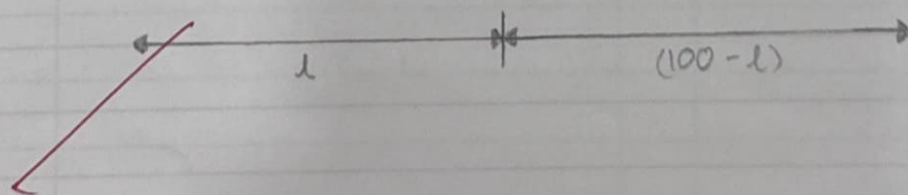
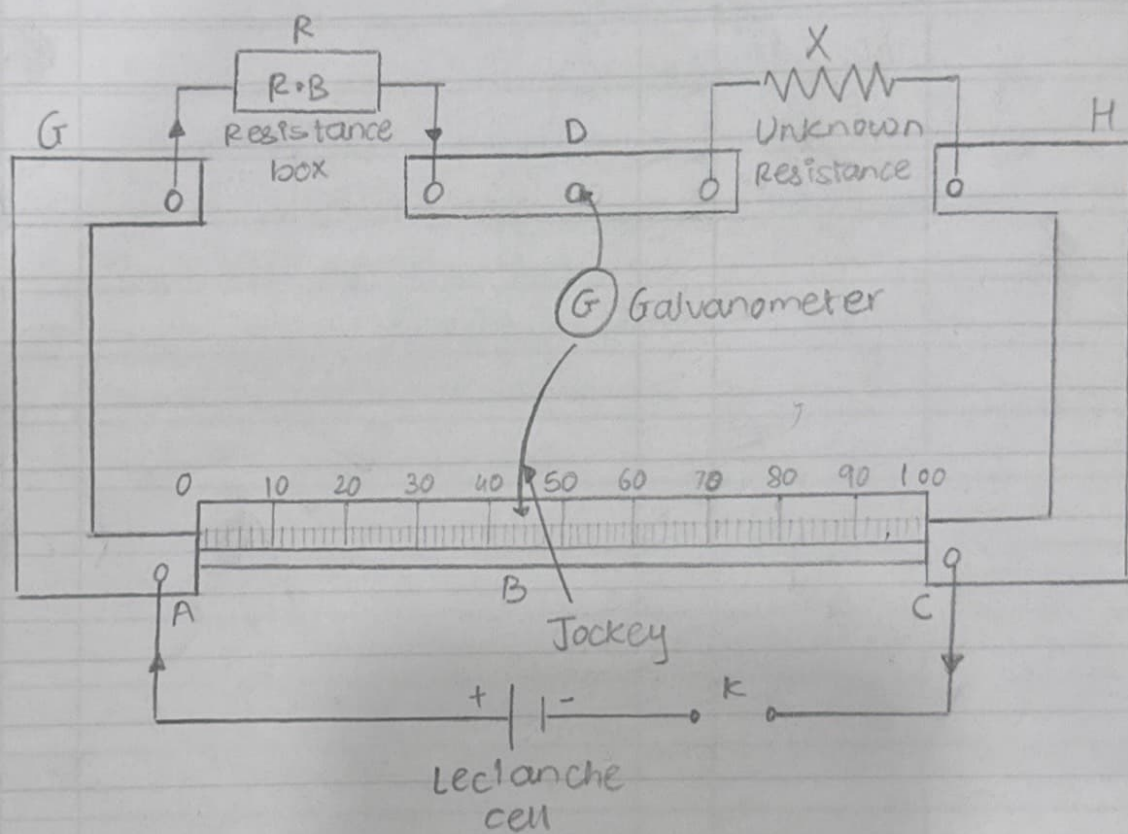


PARTICULARS OF THE EXPERIMENTS PERFORMED

Diagram:



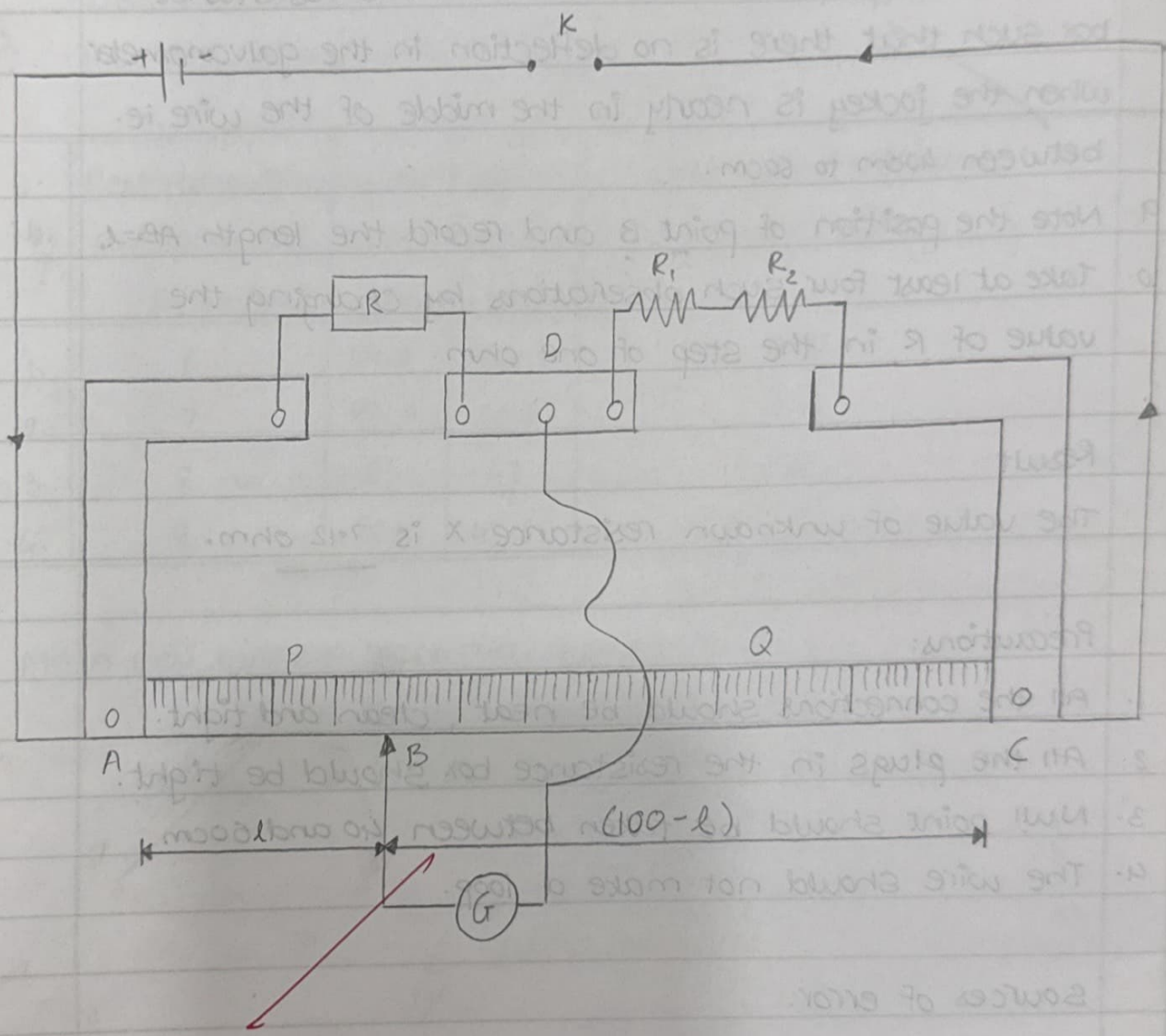
OBSERVATIONS:

1. Length of the wire $L = 1.2m$

S. No.	Resistance from resistance box R (ohm)	length AB (cm)	length BC (cm)	Unknown Resistance $X = \left(\frac{100-l}{l} \right) R$ (ohm)
1.	6	44.5	55.5	7.26
2.	7	49.4	50.6	7.17
3.	8	53	47	7.09
4.	9	56.4	43.6	6.95

Mean resistance = $\frac{7.26 + 7.17 + 7.09 + 6.95}{4} = 7.12 \Omega$

Diagram:



1. The bridge may not be clean.
2. The wire may not have uniform cross-sectional area.
3. The instrument scales may be loose.

OBSERVATIONS:

Resistance coil	S. No.	Resistance from Resistance box R (ohm)	length AB = l (cm)	length BC = (100-l) (cm)	Resistance $r = \left(\frac{100-l}{l}\right)R$ (ohm)	Mean Resistance (ohm)
R_1	1.	5	46.2	53.8	$R_1 = 5.82$	$R_1 = 5.54$
	2.	6	52.4	47.6	$R_1 = 5.45$	
	3.	7	56.6	43.4	$R_1 = 5.36$	
R_2	1.	5	49	51	$R_2 = 5.20$	$R_2 = 5.12$
	2.	6	54.4	45.6	$R_2 = 5.02$	
	3.	7	57.7	42.3	$R_2 = 5.13$	
R_1 and R_2 in series	1.	8	45.2	42.3	$R_s = 9.69$	$R_s = 9.47$
	2.	9	48.5	51.5	$R_s = 9.55$	
	3.	10	50.8	49.2	$R_s = 9.68$	

Calculations:

$$1. R_1 = \left(\frac{100-l}{l}\right)R = \left(\frac{53.8}{46.2}\right)5$$

$$= 5.82 \Omega$$

$$2. R_1 = \left(\frac{100-l}{l}\right)R = \left(\frac{47.6}{52.4}\right)6$$

$$= 5.45 \Omega$$

$$3. R_1 = \left(\frac{100-l}{l}\right)R = \left(\frac{43.4}{56.6}\right)7$$

$$= 5.36 \Omega$$

$$\text{Mean } R_1 = \frac{5.82 + 5.45 + 5.36}{3}$$

$$= 5.54 \Omega$$

$$1. R_2 = \left(\frac{100-l}{l}\right)R = \left(\frac{51}{49}\right)5$$

$$= 5.20 \Omega$$

$$2. R_2 = \left(\frac{100-l}{l}\right)R = \left(\frac{45.6}{54.4}\right)6$$

$$= 5.02 \Omega$$

$$3. R_2 = \left(\frac{100-l}{l}\right)R = \left(\frac{42.3}{57.7}\right)7$$

$$= 5.13 \Omega$$

$$\text{Mean } R_2 = \frac{5.20 + 5.02 + 5.13}{3}$$

$$= 5.12 \Omega$$

$$1. R_s = \left(\frac{100-l}{l}\right)R = \left(\frac{42.3}{45.2}\right)8$$

$$= 9.69 \Omega$$

$$2. R_s = \left(\frac{100-l}{l}\right)R = \left(\frac{51.5}{48.5}\right)9$$

$$= 9.55 \Omega$$

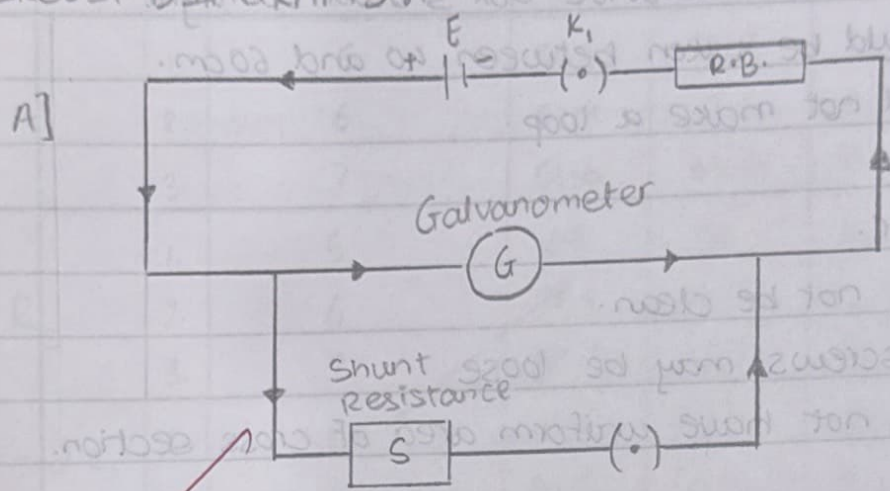
$$3. R_s = \left(\frac{100-l}{l}\right)R = \left(\frac{49.2}{50.8}\right)10$$

$$= 9.68 \Omega$$

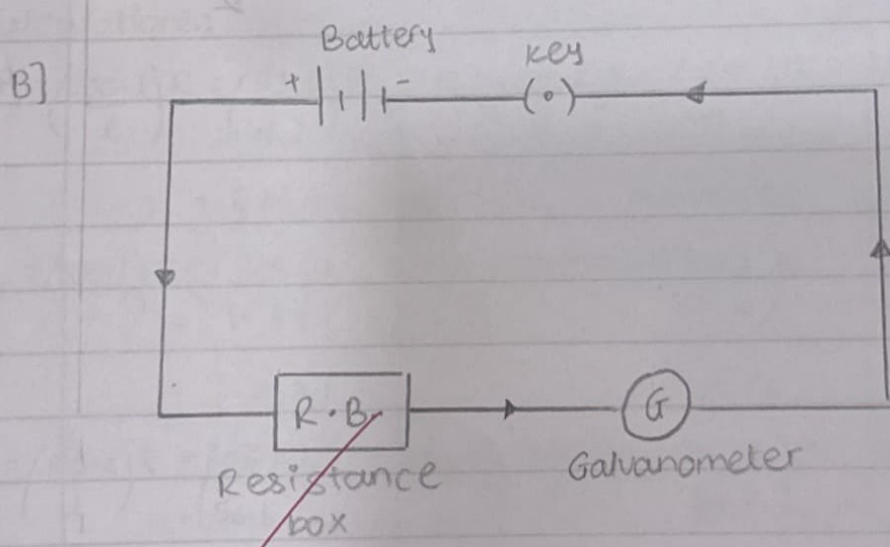
$$\text{Mean } R_s = \frac{9.69 + 9.55 + 9.68}{3}$$

$$= 9.47 \Omega$$

CIRCUIT DIAGRAMS:



Determination of Resistance of galvanometer
by half deflection method



Determination of figure of merit
of the galvanometer

OBSERVATIONS: To determine the resistance of a galvanometer by half-deflection method:

1) Resistance of galvanometer by half-deflection method:

S. No.	Resistance R (ohm)	Deflection in galvanometer (θ) (divisions)	Shunt Resistance S (ohm)	Half deflection $\theta/2$ (divisions)	Galvanometer Resistance $G = \frac{R \cdot S}{R - S}$ (ohm)
1.	7000	18	100	9	101
2.	8000	16	100	8	101
3.	9000	14	100	7	101
4.	10000	12	100	6	101

2) Table for Figure of merit:

S. No.	e.m.f. of the cell (E)	Resistance from resistance box (R)	Deflection in Galvanometer (θ)	Figure of Merit
1.	1.2	5000	12	3.26×10^{-5}
2.	1.4	6000	18	3.64×10^{-5}
3.	1.6	8000	22	3.36×10^{-5}
4.	1.8	10000	23	3.44×10^{-5}

Calculations:

1. Calculate resistance of galvanometer G by using Formula:

$$G = \frac{R \cdot S}{R - S}$$

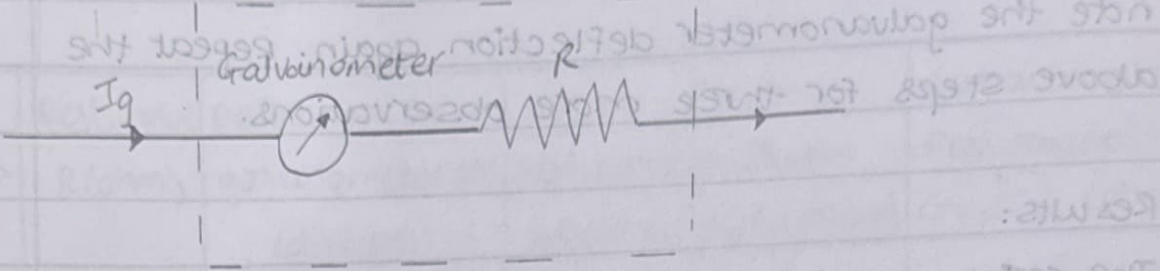
2. Calculate figure of merit by Formula:

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

deflection θ in the galvanometer.

2. Now change the value of R from the resistance box and

note the galvanometer deflection. Repeat the above steps for three observations.



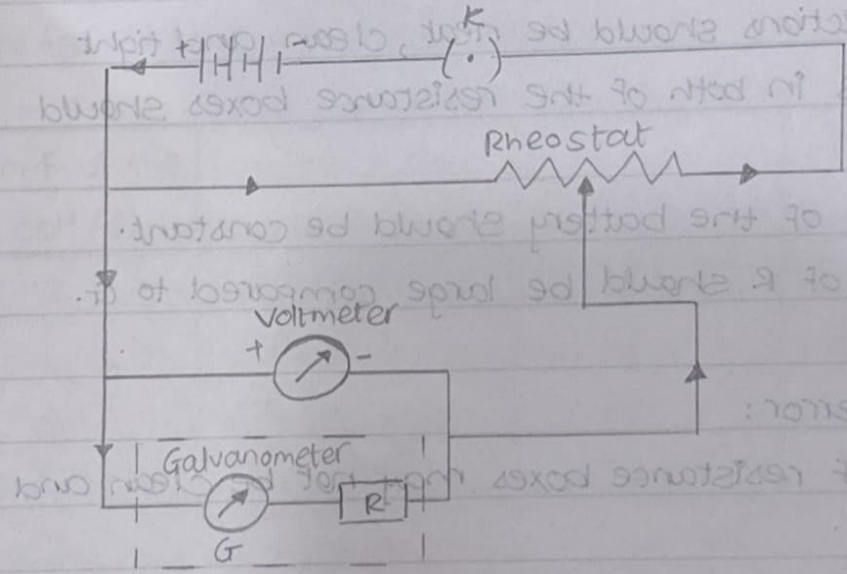
Results:

1. The resistance of the given galvanometer by half-deflection method is _____ Ω .

Conversion of Galvanometer into voltmeter

Precautions:

1. All the connections should be tight, clean and right.
2. All the plugs in both of the resistance boxes should be tight.
3. The e.m.f. of the battery should be constant.
4. The value of R should be large compared to it.



Sources of error:

1. The plugs of resistance boxes must be tight.
2. The e.m.f. of battery may not be constant.
3. The galvanometer division may not be equal.

Converted Galvanometer

Verification of converted Galvanometer by comparing it with standard voltmeter.

Signature

OBSERVATION TABLE

S. No.	Reading of converted Voltmeter Deflection θ (division)	Potential Difference $V_1 = \theta \times L.C. (volt)$	Standard Voltmeter Reading $V_2 (volt)$	Error $V_1 - V_2 (volt)$
1.	2	0.2	0.36	0.16
2.	4	0.4	0.72	0.32
3.	5	0.5	0.9	0.4
4.	6	0.6	1.08	0.48

CALCULATIONS:

Compute the value of required series resistance by

the relation, $R = \frac{V}{I_g} - G.$

1. Note down given value of galvanometer resistance.
2. Compute the value of I_g using the relation $I_g = \frac{V}{G}$.
3. Calculate the value of required resistance to be connected in series with galvanometer for the conversion of given galvanometer into voltmeter of given range by the relation, $R = \frac{V}{I_g} - G.$
4. Connect resistance box of range 0-1000 ohm in series with galvanometer and take out plug of resistance R from it. Now galvanometer with this resistance in series is converted into voltmeter of given range.
5. Make the connections shown in circuit diagram.
6. Take out plug of calculated resistance R from the resistance box of range 0 to 1000 ohm and insert key K and adjust rheostat so that the deflection in galvanometer becomes maximum.
7. Note the readings of standard voltmeter and

Aim: To determine resistivity of two/ three wires by plotting a graph for potential difference vs current

OBSERVATION TABLE

Voltmeter reading (V) volt		Ammeter reading (I) Ampere	
Observed V	Corrected V	Observed I	Corrected I
0	0	0	0
0.2	0.2	20	20
0.4	0.4	40	40
0.6	0.6	60	60
0.8	0.8	80	80
1	1	100	100

1. Arrange the apparatus as shown in circuit diagram.
2. Ensure that ammeter is connected in series with

Resistance and voltmeter is connected in parallel with the wire of different material, the voltmeter, ammeter, battery eliminator, connecting wires, switch, one-way key, and a rheostat.

3. Vary the resistance by changing the rheostat and note down the readings of voltmeter and ammeter.

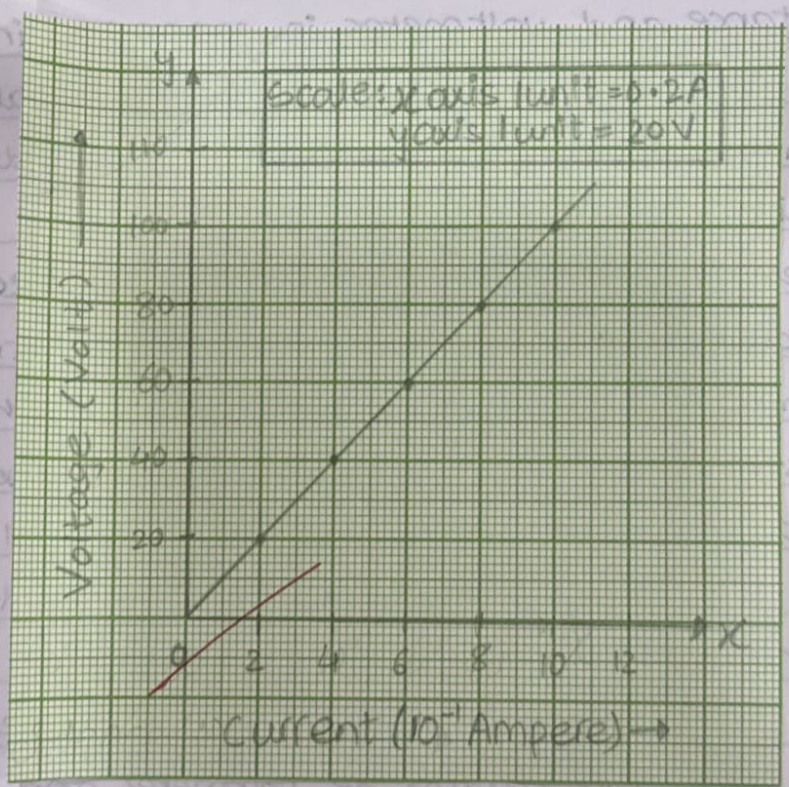
Take six more observations increasing the current through the resistance coil.

4. Now draw a graph between potential difference (V) and current (I).

Shift the origin of the graph to the point where the current is zero and potential difference is zero.

Take six more observations increasing the current through the resistance coil.

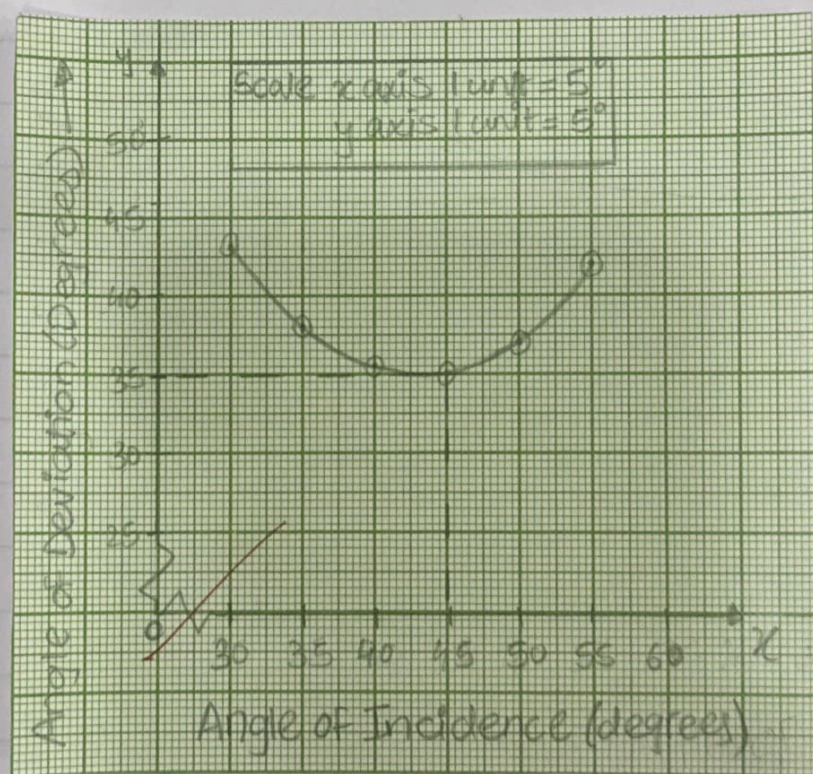
5. Cut the wire at the point where it leaves the terminals between ammeter and rheostat. Stretch it and find its length.

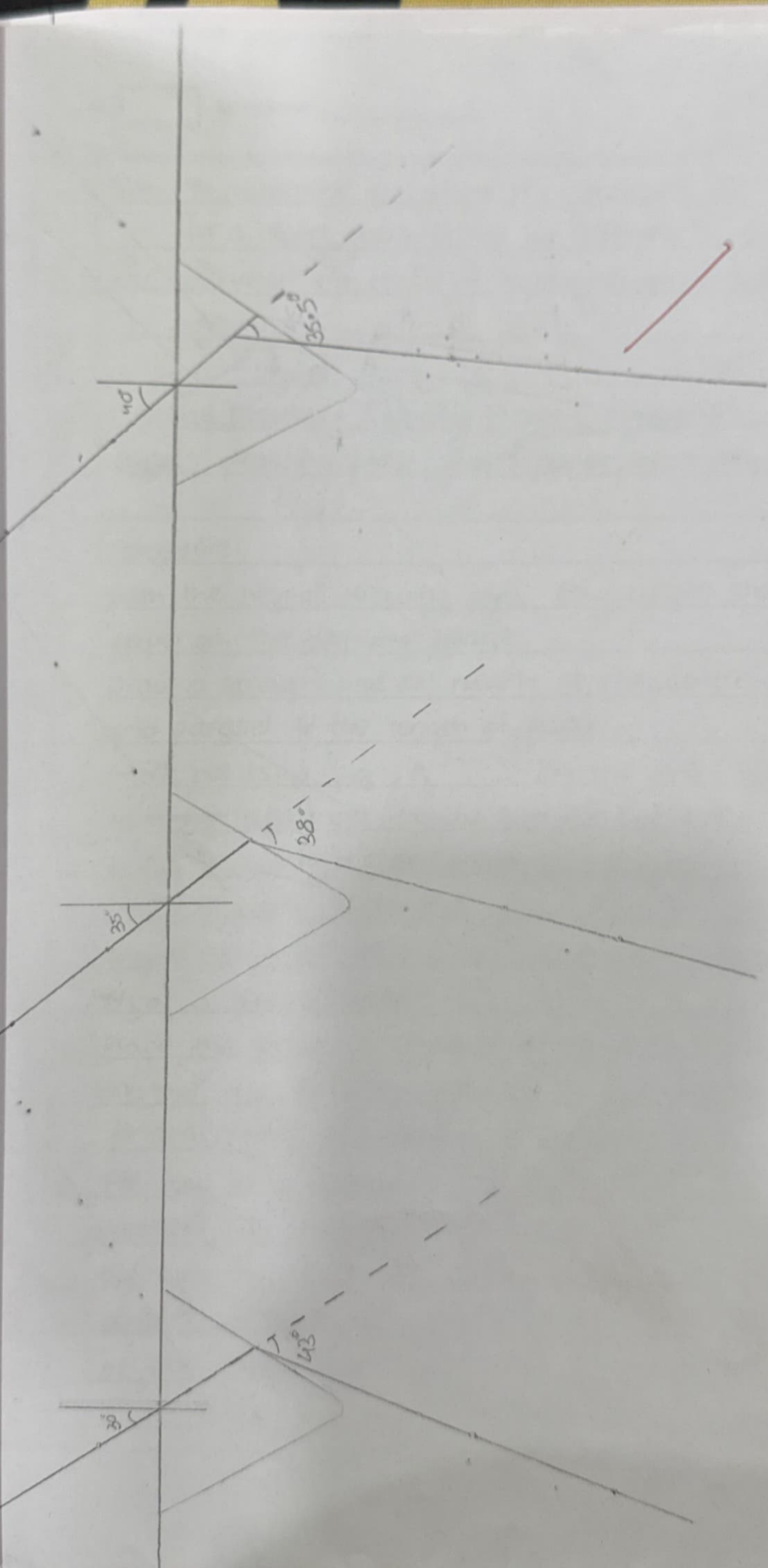


Angle of Incidence
(Degrees)

Angle of Deviation
(Degrees)

1.	30°	43°
2.	35°	38°
3.	40°	35.5°
4.	45°	35°
5.	50°	37°
6.	55°	42°





Aim: To find the values of 'u' for different values of 'v' in case of concave mirror and to find the focal length of the mirror.

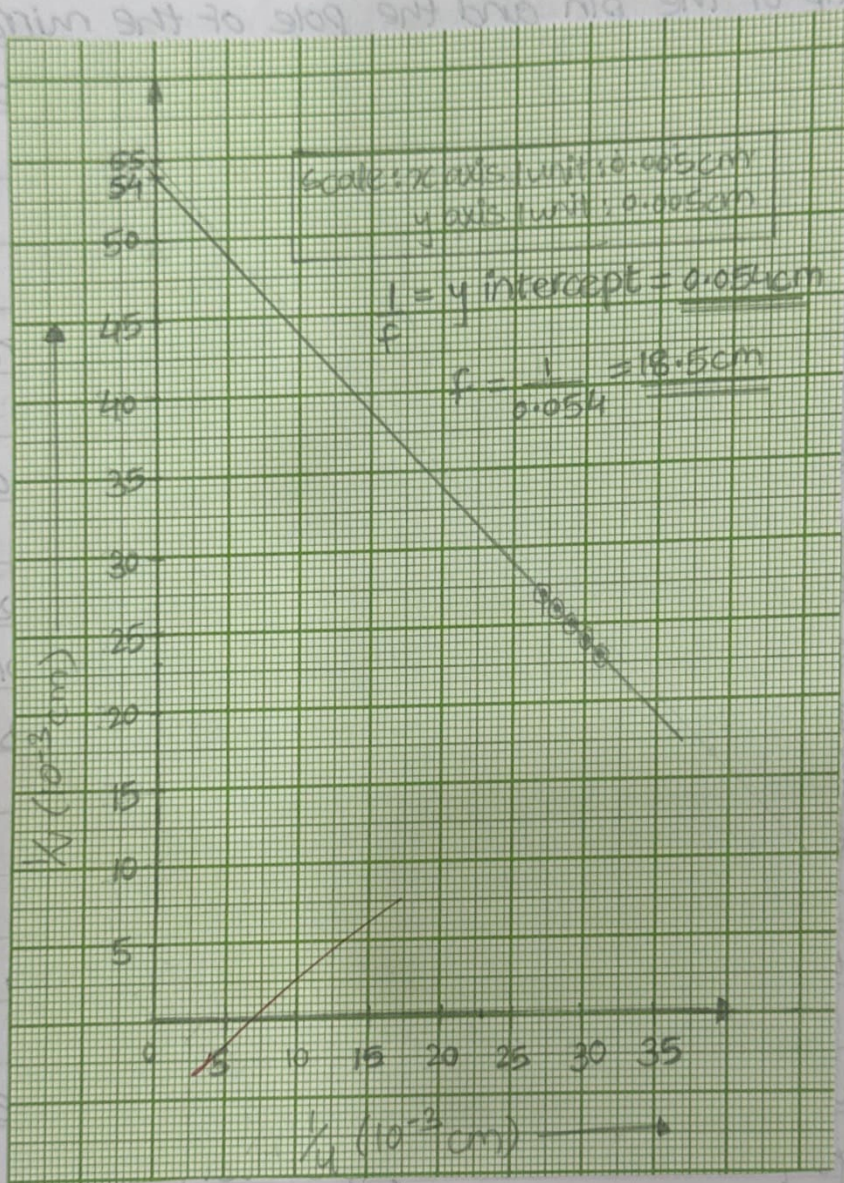
S. No.	Position of (cm)			Observed distance (cm)		Corrected Distance (cm)		1/u (cm ⁻¹)	1/v (cm ⁻¹)	f = uv / (u+v) (cm)
	Concave Mirror P	object needle	Image needle	u = PA	v = PI	u = PA	v = PI	(cm ⁻¹)	(cm ⁻¹)	(cm)
1	2.3	34.6	44.4	32.3	42.1	32.3	42.1	0.031	0.024	18.5
2	2.3	35.6	43.5	33.3	41.2	33.3	41.2	0.030	0.024	18.5
3	2.3	36.6	42.3	34.3	40.0	34.3	40.0	0.029	0.025	18.5
4	2.3	37.6	40.8	35.3	38.5	35.3	38.5	0.028	0.026	18.5
5	2.3	38.6	39.3	36.3	37.7	36.3	37.7	0.027	0.027	18.5

Mean focal length = $\frac{18.5 + 18.5 + 18.5 + 18.5 + 18.5}{5} = 18.5 \text{ cm}$

which gives approximate value of focal length of concave mirror.

- Place optical bench on a rigid table. Clamp the concave mirror on an upright and mount it vertically near one end of the optical bench.
- Move object pin P on optical bench back and forth so that its image is formed at the same height. Make slight adjustments of the height of the pin or the mirror inclination. This ensures that the principal axis of the mirror is parallel to the optical bench.
- Place another vertically mounted sharp pin P₂ in front of the reflecting surface of the concave mirror. Adjust the pins P₁ and P₂ so that the height of the tips of these pins becomes equal to the height of the pole P of the mirror from base of optical bench.

To determine the focal length of a concave mirror, a thin straight needle is placed so that its one end A, touches the tip of the pin and the other end B touches the pole P of the mirror. The positions of the uprights are read on the scale. Their difference gives the observed distance between tip of the pin and the pole of the mirror.



Repeat experiment 2 times and record your readings. Find the value of focal length, f .

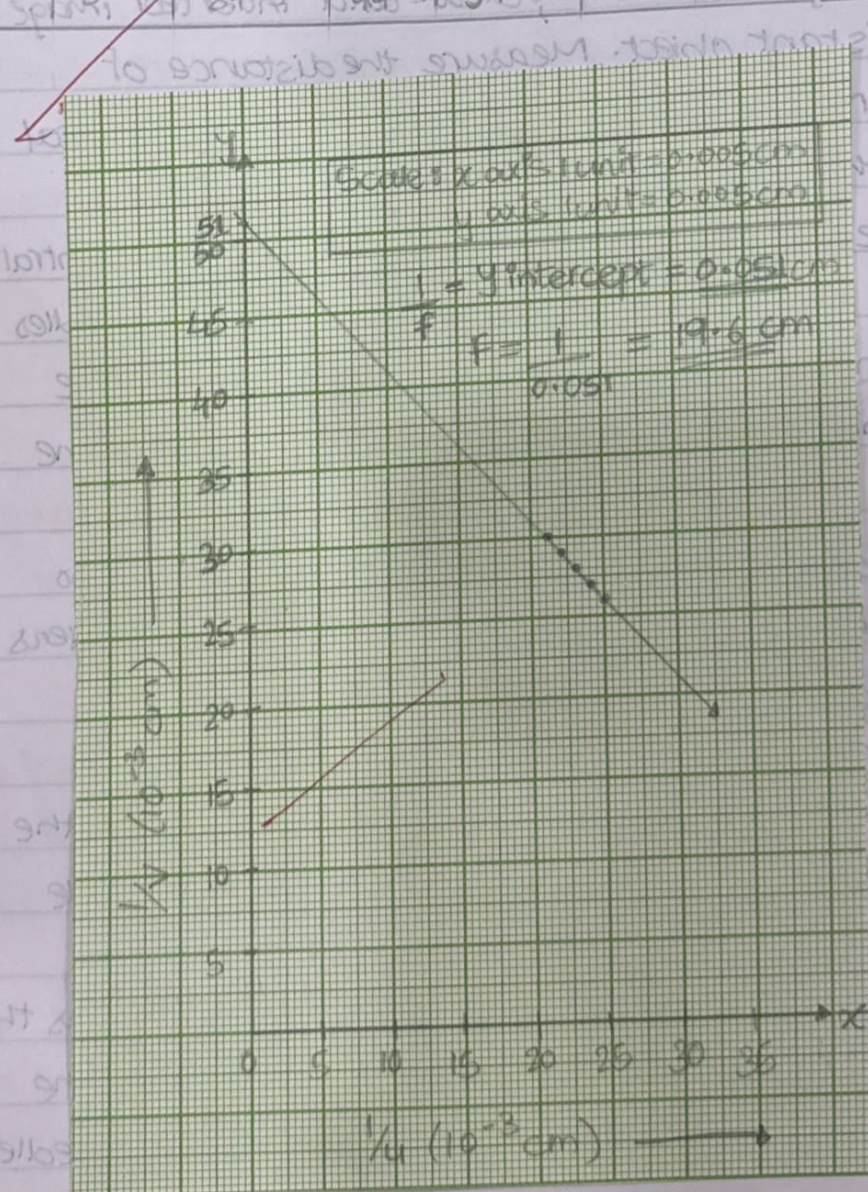
Observations:

1. Rough focal length of the concave mirror = 18 cm
2. Actual distance / length of the needle = $x = 10 \text{ cm}$

To find the focal length of a convex lens by plotting graph between u and v or between $\frac{1}{u}$ and $\frac{1}{v}$

OBSERVATION TABLE:

Sl. No.	Position of (cm)			observed		corrected		$\frac{1}{u}$	$\frac{1}{v}$	$f = \frac{uv}{u+v}$
	Object needle A	Lens	Image needle B	distance (cm)	distance (cm)	distance (cm)	distance (cm)	(cm)	(cm)	(cm)
1.	10	50	88.5	40	38.5	40	38.5	0.025	0.026	19.6
2.	8	50	87	41	37	41	37	0.024	0.027	19.6
3.	7	50	86	42	36	42	36	0.023	0.028	19.6
4.	2.5	50	83.4	47.5	33.4	47.5	33.4	0.021	0.030	19.6
5.	6	50	84	44	34	44	34	0.022	0.029	19.6



OBSERVATION TABLES:

Focal length of convex lens (f_1)

	Distance of tip of needle from upper surface of convex lens (a) (cm)	Distance of tip of needle from upper surface of plane mirror (b) (cm)	Focal length of convex lens $f_1 = \frac{a+b}{2}$ (cm)
1.	19.3	19.6	19.45
2.	19.2	19.6	19.4
3.	19.1	19.5	19.3

Mean focal length $f_1 = \frac{19.45 + 19.4 + 19.3}{3} = 19.4$

Focal length of combination of convex lens and plane mirror (F)

	Distance of tip of needle from upper surface of convex lens (a') (cm)	Distance of tip of needle from plane mirror (b') (cm)	Focal length of combination $F = \frac{a'+b'}{2}$ (cm)
1.	28.6	29.1	28.85
2.	28.8	29.1	28.95
3.	28.6	29.0	28.8

Mean focal length $F = \frac{28.85 + 28.95 + 28.8}{3} = 28.87$

Table for (b):

	Initial circular scale reading on convex lens (a)	No. of complete rotations made by circular scale (n)	Final reading of circular scale on the glass slab (b)	Additional division moved (m)
1.	68	0	68	0
2.	67	0	67	0
3.	68	0	68	0

Mean distance of the tip of the needle from the upper surface of the convex lens (f_2)

Distance of the tip of the needle from the plane mirror

CALCULATIONS: since only to right focal length, 'd' is set

$$f_1 = 19.4$$

$$F = 28.85$$

$$\frac{1}{F} = \frac{1}{f_1} - \frac{1}{f_2}$$

$$f = 59.22 \text{ cm}$$

Radius of curvature of convex surface of lens is:

$$R = \frac{f^2}{2h}$$

Now proceed in steps 8 to 10 to find focal length of the combination of plano-convex lens (f) and plano-concave lens (F) are the distances of upper

surface of the convex lens and the plane surface of the concave lens, then focal length of the combination is given by $\frac{1}{f} + \frac{1}{F} = \frac{1}{s}$

10. Repeat steps 8 to 10 at least two times more and record all observations.
11. After focal length of convex lens f and focal length of combination of convex lens and plano-concave lens formed by water F is determined, the focal length of plano-concave lens can be calculated as:

$$\frac{1}{f} - \frac{1}{F} = \frac{1}{f_2}$$

Aim: To determine refractive index of glass slab using travelling microscope

Cross mark without slab			Cross mark with slab			Powder on Slab		
M.S.R. a (cm)	Vernier division coinciding n	$R_1 = a + \frac{n \times L.C.}{100}$ (cm)	M.S.R. b (cm)	Vernier division coinciding n	$R_2 = b + \frac{n \times L.C.}{100}$ (cm)	M.S.R. c (cm)	Vernier division coinciding n	$R_3 = c + \frac{n \times L.C.}{100}$ (cm)
1. 8.3	12	8.3012	8.7	10	8.7010	9.8	9	9.8009
2. 8.3	10	8.3010	8.7	10	8.7010	9.8	9	9.8009
3. 8.3	11	8.3011	8.7	9	8.7009	9.8	10	9.8010

Mean $R_1 = 8.3011$ cm, Mean $R_2 = 8.7008$ cm, Mean $R_3 = 9.8008$ cm

Calculations: Real thickness of glass slab $R_3 - R_1 = 1.5007$ cm

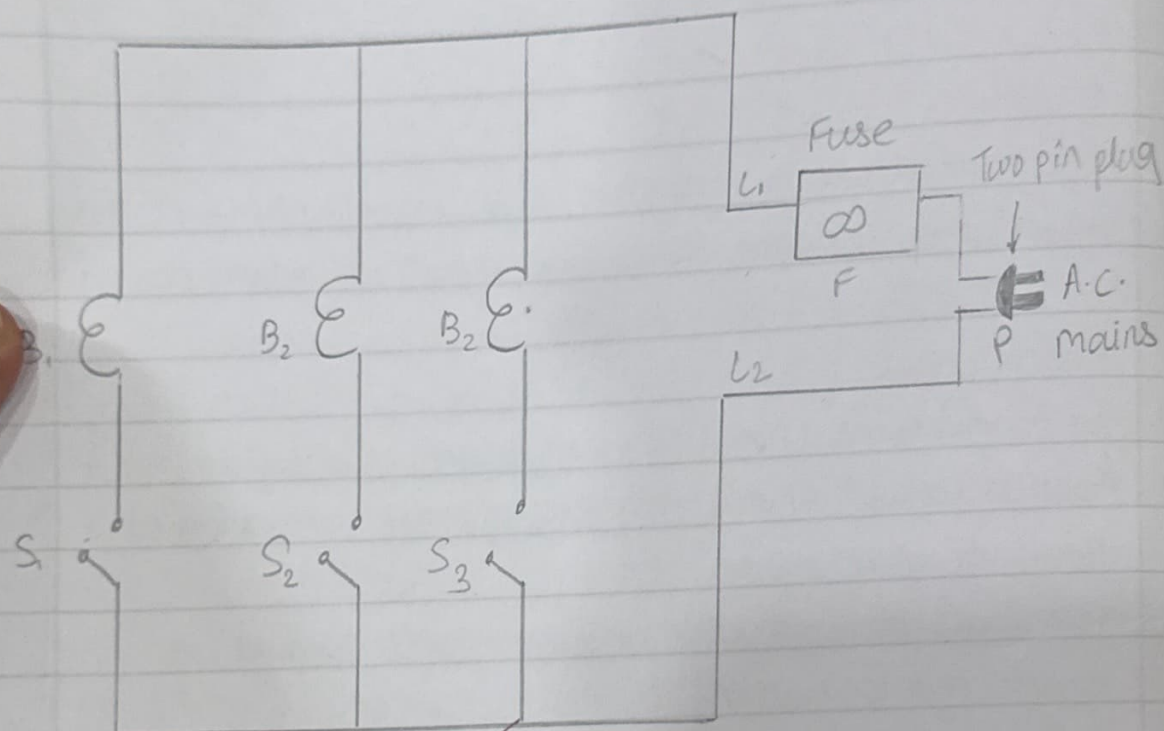
Apparent thickness of glass slab $R_3 - R_2 = 1.1000$ cm

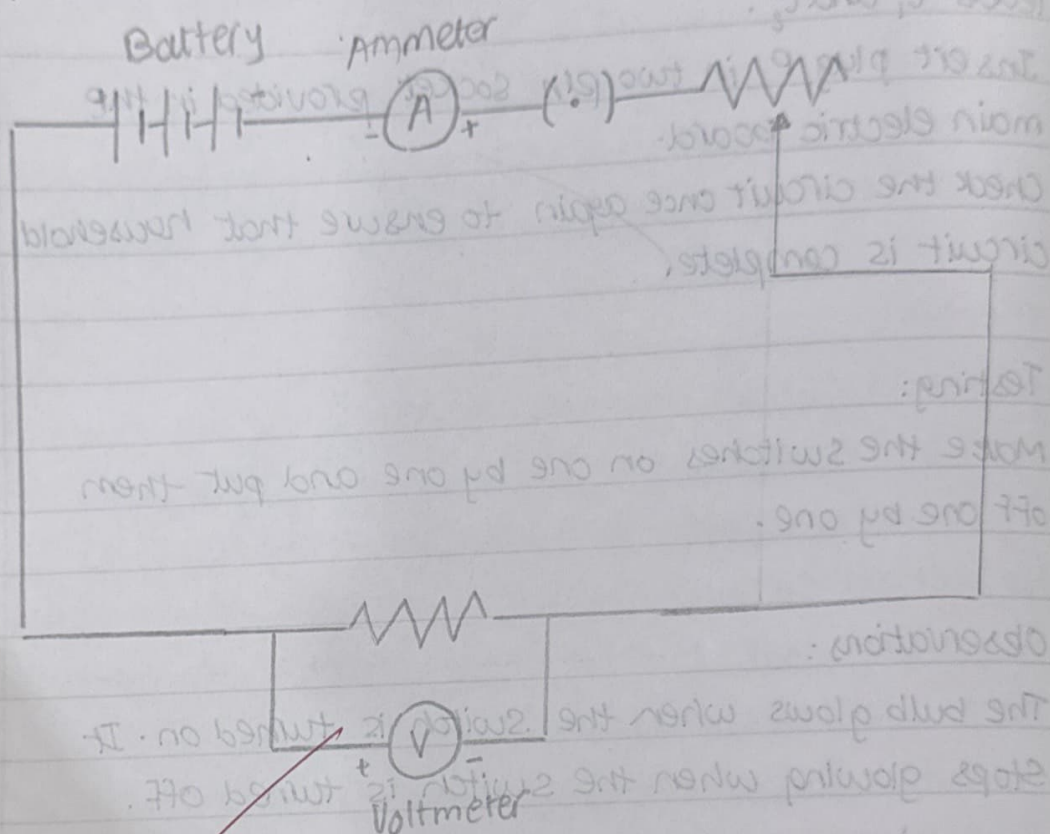
Refractive index $\mu = \frac{\text{Real thickness of slab}}{\text{Apparent thickness of slab}}$

$\mu = \frac{1.5007}{1.1000} = 1.3643$

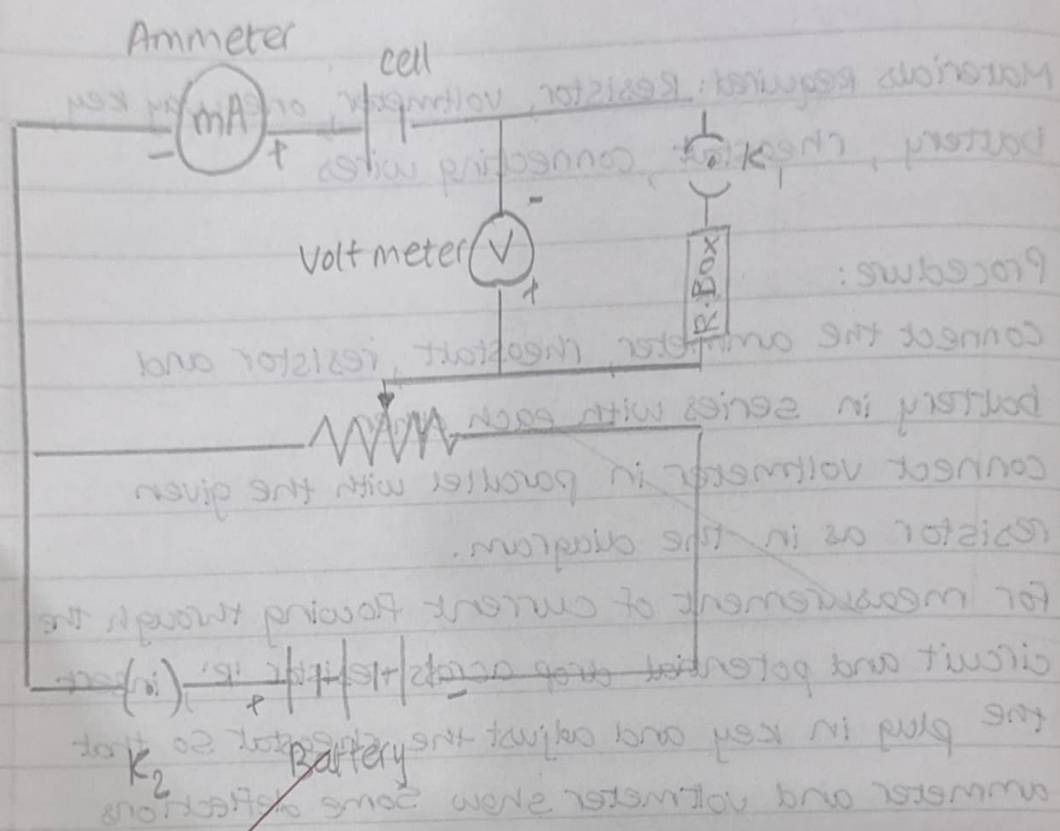
2. Sprinkle a very small quantity of lycopodium powder on the glass slab and bring the cross-mark in focus so that the cross of the cross-wire of vernier scale readings on vertical scale. This gives reading R_1 .
3. Place the given glass slab on the black cross-mark. It is observed that the cross-mark appears to be raised. Now move the microscope gradually and gently upwards to bring the cross-mark in focus on the cross-wire of the eye piece. Note this reading on the vertical scale of travelling microscope and record it R_2 .
4. Make a black ink cross mark at the base of the microscope. This mark will act as point 'c'. Now make the microscope vertical and note the reading R_3 .
5. Repeat the above steps for three more readings and take the mean value of R_1, R_2, R_3 .
6. Calculate the real thickness of glass slab $R_3 - R_1$ and apparent thickness of glass slab $R_3 - R_2$.
7. Calculate the refractive index $\mu = \frac{R_3 - R_1}{R_3 - R_2}$.

Sr. No.	For forward biasing		For reverse biasing	
	Forward bias Voltage V_f (V)	Forward bias current I_f (mA)	Reverse bias Voltage V_R (V)	Reverse bias current I_R (μ A)
1.	0	0	0	0
2.	0.1	0	1	2
3.	0.2	0.2	2	4
4.	0.3	0.4	3	6
5.	0.4	0.6	4	8
6.	0.5	0.8	5	10
7.	0.6	1.2	6	12
8.	0.7	1.4	7	14
9.	0.8	1.8	8	16
10.	0.9	2	9	18
11.	1	2.4	10	20
12.	1.1	2.8	11	22
13.	1.2	3	12	24
14.	1.3	3.4	13	26
15.	1.4	3.8	14	28
16.	1.5	4	15	30
17.	1.6	4.4	16	32
18.	1.7	4.8	17	34
19.	1.8	5.2	18	36
20.	1.9	5.6	19	38





Aim: To assemble the components of a given electrical circuit



1. Assemble of electric components in electric circuit is complete.
2. Connect voltmeter in parallel with the given resistor as in the diagram.
3. Connect the ammeter, rheostat, resistor and battery in series with each other.
4. For measurement of current flowing through the circuit and potential drop across the resistor, the plug in key and adjust the rheostat so that ammeter and voltmeter show some deflection and record observation.

Result: Assembly of all components in electric circuit is complete.

Utility: It is used for measuring an unknown resistance.

- Precautions:
1. Ammeter is connected in series in the circuit.
 2. Voltmeter is connected in parallel with given resistor.

