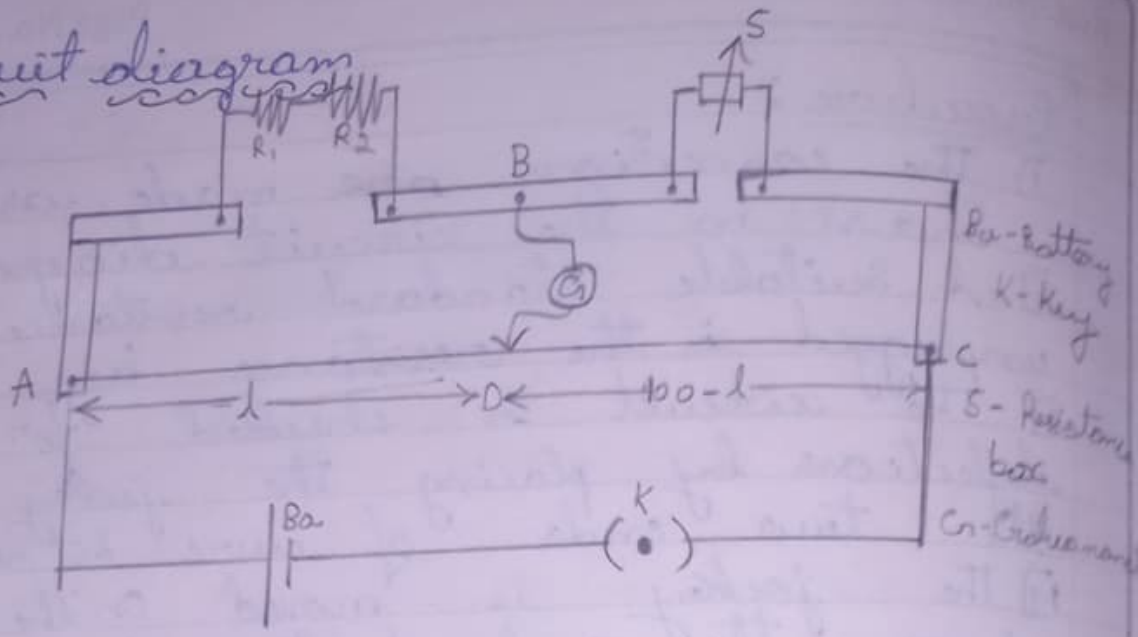
7] The length of L of the experimental wire is measured.

8] The resistivity of the wire is calculated using the formula.

Result :- Resistivity of the material of wire $\rho_s = 0.7776 \times 10^{-6}$ Ω m

Teacher's Signature : _____

circuit diagram



observation

1] Resistance R_1 = 4 Ω
2] Resistance R_2 = 7 Ω

Tabular column

Trial No	Resistance S in Ω	Balancing length l in cm	(100-l) in cm	$R_S = \frac{Sl}{(100-l)}$ in Ω
1	25	17.9	82.1	5.450
2	30	15.3	84.7	5.419
3	35	13.1	86.9	5.27
4	40	11.2	88.8	5.017

Mean R_S = 5.29 Ω

Date

Expt. No. 8 Page No. 20

Experiment no: 8

Combination of Resistances (CS)

Aim:- (a) Verification of the laws of resistances in series using meter bridge

Apparatus:- Meter bridge, two different resistors, plug key, resistance box, jockey, galvanometer & battery

Principle:- i] wheatstone's bridge is balanced when current through the galvanometer is zero.

ii] If P, Q, R & S represent the resistances of four arms of wheatstone's bridge then

$$P/Q = R/S$$

Formula:-

1) Resistance $R_S = \frac{Sl}{(100-l)}$

S - Standard resistance.
l - the balancing length.

2] Equivalent resistance in series $R_S = R_1 + R_2$

Teacher's Signature : _____

calculation

Theoretical value of equivalent resistance

$R_S = R_1 + R_2 = 4 + 1\,\Omega$

Trial 1 :- $\frac{Sl}{(100-l)}$ $\frac{25 \times 17.9}{82.1} = 5.450$

Trial 2 :- $\frac{Sl}{(100-l)}$ $\frac{30 \times 15.3}{84.7} = 5.41$

Trial 3 :- $\frac{Sl}{(100-l)}$ $\frac{35 \times 13.1}{86.9} = 5.27$

Trial 4 :- $\frac{Sl}{(100-l)}$ $\frac{40 \times 11.2}{88.8} = 5.045$

Date .....

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Procedure:-

1] The connections are made as shown in circuit diagram.
2] A Suitable Standard resistance S is unplugged in the resistance box.
3] The circuit is checked for opposite deflections by placing the jockey at the two ends of the metre bridge wire A C alternately.
4] The jockey is moved first on the wire from the end A towards C till the galvanometer shows zero deflection.
5] The balancing length l is measured. The equivalent resistance of the Series combination is calculated using the formula

$$R_s = \frac{Sl}{(100-l)}$$

6] The experiment is repeated for different value of S and average value is calculated.

Result:- Theoretical value of resistance (R_e) is equal or nearly equal to Experimental value of resistance (R_s) Hence the law of combination of resistance in Series is verified.

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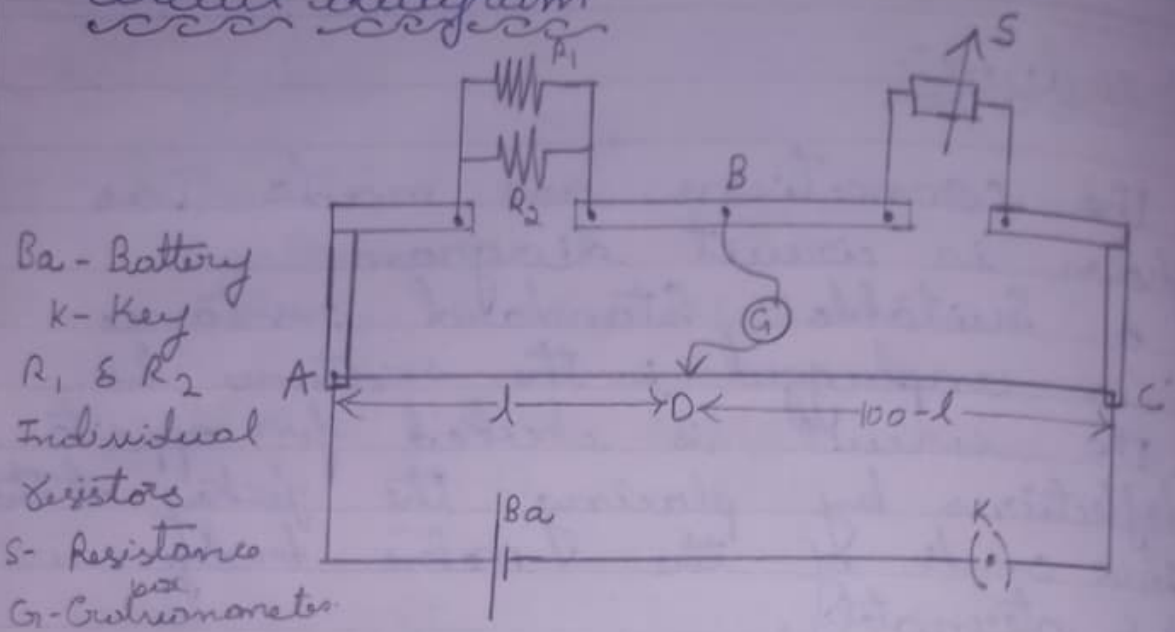
circuit diagram



Ba - Battery
K - Key
R_1 & R_2 Individual Resistors
S - Resistance box
G - Galvanometer

observation

1] Resistance R_1 = ___9___ Ω
2] Resistance R_2 = ___5___ Ω

Tabular column

Trial No	Resistance S in Ω	Balancing length l in cm	(100-l) in cm	$R_p = \frac{Sl}{(100-l)}$ in Ω
1	25	7.9	92	2.144
2	30	6.4	93.6	2.051
3	35	5.5	94.6	2.037

mean R_p 2.08 Ω

Date

Expt. No. 8 Page No. 22

Combination of Resistances (P)

Aim:- Verification of the law of combination of resistance in parallel using meter bridge.

Apparatus:- Meter bridge two different resistors, plug key, resistance box, jockey galvanometer & battery

Principale:- 1] Wheatsone's bridge is balanced when current through the galvanometer is zero.

2] If P, Q, R, & S represent the resistance of four arms of wheatstone's bridge then

$$P/Q = R/S$$

Formula:-

1] Resistance $R_p = \frac{S\,l}{(100-l)}$

where S - Standard resistance
l - the balancing length.

2] Equivalent resistance in parallel

$$R_p = \frac{R_1 R_2}{R_1 + R_2}$$

where R_1 & R_2 - Individual resistance.

Teacher's Signature : _____

Calculation

Theoretical value of equivalent resistance

$$R_p = \frac{R_1 R_2}{R_1 + R_2} = 2.22\,\Omega$$

Trial 1

$$\frac{Sl}{(100-l)} = \frac{197.5}{92} = 2.146\,\Omega$$

Trial 2 $\frac{Sl}{(100-l)} = \frac{192}{93.6} = 2.05\,\Omega$

Trial 3 $\frac{Sl}{(100-l)} = \frac{192.5}{94.5} = 2.037\,\Omega$

Date .....

Expt. No. 8 Page No. 23

Procedure:-

1] The connections are made as shown in the circuit diagram.
2] A suitable resistance S is unplugged in the resistance box.
3] The circuit is checked for opposite deflections by placing the jockey at the two ends of the meter bridge wire A C alternately.
4] The jockey is moved on the wire from the end A towards C till the galvanometer shows zero deflection.
5] The balancing length l is measured. The equivalent resistance of the series combination is calculated using the formula.

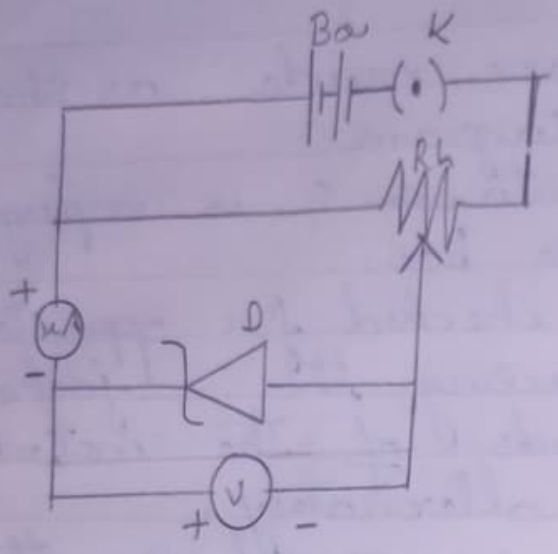
$$R_p = \frac{Sl}{(100-l)}$$

6] The experiment is repeated for different values of S & average value of R_p is calculated.

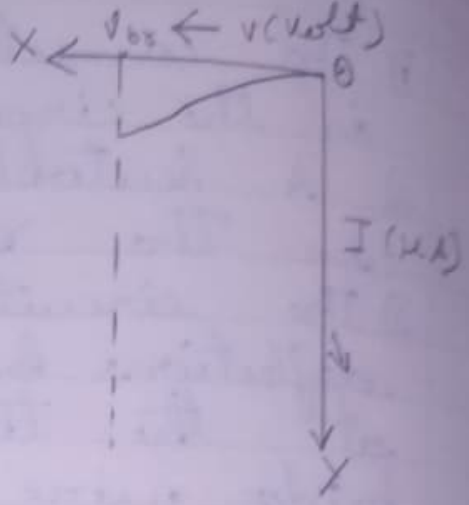
Result: Theoretical value of resistance (R_p) is equal or nearly equal to experimental value of resistance (R_p). Hence the law of combination of resistance parallel is verified.

Teacher's Signature : _____

circuit diagram



Graph



Ba - Battery
K - Key
Rh - Rheostat
V - Voltmeter
μA - Micrometter
D - Zener Diode

observation

Voltage V in V	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5
current I in μA	0	0	0	0	0	0	5	30	110	[illegible]

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Experiment no: 9

Zener diode

Aim :- To draw the current (I) verses voltage (V) characteristic curve of zener diode in reverse bias & hence to determine its breakdown voltage.

Apparatus :- Zener diode, microammeter, voltmeter, rheostat, battery.

Principal :- When the zener diode is reverse biased, at a particular negative voltage the reverse current increases suddenly & sharply so that voltage across diode remains constant. This voltage is called breakdown voltage or zener voltage.

Procedure :-

1) The connections are made as shown in the circuit diagram.
2) A suitable voltage V is adjusted by using rheostat & the corresponding current I is noted.

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3] The experiment is repeated for different values of voltage & readings are tabulated

4] A graph is plotted between V & I taking voltage V along X-axis & current I along Y-axis.

5] The breakdown voltage V_m is noted from the graph.

Result: The breakdown voltage of zero diode V_{BR} = 4 V

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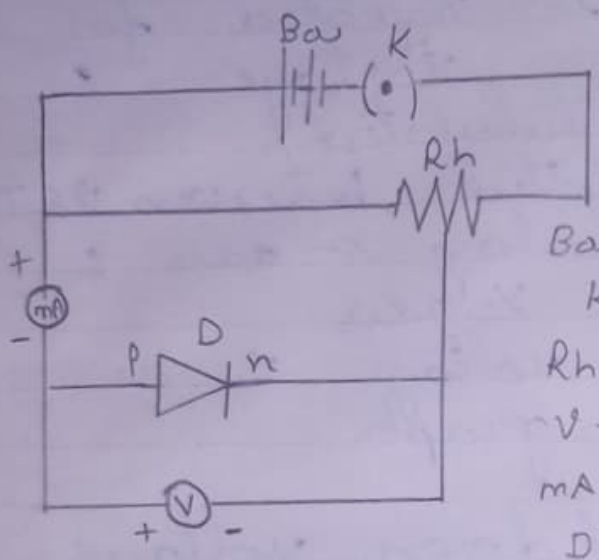
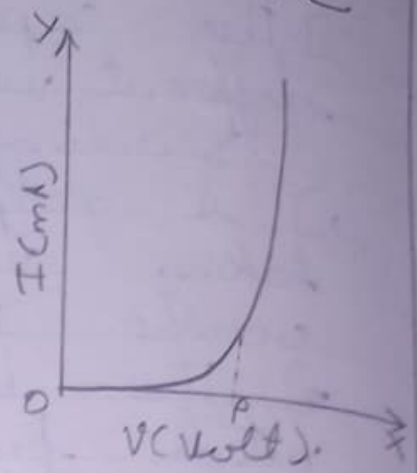
circuit diagram



Ba - Battery
K - Key
Rh - Rheostat
V - Voltmeter
mA - Milliammeter
D - Semiconductor Diode

Graph



observation

Voltage V in V	0·1	0·2	0·3	0·4	0·45	0·5	0·6	0·65
current I in mA	0	0	0	0	0·5	1·5	6	11

Experiment No:-10A

Semiconductor diode

Aim:- To draw the current (I) verse voltage(V) characteristic curve of a junction diode in forward bias & hence find cut in voltage.

Apparatus:- Semiconductor diode, milliammeter, voltmeter, rheostat & battery.

Principal:- when the diode is forward biased it offers very low resistance.
cut in voltage is the characteristic voltage at which diode current increases exponentially even for a small increase exponentially even for a small increase in bias voltage in bias voltage when diode is forward bias.

Procedure:-

1] The connection are made as shown in the circuit diagram.

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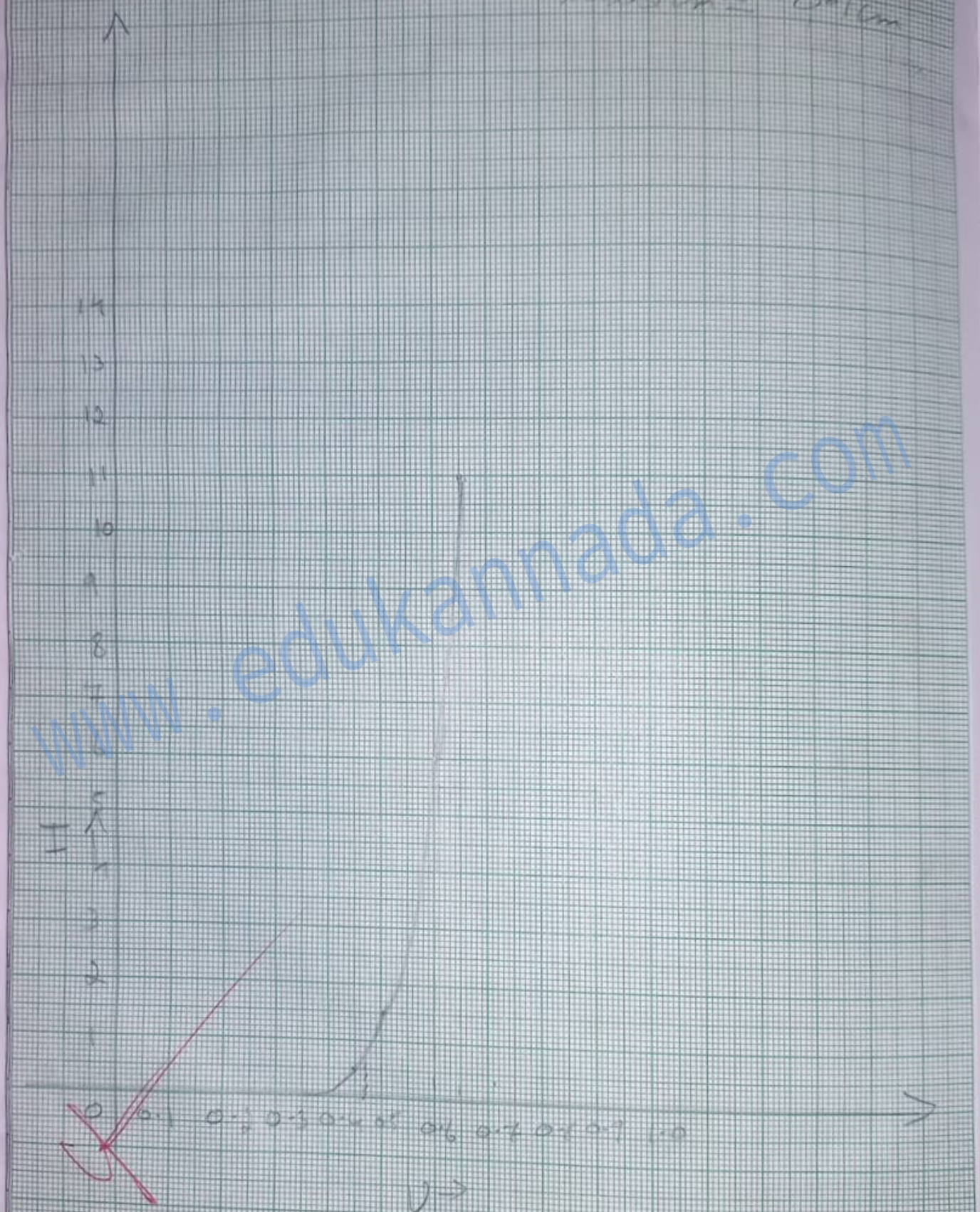
Scale x-axis = 1 cm

x axis = 0.1 cm



2] Using the rheostat, the voltage is adjusted for Suitable value V. The voltage & the corresponding current I are noted.

3] The voltage is increased in small steps. The values of V and I are noted each case & reading are noted.

4] A Graph is plotted between V & I, taking the voltage V along x-axis & current I along Y-axis.

5] cut in voltage is found.

Result:- cut in voltage of the given diode = 0.4 V

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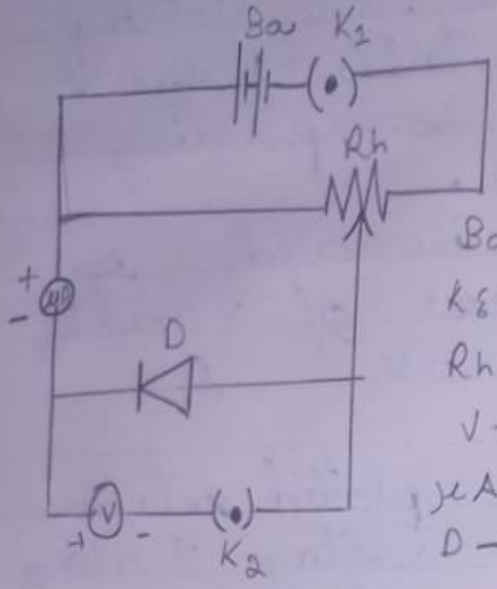
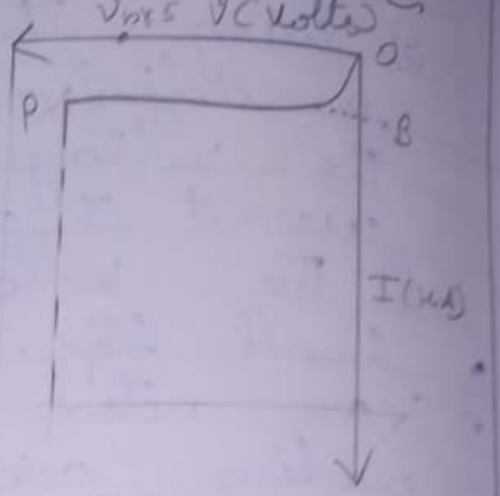
circuit diagram



Ba - Battery
K & K2 - Keys
Rh - Rheostat
V - Voltmeter
μA - Microammeter
D - Semiconductor Diode

Graph



OB → Reverse Saturation current.

observation

Voltage V in V	1 to 13	14	15	16	17	18	19	20
current I in μA	0	6	14	24	34	44	55	64

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Experiment: 10 B

Semiconductor diode

Aim:- To draw the current (I) verse voltage (V) characteristic curves of a P-N-P junction diode in reverse bias & hence to determine reverse saturation current.

Apparatus:- Semiconductor diode, microammeter, voltmeter, rheostat & battery.

Principle:- When the diode is reverse biased it offers very high resistance.

Procedure:-

1] The connections are made as shown in the circuit diagram.

2] A suitable voltage V is adjusted by using rheostat & corresponding current I is noted.

3] The experiment is repeated for different values of V & the reading

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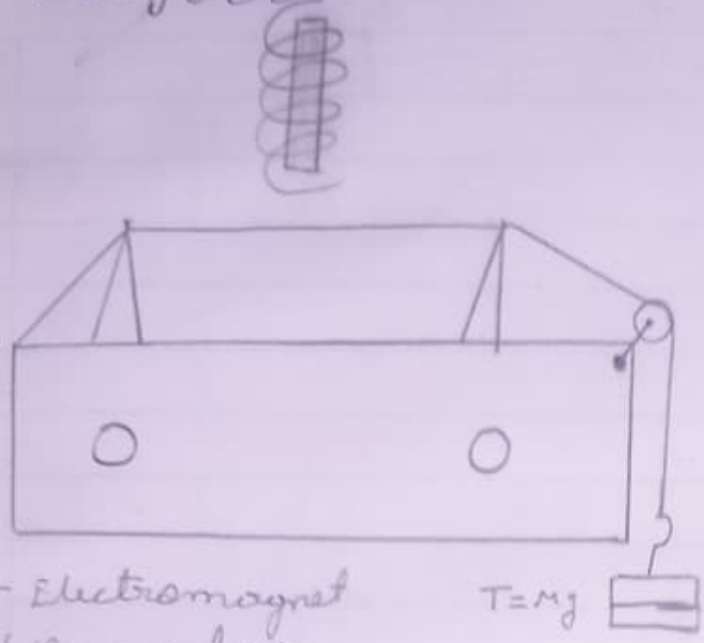
are tabulated

4] A graph is plotted between V & I, taking voltage V along x-axis & current I along Y-axis & reverse saturation current is found.

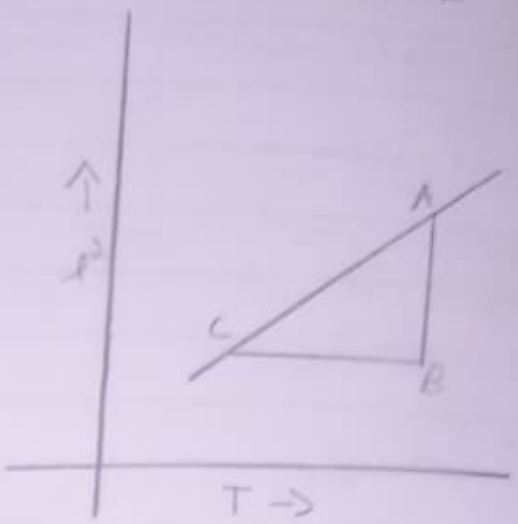
Result:- The Reverse Saturation current for the given diode is 5.0 μA

Diagram



E - Electromagnet
P & Q - cradles
l - Resonating length
T = Mg
T - Tension

Graph



Slope = $\frac{AB}{BC}$

Observation

1] Mass per unit length of the wire
m (given) = 1.93×10^{-3} kg m^{-1}

2] Acceleration due to gravity $g = 9.8\ ms^{-2}$

Tabular column.

Trial no	mass attached to the string (M) in kg	Tension T = Mg in N	Resonating length l in m	l^2 in m^2
1	1	9.8	0.406	0.16
2	1.5	14.6	0.503	0.25
3	2	19.6	0.574	0.34
4	2.5	24.5	0.644	0.41

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Experiment no 11

Frequency of A.C

Aim:- Determination of the frequency of alternating current using a Sonometer & electromagnet.

Apparatus:- Sonometer with wire, an electromagnet, Slotted weights with hanger.

Principle:- 1) In each cycle of A.C the Sonometer String is pulled & released twice

2) At resonance, the frequency of alternating current is equal to half of the frequency of fundamental mode of vibration of the stretched string.

Formula:- Frequency of alternating current

$$f = \frac{1}{4\sqrt{m \times \text{Slope}}}$$

where $\text{Slope}_{(m)}$ = Slope of the graph of l^2 Versus T

m = mass per unit length of the string

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Scale

x axis 1cm = 2.5cm

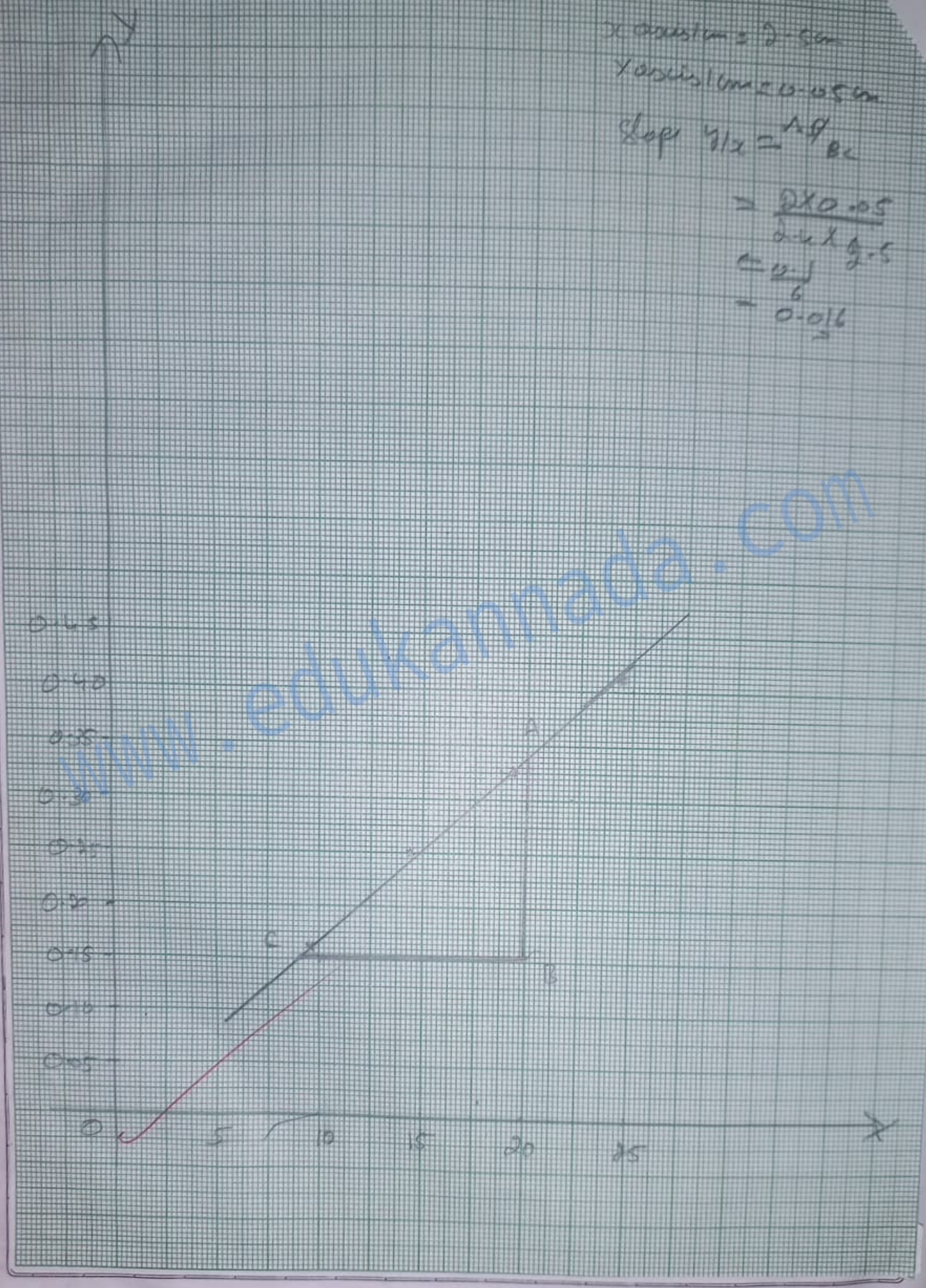
y axis 1cm = 0.05cm

Slope $y/x = \frac{\Delta y}{\Delta x}$

$= \frac{2 \times 0.05}{0.4 \times 2.5}$

$= \frac{0.1}{6}$

$= 0.016$



calculation:-

$$f = \frac{1}{4\sqrt{m \times slope}}$$

$$f = \frac{1}{4\sqrt{0.00153 \times 0.166}}$$

$$f = \frac{1}{4 \times 0.00503}$$

$$f = \frac{1}{0.020}$$

$$f = 50\,Hz$$

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Procedure :-

1] Suitable mass is attached to the string & tension T is found

2] One pole of the electromagnet is placed close to the middle of sonometer wire

3] The resonating length l is noted

4] The experiment is repeated for different values of T and readings are tabulated

5] The experiment is repeated for different value of T & reading are tabulated

6] A graph is plotted between T & l^2 taking T on X-axis l^2 on Y-axis the slope of the graph is found

7] frequency of the alternating current is calculated using the formula

$$\nu = \frac{1}{4l\sqrt{m \times \text{Slope}}}$$

Result :- The frequency of alternating current is 50 Hz

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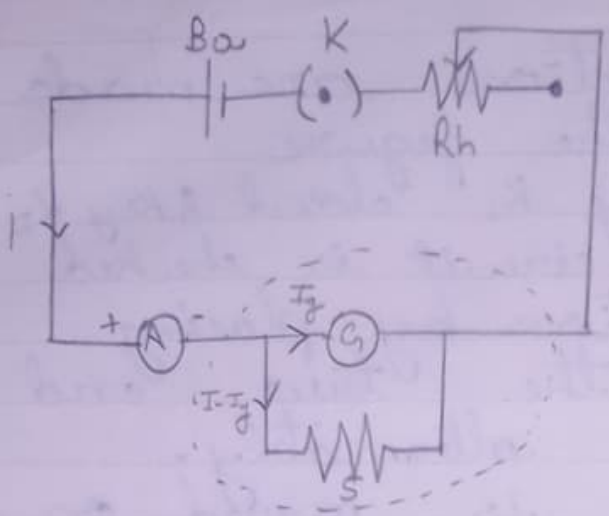
circuit diagram



Ba - Battery
K - Key
Rh - Rheostat
G - Galvanometer
A - Ammeter
S - Shunt resistor

Observation

1] Resistance of the galvanometer G (given) = 120 Ω

2] Figure of merit of the galvanometer K given = 12×10^{-6} A/div.

3] Number of divisions on either side of zero of the galvanometer scale N = 30 div

4] current required for producing full scale deflection of N divisions $I_g = NK = 360 \times 10^{-6}$ A

5] Maximum current to be measured I (Say 30mA) = 30×10^{-3} A

Experiment no : 12A

Ammeter

Aim :- To convert the given galvanometer into an ammeter of the required range (0-30mA) & verify the same.

Apparatus :- Pointer galvanometer, battery, ammeter, resistor, Key & rheostat.

Principle :- Galvanometer can be converted into ammeter by connecting suitable low resistance in parallel with it, so that very small current flows through the galvanometer

Formula :- 1] current required for full scale deflection

$$I_g = NR$$

2] Shunt resistance $S = \frac{I_g G}{I - I_g}$

Procedure :-

Calculation

Trial 1

$$S = \frac{I_g G}{I - I_g} = \frac{360 \times 10^{-6} \times 120}{(300 \times 10^{-3}) - (360 \times 10^{-6})} = \frac{1.1454 \times 10^{-3}}{1.45} = 1.45\,m\Omega$$

Trial 2

$$l \frac{\pi d^2}{4} = \frac{1.45 \times 3.14 \times (0.25 \times 10^{-3})^2}{0.1 \times 0.6}$$

$$= \frac{0.284 \times 10^{-6}}{0.1 \times 10^{-6}} = 2.8\,m\Omega$$

Trial 3

$$S' = \frac{\rho l}{\pi d^2} = \frac{0.1 \times 10^{-6} \times 3}{3.14 (0.25 \times 10^{-3})^2}$$

$$= \frac{0.3 \times 10^{-6}}{3.14 \times 0.0625 \times 10^{-6}} = \frac{0.3 \times 10^{-6}}{0.196 \times 10^{-6}}$$

$$= 1.57\,m\Omega$$

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1] The current for full scale deflection in the galvanometer $I_g = NR$ is calculated

2] The Shunt resistance S is calculated using the formula $S = \frac{I_g G}{I - I_g}$

3] With the given values of radius r & resistivity ρ of the wire, the length l of the wire is calculated using the formula.

$$l = \frac{S \pi r^2}{\rho}$$

4] The wire of slightly longer length than the calculated length is connected in parallel with the galvanometer are made as shown in the circuit diagram.

5] The rheostat is adjusted for 30mA current in ammeter.

6] The length of the wire is adjusted for full scale deflection in the galvanometer & its length l is measured.

7] Shunt resistance S' is calculated using the formula

$$S' = \rho l' / \pi r^2$$

8] S' is equal or nearly equal to S & hence conversion is verified.

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Result:- Theoretical value of Shunt resistance, S = 1.145 Ω

Experimental value of Shunt S' = 1.57 Ω

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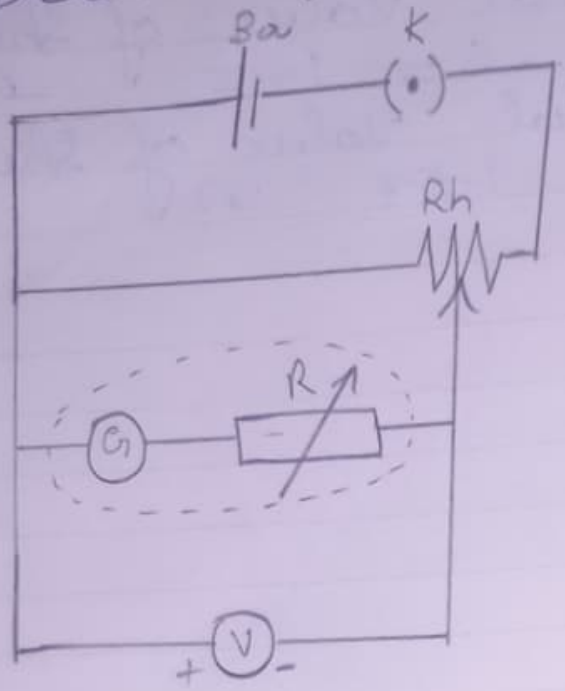
circuit diagram.



Ba - Battery
K - Key
Rh - Rheostat
Gr - Galvanometer
V - Voltmeter
R - Resistance box.

observation :-

1] Resistance of the galvanometer Gr(given) = 120 Ω

2] Figure of merit of the galvanometer K(given) = 12×10^{-6} A/div

3] Number of division on either side of zero of the galvanometer Scale N = 30 div

4] current required for producing full scale deflection of N divisions $I_g = NK = 360 \times 10^{-6}$ A

5] Maximum voltage to be measured V (say 3V) = 30×10^{-1} V

Experimental 12 B

Voltmeter

Aim :- To convert the given galvanometer into a voltmeter of the required range (0-3V) & verify the same.

Apparatus :- Pointer galvanometer, battery, voltmeter, resistance box, Key, rheostat.

Principal :- Galvanometer can be converted into voltmeter by connecting suitable high resistance in series with it, so that very small current flows through the galvanometer.

Formula :- 1] current required for full scale deflection

$$I_g = NK$$

2] High resistance to be connected in series with the galvano-meter $R = \frac{V}{I_g} - G$

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calculation

$$R = V/I_g - G$$

$$= \frac{3}{360 \times 10^{-6}} - 120$$

$$= 0.0083 \times 10^{6} - 120$$

$$= 8300 - 120$$

$$R = 8180\ \Omega$$

Procedure:-

1] The value of resistance is calculated using the formula $R = V/I_g - G_n$

2] The circuit connections are made as shown in the circuit diagram

3] The calculated high resistance R is unplugged in the standard resistance box and the rheostat is adjusted so that the voltage shown in the voltmeter is equal to the desired range

4] Resistance from the resistance box is adjusted such that galvanometer shows full scale deflection. Then R' from the resistance box is noted

5] R' is equal to or nearly equal to R. Hence conversion is verified.

Result:- The value of calculated resistance R = 8180 Ω

The value of the observed series resistance R' = 8000 Ω

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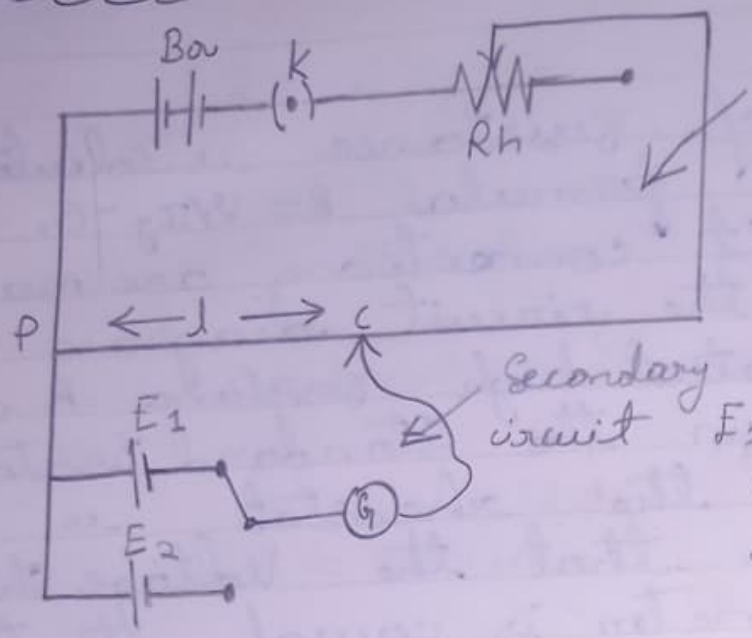
circuit diagram



Primary circuit

Ba - Battery
K - Key
Ph - Rheostat
Pd - Potentiometer wire
E_1 & E_2 - cells
Cr - Galvanometer
A - Ammeter

Secondary circuit

observation

Trial No	Balancing length l_1 in cms	Balancing length l_2 in cm	$\frac{E_1}{E_2} = \frac{l_1}{l_2}$
1	83.9	83.7	1.002
2	53	53.4	0.992
3	52.7	53.7	0.997

Average value E_1/E_2 = 0.990

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Experiment no :-13

Comparison of emf's of two cells.

Aim :- Comparison of the emf of two given cells using a potentiometer.

Apparatus :- Potentiometer, battery, given two cells, galvanometer, two-way key, rheostat & plug key.

Principle :- Principle of potentiometer :- when a steady current flows through a conducting wire of uniform thickness, potential difference between any two points on it is directly proportional to the length of the wire between those two points.

Formula :- The ratio of emfs of the cells $\frac{E_1}{E_2} = \frac{l_1}{l_2}$

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Calculation

Trial 1 :-

$$\frac{l_1}{l_2} = \frac{83.9}{83.7} = 1.002$$

Trial 2 :-

$$\frac{l_1}{l_2} = \frac{53}{53.4} = 0.99$$

Trial 3 :-

$$\frac{l_1}{l_2} = \frac{52.5}{53.7} = 0.97$$

Average value of $\frac{\epsilon_1}{\epsilon_2} = \frac{1.002 + 0.99 + 0.97}{3}$

$= 0.990$

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Procedure :-

1] The circuit connections are made as shown in the circuit diagram.

2] The key K is closed & two key is connected to the cell E_1. The circuit is checked for opposite deflections by placing jockey at the two ends of the wire PQ alternately.

3] The jockey is moved on the potentiometer wire from P towards the end Q till the galvanometer show zero deflection. The balancing length l_1 is measured.

4] The two key is disconnected from the cell E_1 & connected to the cell E_2. The balancing length l_2 is measured. The ratio of E_1/E_2 is calculated using the formula $E_1/E_2 = l_1/l_2$

5] The experiment is repeated by shifting the contact point of rheostat & average value of ratio of emfs of the cells is found.

Result :- The ratio of emfs of the cells $E_1/E_2 = 0.990$

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Diagram

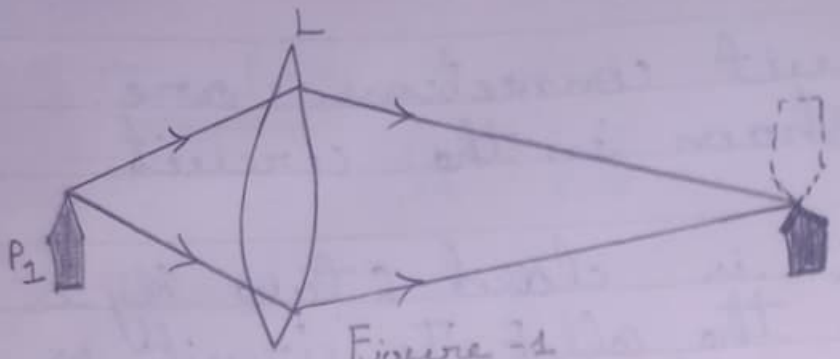

Figure -1

P_1 - Object pin
P_2 - Image pin
I - Image
L - Convex lens
M - Convex mirror
C - Centre of curvature of convex mirror
R - Radius of curvature of convex mirror

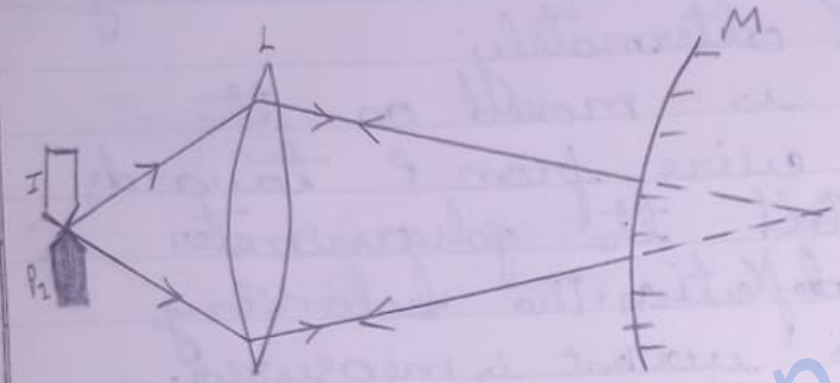

Figure - 2

Observation

Trial No	Position of the image in cm	Position of the convex mirror in cm	Radius of curvature R=(C-m) in cm	Focal length f= R/2 in cm
1				
2	60	39	21	10.5
3	62	41.5	21.5	10.7

Experiment no: 14

Focal length of convex mirror

Aim:- Determination of the focal length of a convex mirror using a convex lens.

Apparatus:- optical bench, two sharp-edged pins, convex mirror of less than 20cm focal length, four uprights with clamps & metre scale.

Principle:- 1] The object distance must be greater than focal length of the convex lens to get real & inverted image

2] The reflected ray from a convex mirror appears to be coming from its centre of curvature for normal incidence.

Formula:- Focal length of convex mirror

$$f = R/2$$

where R - radius of curvature of the convex mirror

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Calculation

Trial 1

$f = R/2$

$= 21/2$

$= 10.5\text{cm}$

Trial 2

$f = R/2$

$= \frac{21.5}{2}$

$= 10.75\text{cm}$

$\text{Mean} = \frac{10.5 + 10.75}{2}$

$= \frac{21.25}{2}$

$= 10.625\text{cm}$

Procedure :-

1] The uprights mounted with convex lens object pin P_1 and image pin P_2 are placed on the optical bench as shown in figure

2] The heights of the object pin P_1 and image pin P_2 are adjusted such that their tips lie on the principal axis of the lens.

3] The position of the object pin P_1 is adjusted such that it will be at a distance which is greater than focal length of the convex lens.

4] The given convex mirror is introduced between lens & image pin P_2 as shown in figure.

5] The position of the mirror is adjusted such that the pin P_1 coincides with the tip of its image. The position M of the mirror is noted.

7] The distance between the position of convex mirror & the position measured which is equal to radius of curvature R of the convex mirror

8] Focal length of the convex mirror is calculated using the formula.

$f = R/2$

9] The experiment is repeated by

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changing the distance between object pin P_1 & the lens. The average value of focal length of convex mirror f is found.

Result:- The focal length of the convex mirror f = 10.625 cm

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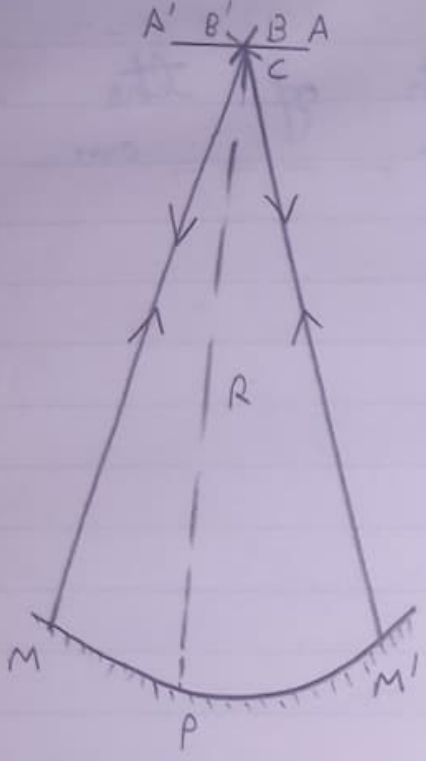
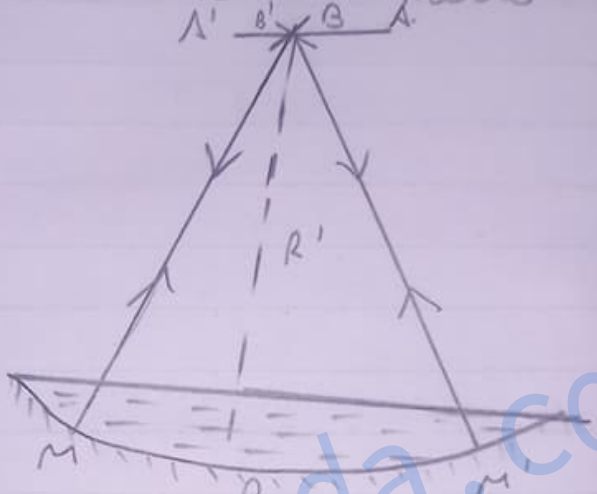
Diagram

AB - object pin
A'B' - Image by concave mirror
A"B" - Image by water filled concave mirror
MM' - concave mirror





observation.

1] Radius of curvature of concave mirror R = 41 cm
2] Radius of curvature of concave mirror with water R' = 30.5 cm

Experiment no:- 16A

Refractive index of water

Aim:- Determination of the refractive index of water using a concave mirror

Apparatus:- concave mirror, water, a pin and a meter Scale.

Principle:- 1) The rays of light from the object incident normally on the concave mirror, retrace their paths so that image of the object forms by the side of object
2) The bottom of the concave mirror containing water, appears to be raised up because of refraction of light through water.

Formula:-

Refractive index of water with respect to air

$$n_{aw} = \frac{R}{-R'}$$

where R - Radius of curvature of concave mirror.
R' - apparent radius of curvature of concave

Teacher's Signature : _____

Calculation:

Refractive index of water with respect to air

$$n_w = \frac{R}{R_1}$$

$$= \frac{41}{30.5}$$

$$= 1.34$$

mirror with water

Procedure:-

1] A concave mirror is placed on the base of laboratory stand as shown in the figure.

2] A sharp edged bright pin AB is placed horizontally just above the pole of the mirror & clamped.

3] The position of the pin AB is adjusted such that the tip of the pin coincides exactly with the tip of image A'B' without parallax.

4] The vertical distance R between the mirror & pin is measured.

5] Now a small quantity of water is poured into the concave mirror

6] The position of the pin AB is lowered such that the tip of the pin coincides with the tip of its image A''B'' without parallax.

7] The vertical distance R' between the mirror & the pin is measured after the removal of water

8] Refractive index of water is calculated using the formula $n_{H_2O} = R/R'$

Result :- The refractive index of water ... = 1.34

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