EXPERIMENT No. 1

AIM:- To determine resistivity of two/three wires by plotting a graph for potential difference versus current.

APPARATUS REQUIRED:- A Voltmeter, an Ammeter (mA), rheostat, two wires, Battery, 1 Key, meter scale.

Theory:-

By Ohm's Law

$$V \propto I$$

$$\frac{V}{I} = \text{Constant } (R)$$

$$\because R \propto \frac{l}{A} \Rightarrow R = \rho \frac{l}{A}$$

$$\boxed{\rho = \frac{RA}{l}} \qquad \boxed{\rho = \frac{R\pi r^2}{l}}$$

Resistivity of the wire.

A = Area of wire.
l = length of wire.
R = Resistance of wire.

Observations:-

Range of ammeter = 0 – 500 (mA)
Range of Voltmeter = 0 – 500 (mV)

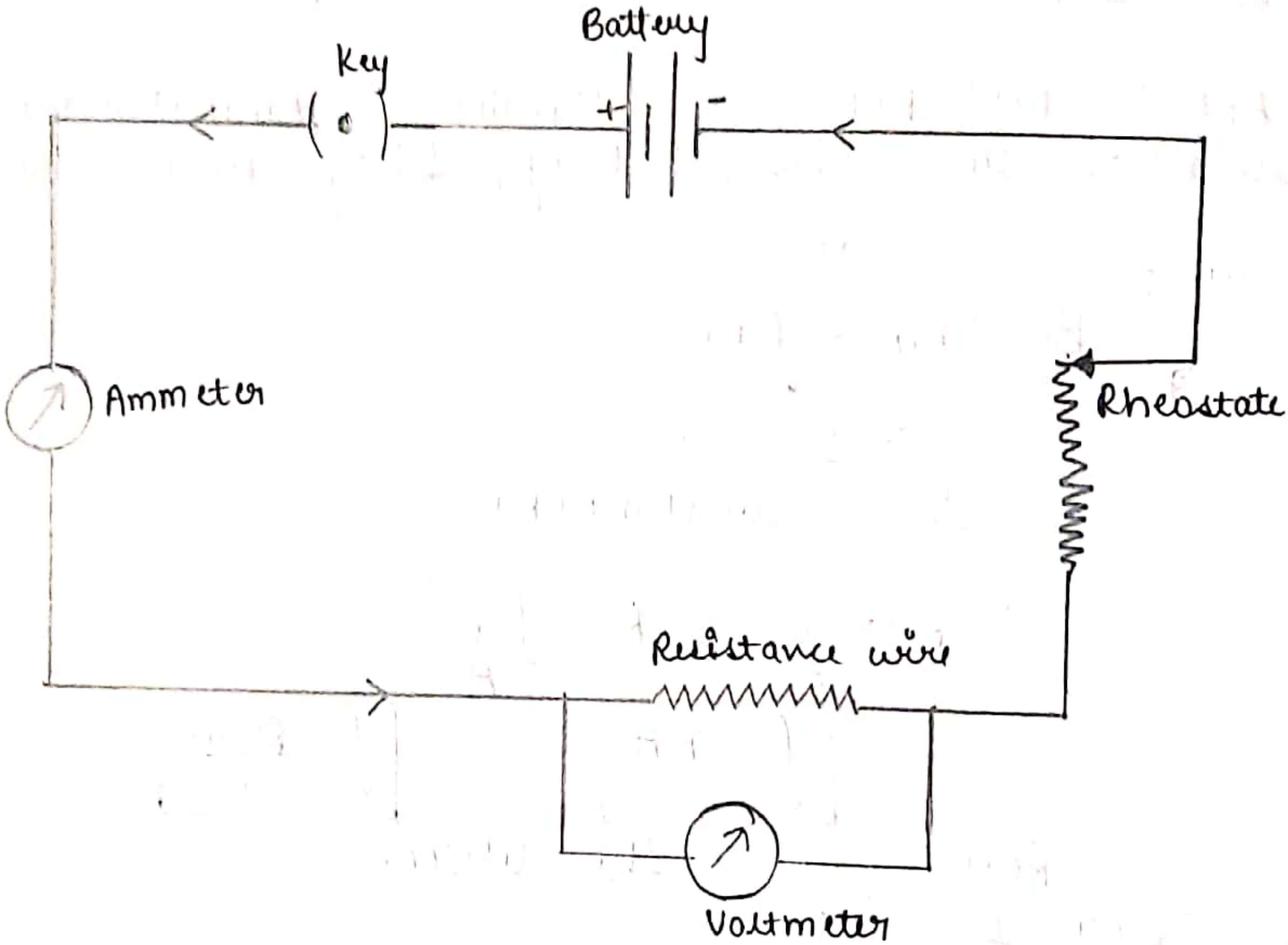


Figure :- Circuit to find resistance of wire.

Least Count of Ammeter = $\frac{100}{10}$ = 10mA = 0.01A
Least Count of Voltmeter = $\frac{100}{10}$ = 10mV = 0.01V

For I[st] Wire:-
length of the wire l_1 = 30cm

For II[nd] wire:-
length of the wire l_2 = 30cm

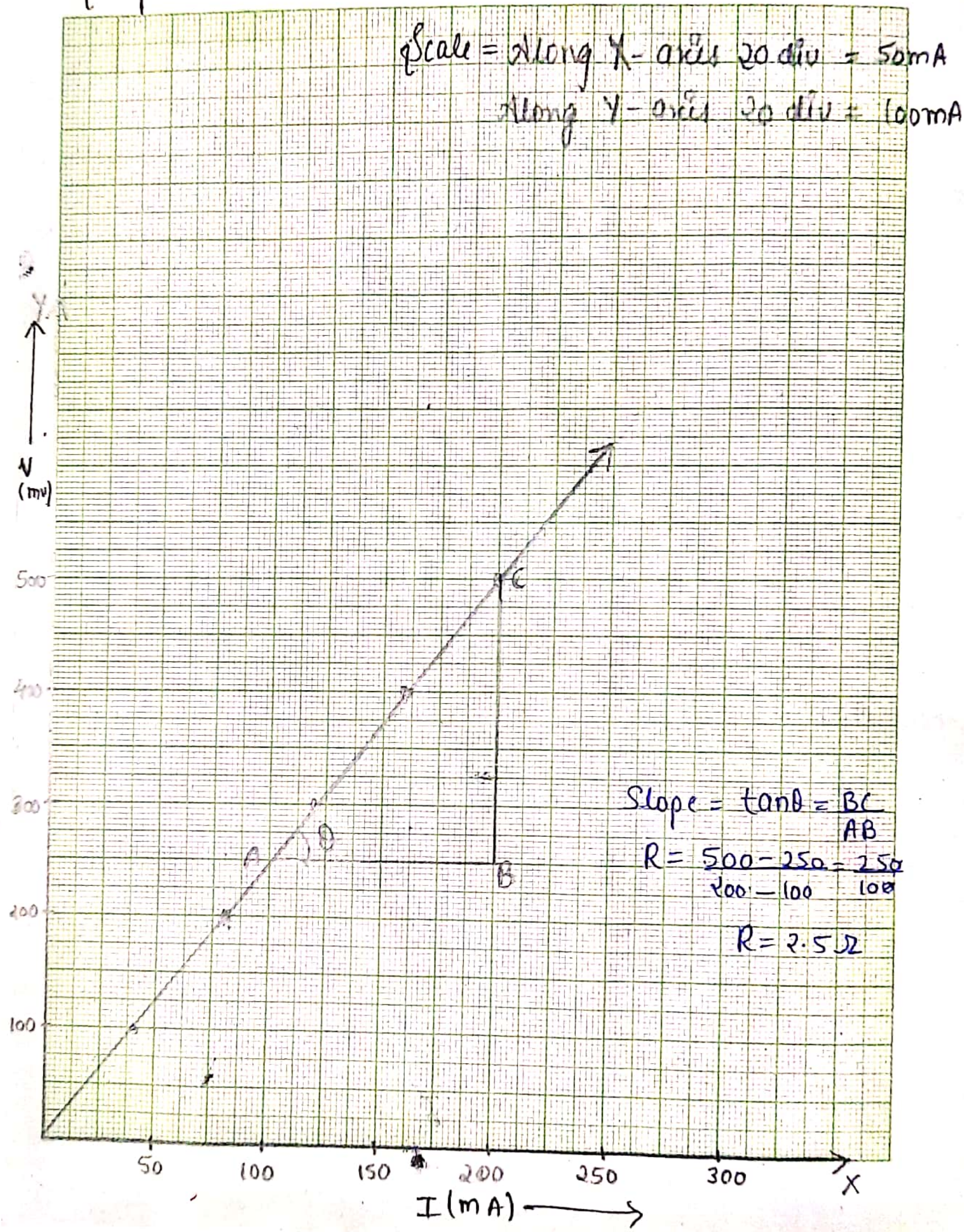
For Diameters of Wire :- (Observation Table):-

	S.NO.	Main Scale (x)	Coincides (n)	(y) = n × L.C	D = x+y	± ΔD
I[st] wire	1.	0	35	35×0.01	0.35	0.3
	2.	0	35	35×0.01	0.35	0.3
II[nd] wire	1.	0	45	45×0.01	0.45	0.4
	2.	0	45	45×0.01	0.45	0.4

∴ $D_1 = 0.3$, $r_1 = \frac{0.3}{2}$ mm

$D_2 = 0.4$, $r_2 = \frac{0.4}{2}$ mm

Graph b/w V v/s I (Ist Wire)



Observation Table (Ist Wire) :-

S.NO.	Voltmeter Reading (mV)	Ammeter Reading (mA)	Resistance (Ω) $\left(R = \frac{V}{I}\right)$
1.	100	4 x 10 = 40mA	2.5
2.	200	8 x 10 = 80mA	2.5
3.	300	12 x 10 = 120mA	2.5
4.	400	16 x 10 = 160mA	2.5
5.	500	20 x 10 = 200 mA	2.5

Calculations (Ist Wire) :-

$R_1 = 2.5 \Omega$

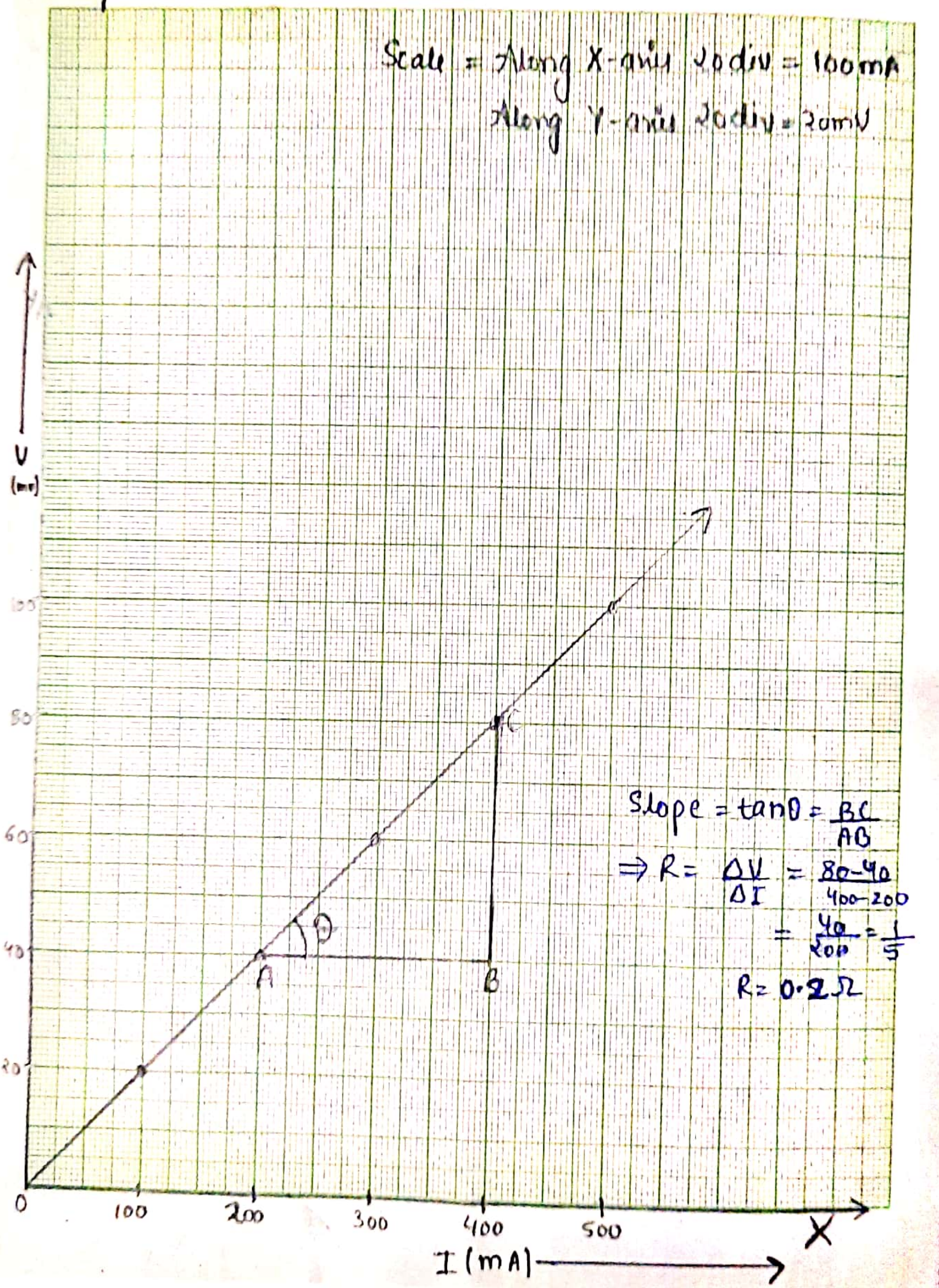
$$R_1 = \frac{\rho_1 l_1}{A_1}$$

$$\Rightarrow \rho_1 = \frac{R_1 A_1}{l_1}$$

$$\Rightarrow \rho_1 = \frac{R_1 \pi (r_1)^2}{l_1}$$

$$= \rho_1 = \frac{2.5 \times 3.14 \times \left(\frac{0.3 \times 10^{-3}}{2}\right)^2}{30 \times 10^{-2}}$$

Graph b/w V & I (II^{nd} wire)



$\Rightarrow \rho_1 = 58.8 \times 10^{-8}\ \Omega m$.

Observation Table (II^nd Wire):-

S.NO.	Voltmeter Reading (mV)	Ammeter Reading (mA)	Resistance (R) = V/I (Ω)
1.	20	100	0.2
2.	40	200	0.2
3.	60	300	0.2
4	80	400	0.2
5.	100	500	0.2

Calculation (II^nd Wire):-

$R_2 = 0.2\,\Omega$

$$R_2 = \rho_2 \frac{l_2}{A_2} \Rightarrow \rho_2 = \frac{R_2 A_2}{l_2}$$

$$\Rightarrow \rho_2 = \frac{R_2 \pi (r_2)^2}{l_2} = \frac{0.2 \times 3.14 \times \left[\frac{0.4 \times 10^{-3}}{2}\right]^2}{30 \times 10^{-2}}$$

$$\Rightarrow \rho_2 = 8.3 \times 10^{-8}\ \Omega m$$

PRECAUTIONS :-

1. The end of the wire should be neat and clean.
2. The Connection should be tight.
3. A low resistance rheostate must be used.
4. The current should be passed for a short interval of time.

SOURCES OF ERRORS :-

1. The Connection might be loose.
2. High resistance rheostate may be used.
3. The Wire may not have uniform thickness.
4. The screw gauge may have faults like backlash error and wrong pitch.

Results :-

Resistivity of 1st wire (ρ_1) = $58.8 \times 10^{-8}\ \Omega m$.

Resistivity of 2nd wire (ρ_2) = $8.3 \times 10^{-8}\ \Omega m$

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EXPERIMENT NO. 2

AIM ⇒ To find resistance of a given wire using metre bridge and hence determine the resistivity (specific resistance) of its material.

MATERIAL REQUIRED ⇒

→ A metre bridge, a Leclanche cell (battery eliminator), galvanometer, a resistance box, a jockey, one way key, a resistance wire, a screw gauge, metre scale, a set square, connecting wires, & piece of sand paper.

THEORY ⇒

(i) The unknown resistance 'X' is given by:-

→ $X = \frac{(100-l)R}{l}$

→ Where R is known resistance placed in left gap and unknown resistance 'X' in the right gap of metre bridge 'l' cm in the length of metre bridge wire from zero end upto balance point on the metre scale.

(ii) Specific resistance (ρ) of material of the given wire is given by:-

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(A) OBSERVATION TABLE ⇒

S.NO.	Resistance from the resistance box (R) (Ohm)	Length AB = l (cm)	Length BC = $(100-l)$ (cm)	unknown resistance $X = \frac{R(100-l)}{l}$ (Ohm)
1.	0.2	29.2	70.8	$X_1 = 0.48$
2.	0.1	17.4	82.6	$X_2 = 0.47$
3.	10	95.6	4.4	$X_3 = 0.46$
4.	0.3	58.8	41.2	$X_4 = 0.48$

Length of given wire (L) = 22.2 cm

Mean Value of unknown Resistance X = 0.47 Ω

Date

Expt. No. 2 Page No. 7

→ $\rho = \frac{X\pi D^2}{4L}$

→ Where 'L' is length and 'D' is diameter of the given wire.

CALCULATIONS :→

* Least Count of the Screw gauge:-

→ Pitch of Screw gauge = 1mm.

→ Total no. of divisions on circular scale = 100.

→ L.C of screw gauge = $\frac{\text{Pitch}}{\text{no. of division on 'O' Scale}}$

= 0.01mm

* Zero error e = 0mm

* Calculation for 'X' :-

→ Mean $X = \frac{X_1 + X_2 + X_3 + X_4}{4}$

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(B) Table for Diameter (D) of the Wire ⇒

S.No.	Circular Scale Reading			Observed diameter $D_0 = N + n \times L.C$ $D = D_0 + C$ (mm)
	Linear Scale Reading (N) (mm)	no. of Circular Scale division on reference line (n)	Value $n \times (L.C)$ (mm)	
1.	0	35	$35 \times 0.01 = 0.35$	0.35
2.	0	34	$34 \times 0.01 = 0.34$	0.34
3.	0	36	$36 \times 0.01 = 0.36$	0.36

→ $X = \frac{0.48 + 0.47 + 0.46 + 0.48}{4} = 0.47$ Ohm.

* Calculations for D (Diameter) ⇒

→ $D = \frac{D_1 + D_2 + D_3}{3} = \frac{0.35 + 0.34 + 0.36}{3}$

$= 0.35mm = 0.035cm$

* Calculations for Specific Resistance ⇒

→ $\rho = \frac{X \pi D^2}{4L} = \frac{0.47 \times 3.14 \times (0.035)^2}{4 \times 22.2}$

$= 0.00002034$ Ohm cm

$= 2.034 \times 10^{-7}$ Ohm m

→ Diameter of wire (D) = 0.035cm
→ Length of wire (L) = 22.2cm
→ Resistance of wire (X) = 0.47 Ω.

RESULTS ⇒

(1) unknown resistance (X) = 0.47 Ω

(2) Specific resistance (ρ) = 2.034×10^{-7} Ωm

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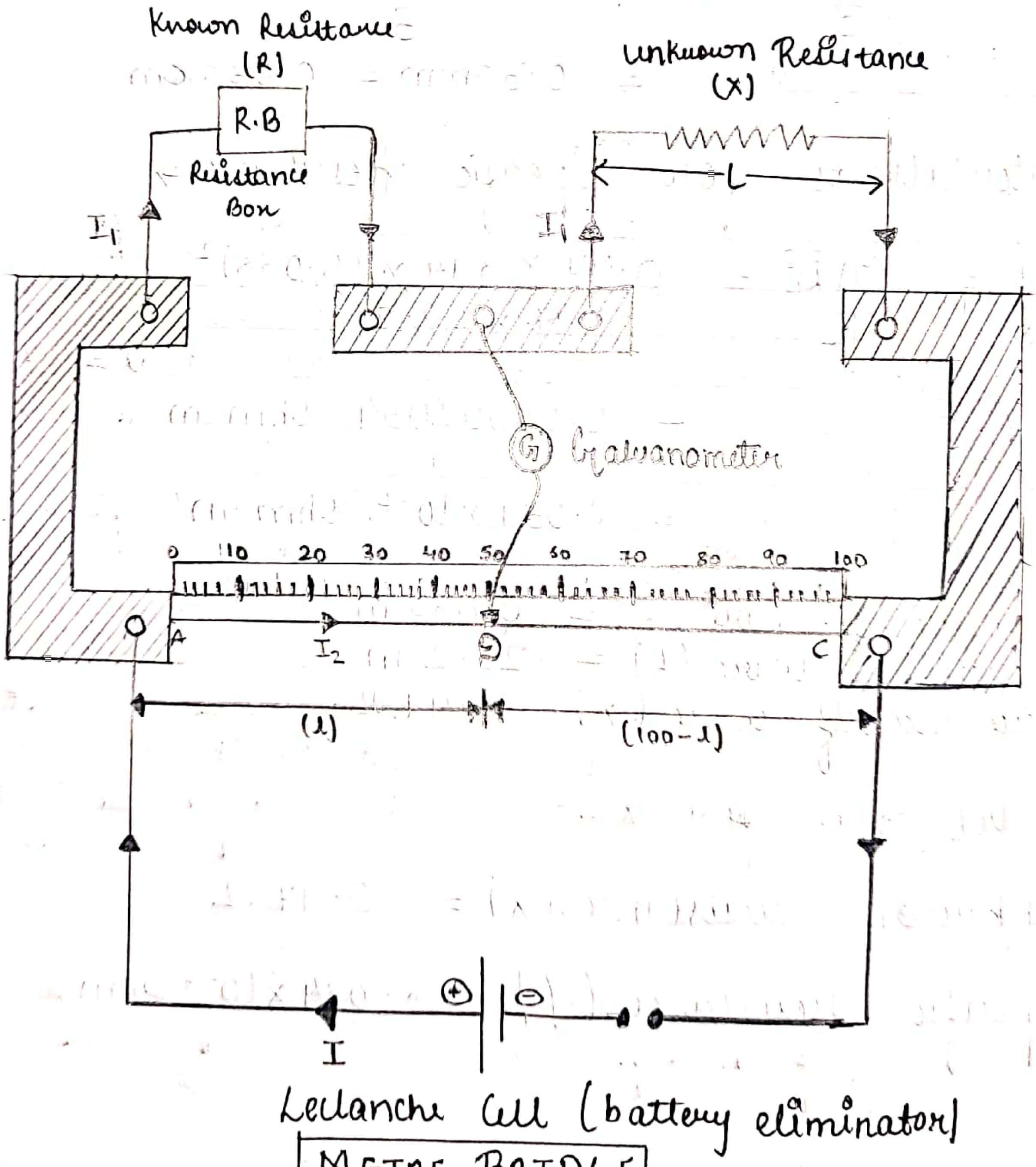
CIRCUIT DIAGRAM ⇒



METRE BRIDGE

PRECAUTIONS ⇒

1. The Connections should be neat, tight & clean.
2. The Wire should not make a loop.
3. Move the jockey gently over the bridge wire and do not rub it.
4. All the plugs of the resistance box should be tight.

ACTIVITY No. 1

AIM ⇒ To measure resistance, Voltage (AC/DC), Current (AC) and check continuity of a given circuit using multimeter.

APPARATUS ⇒
1. Three Carbon resistors.
2. One standard resistance coil
3. a battery eliminator (2V, 4V, 6V)
4. Step down transformer (2V, 4V)
5. Resistor of 100 Ohm.
6. A plug key & multimeter.

THEORY ⇒

* Multimeter ⇒ It is a single measuring device acting as an Ammeter, Voltmeter & an Ohmmeter, for this reason it is also called AVO meter.

→ It can measure alternating as well as direct current & alternating as well as direct Voltage in addition to resistance. There are many ranges in each section so that it can measure from micro (10^{-6}) to mega (10^{6}) units.

OBSERVATION TABLE ⇒

(A) For Measurment of Resistance :-

Resistor used	Colour & Codes of Rings				Value of tolerance from Colour Code. (Ω)	Value by multimeter (Ω)	% Difference
	1.	2.	3.	4.			
R_1	Orange	Red	Brown	Silver	$32 \times 10^1 \pm 10\%$	330	+10.0
R_2	Brown	Black	Brown	Gold	$10 \times 10^1 \pm 5\%$	99	−1
R_3	Yellow	Orange	Brown	No colour	$43 \times 10^1 \pm 20\%$	440	+10.0

(B) For Measurment of Voltage :-

A.C or D.C Volts	Obs. S.No.	Voltage b/w terminals V_0 (Volts)	Voltage reading as measured by multimeter V (Volt)	Difference in Voltage reading & Volt marked $2V - V_0$ (Volt)
A.C	1.	1.00 V_0	0.98 V	0.96
	2.	1.50 V_0	1.48 V	1.46
	3.	1.75 V_0	1.70 V	1.65
D.C	1.	4 V_0	4.9 V	5.8
	2.	6 V_0	6.10 V	6.2
	3.	10 V_0	9.98 V	9.96

→ Rotation of a knob changes the section & the range in one section.

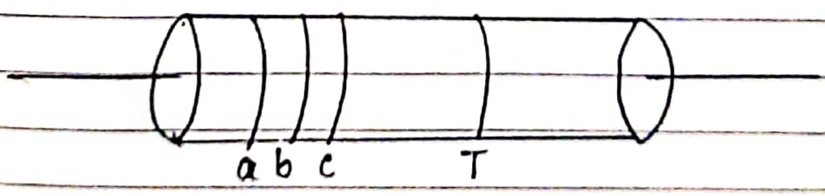
→ Rotation of knob for change in ammeter range, brings shunt resistances of different values in circuit in parallel with the coil.

→ Rotation of knob for change in voltmeter range, brings series resistances of different values in circuit in series with the coil.

→ Rotation of knob for change in ohmmeter range, brings different resistances in circuit in series with the multimeter cell.

① Carbon resistors are frequently used in electrical & electronic circuits and their values vary over a very wide range. A colour code is used to indicate the value of the resistance.

⇒



Colour Code for Carbon resistors :-

Letter	Colour	Figure (a,b)	Multiplier (C)	Colour (for IVth band)	Tolerance (T)
B	Black	0	10^0	Gold	5%
B	Brown	1	10^1	Silver	10%
R	Red	2	10^2	No colour	20%
O	Orange	3	10^3		
Y	Yellow	4	10^4		
G	Green	5	10^5		
B	Blue	6	10^6		
V	Violet	7	10^7		
G	Grey	8	10^8		
W	White	9	10^9		
	Gold				
	Silver				

(2) A Carbon resistance has four different Concentric Coloured rings or bands on its surface. The first three bands a, b and c determine the value of the resistance and the fourth band 'd' gives the percentage of accuracy called tolerance. The resistance of carbon resistor
$R = (ab \times 10^c \pm T\,\%)\,\Omega$

INFERENCE ⇒

(1) The measured values of multimeter match with decoded values of resistors.

(2) A.C & D.C Voltage marked on Voltage sources match with Voltage measured by multimeter.

PRECAUTIONS ⇒

→ Instructions for handling the multimeter should be gone through thoroughly as it is a very handy instruments & is likely to get damaged if carelessly or ignorantly used.

→ Select the appropriate parameter current, Voltage or resistance to the measured & set it on the appropriate range.

→ If range of the parameter measured is not Known start with maximum. for measuring V, never Connect more than maximum 600V.

Teacher's Signature

Date

Expt. No. activity 2. Page No. 14

ACTIVITY NO. 2

AIM ⇒ To assemble the components of a given electrical circuits.

APPARATUS ⇒
1. Resistor.
2. Ammeter.
3. Voltmeter.
4. One-way key.
5. battery.
6. Rheostate.
7. Connecting wire.

THEORY ⇒ 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 the given resistance.

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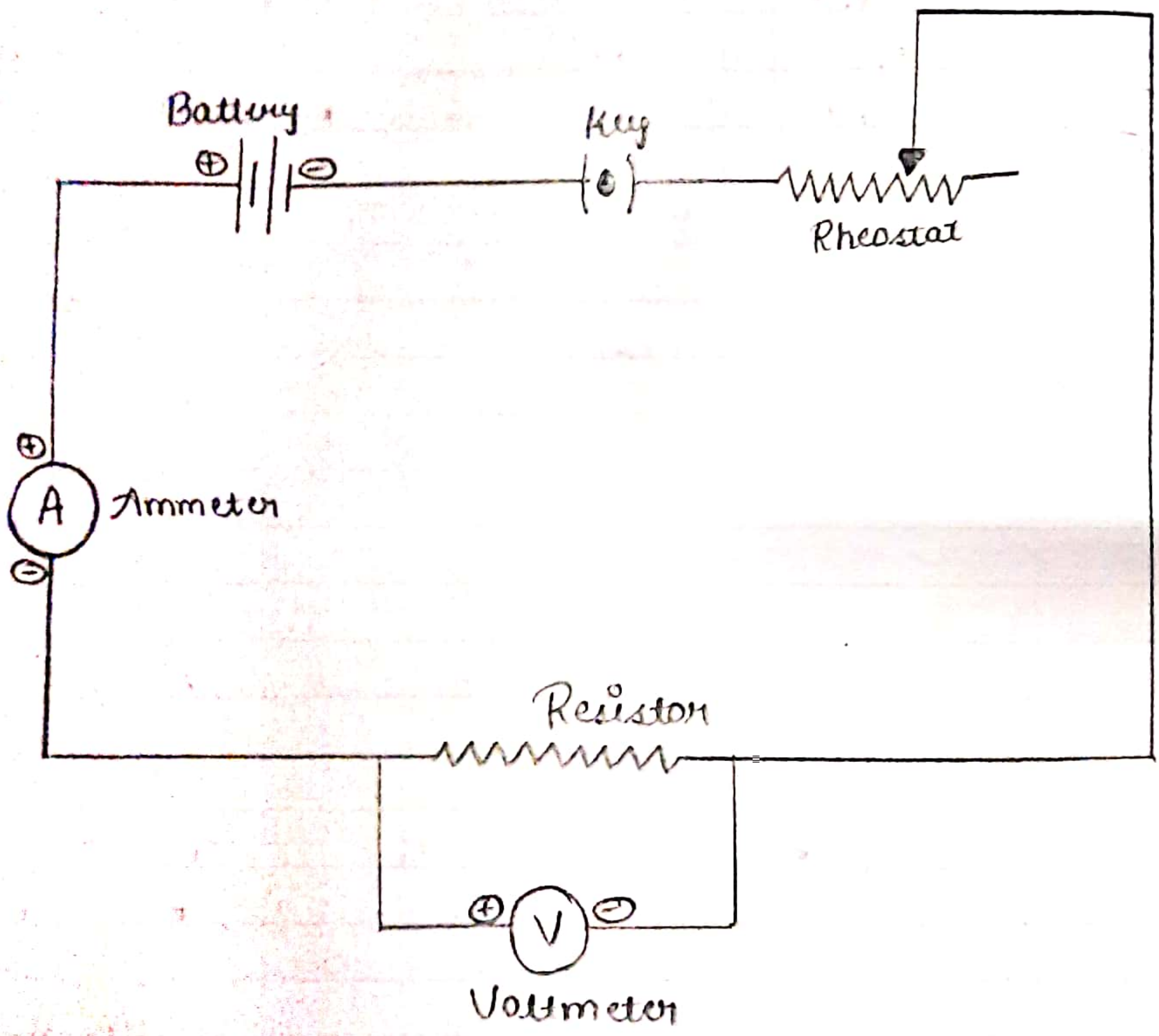
Electrical Circuit using Given Components :-



Date

Expt. No. activity 3. Page No. 15

ACTIVITY No. 3

AIM ⇒ To draw the diagram of a given circuit comprising at least a battery, resistor/rheostat, Key, Ammeter & Voltmeter. Mark the components that are not connected in proper order & correct the circuit & also the circuit diagram.

APPARATUS ⇒
1. A Voltmeter
2. Ammeter.
3. Battery
4. one-way key.
5. Resistor
6. Connecting Wires.

THEORY ⇒ A cell is said to be open circuit when no current is drawn from it.

OBSERVATIONS ⇒ The Key is not closed & the ammeter & Voltmeter are not connected properly.

PRECAUTIONS & SOURCES OF ERRORS ⇒

1. Voltmeter and ammeter of proper range should be used.

2. Ammeter should be connected in series while Voltmeter should be connected in parallel with the circuit.

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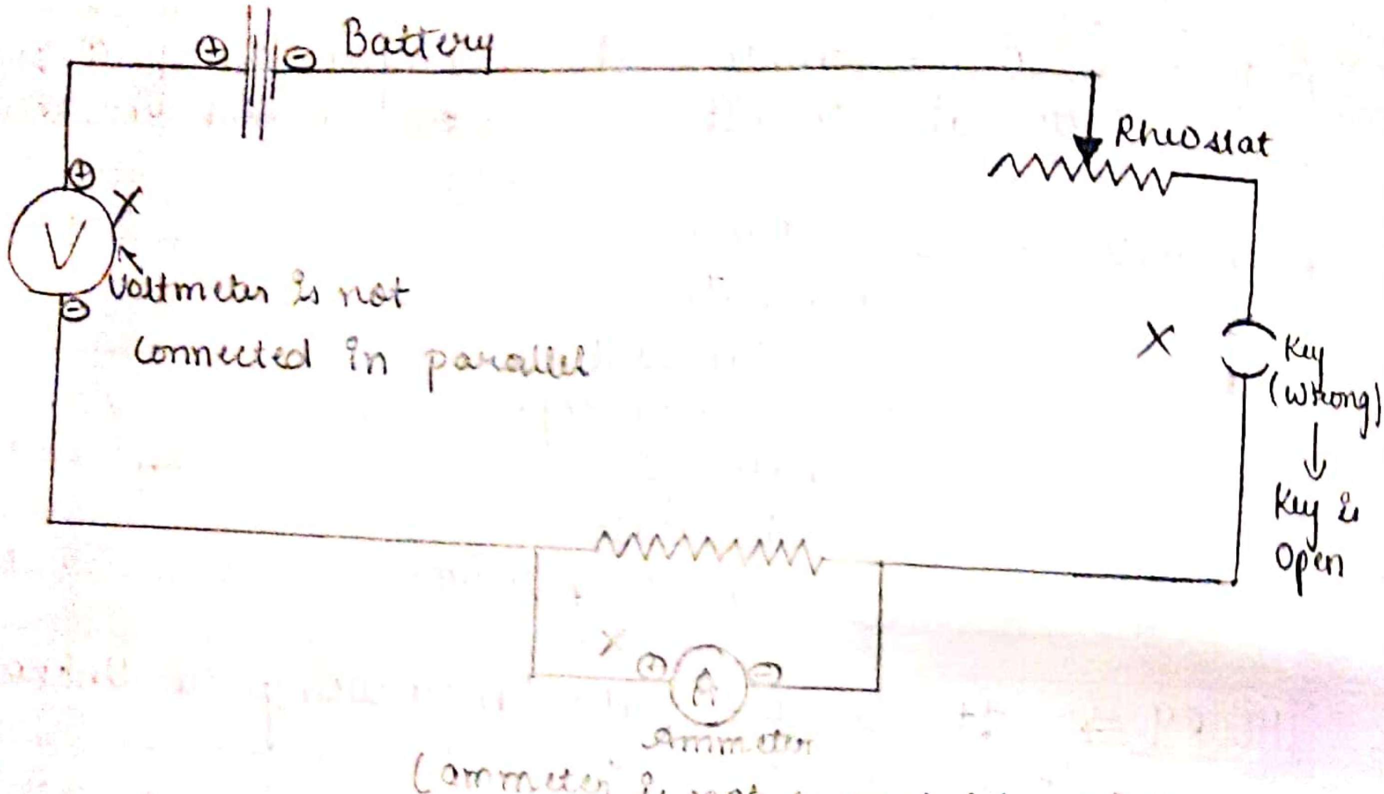
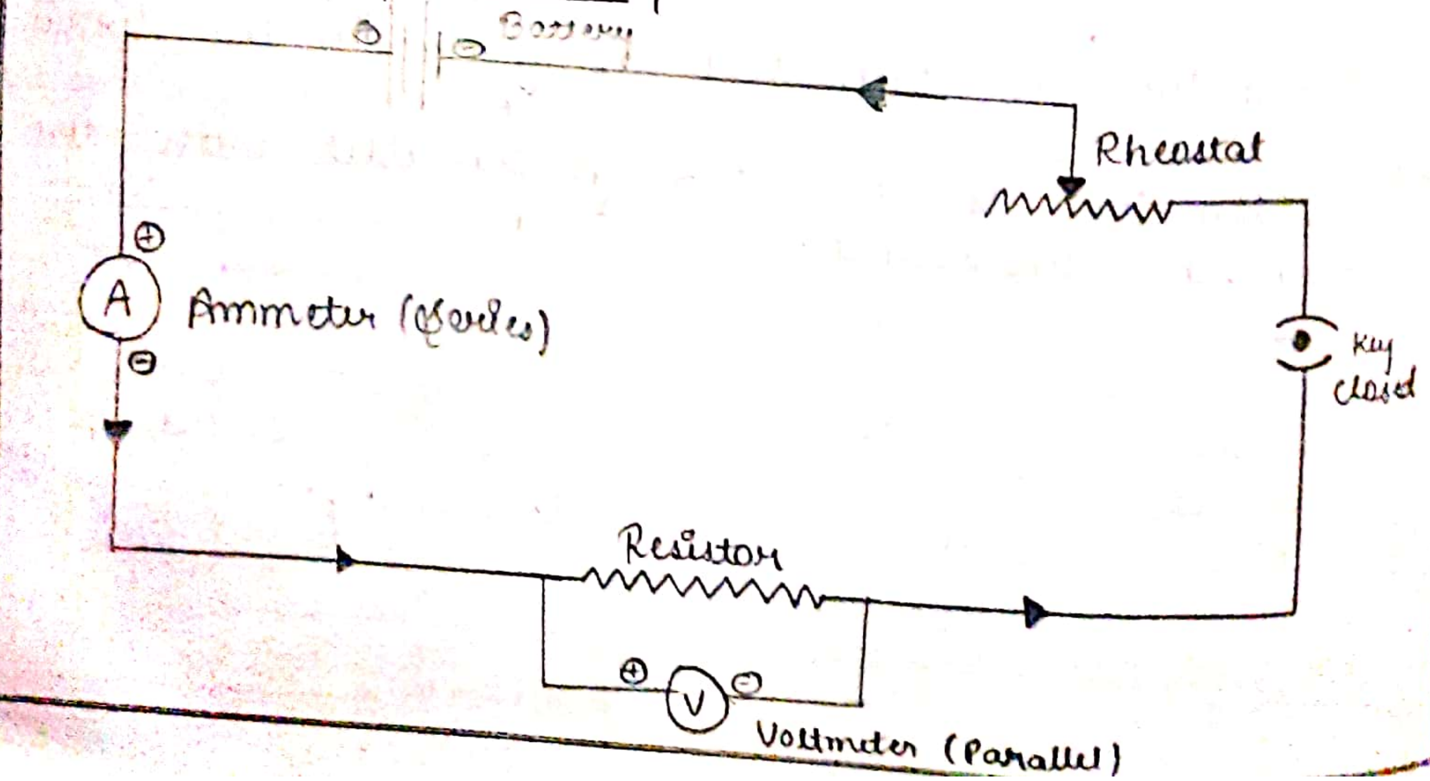
Incorrect Circuit ⇒



(Ammeter is not connected in series)

Correct Circuit ⇒



EXPERIMENT NO. 3

AIM ⇒ To compare the e.m.f of two given primary cells (Leclanche and Daniel cells) using a potentiometer.

APPARATUS ⇒
1. Potentiometer
2. Leclanche cell
3. Daniell cell
4. An ammeter
5. Voltmeter
6. Galvanometer
7. Battery
8. Rheostate
9. Resistance box
10. two-way key
11. Jocky.
12. Connecting Wires.

THEORY ⇒

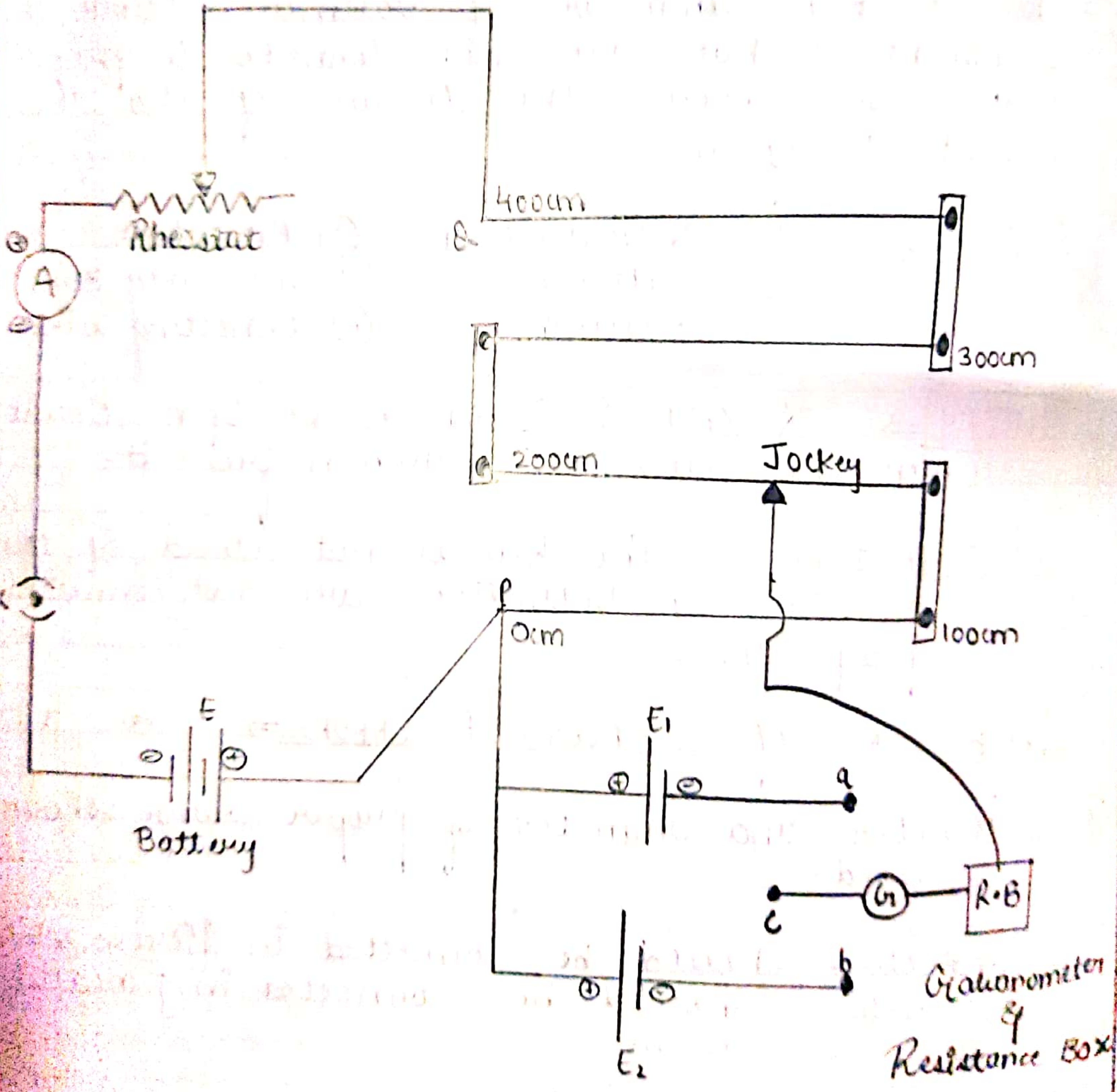
→ Let two primary cells whose e.m.f.s are E_1 & E_2 if l_1 & l_2 are corresponding balancing lengths on the potentiometer wire, then by principle of potentiometer we have:-

→ $E_1 \propto l_1$

→ $E_2 \propto l_2$

→ $$\boxed{\frac{E_1}{E_2} = \frac{l_1}{l_2}}$$

Circuit Diagram for the Comparison of emf's of two cells ⇒



OBSERVATION TABLE ⇒

S.NO.	Balance point when E_1 (Leclanche cell) in the circuit l_1 (cm)	Balance point when E_2 (Daniell cell) in the circuit l_2 (cm)	$\frac{E_1}{E_2} = \frac{l_1}{l_2}$
1.	316	202	1.56
2.	312	196	1.59
3.	327	224	1.46

Calculations ⇒

→ Average $= \frac{1.56 + 1.59 + 1.46}{3}$

$= \frac{4.61}{3} = 1.53$

∴ Mean Value $\left(\frac{E_1}{E_2}\right) = 1.53$

RESULT ⇒

→ The ratio of emfs of the given two cells (ratio of emfs of Leclanche & Daniel cell) is 1:53 by using potentiometer.

PRECAUTIONS ⇒

1. All the positive terminals should be connected at the zero terminal i.e. point 'A' of potentiometer wire.
2. The jockey should touch the wire gently.
3. The rheostat must have a low resistance.
4. The balancing length of the wire should always be measured from the end A (zero terminal) of the wire where all the positive terminals are connected.

SOURCES OF ERROR ⇒

→ Potentiometer wire may not have a uniform across-section throughout the entire length.

→ The emf of driver battery may not be constant.

EXPERIMENT NO. 4

AIM ⇒ To determine the resistance of a galvano-meter by half - deflection method & find its figure of merit.

APPARATUS ⇒ (1) A western type Galvanometer.
(2) Voltmeter (3) Battery eliminator
(4) resistance boxes (5) Two one-way key.
(6) Rheostat (7) Ammeter.
(8) Metre Scale (9) Connecting wires.

THEORY ⇒

→ The resistance of the given galvanometer as found by half deflection method.

→ $$G = \frac{R \times S}{R + S}$$

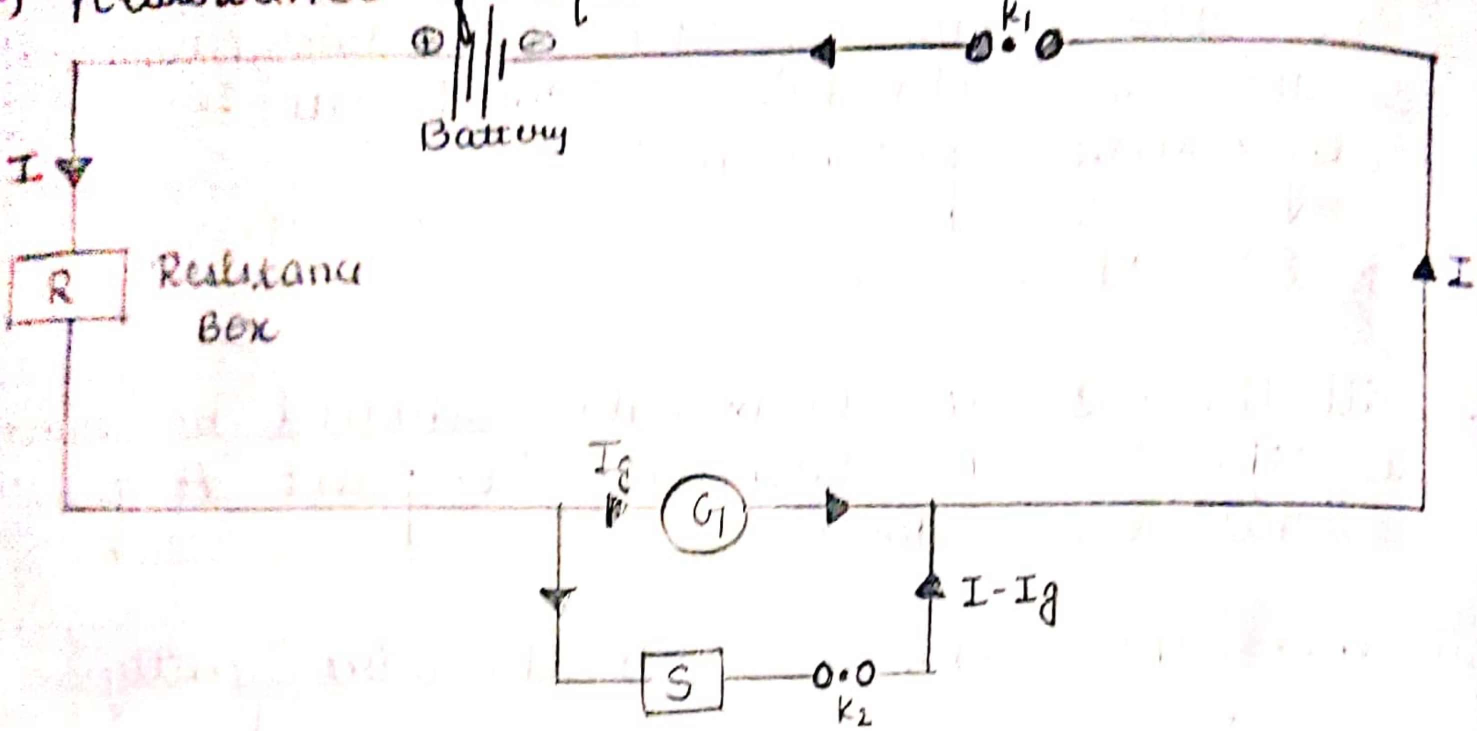
* Where 'R' is the resistance connected in series with the galvanometer and 'S' is the shunt resistance.

→ Figure of merit, $$K = \frac{E}{(R+G)\theta}$$

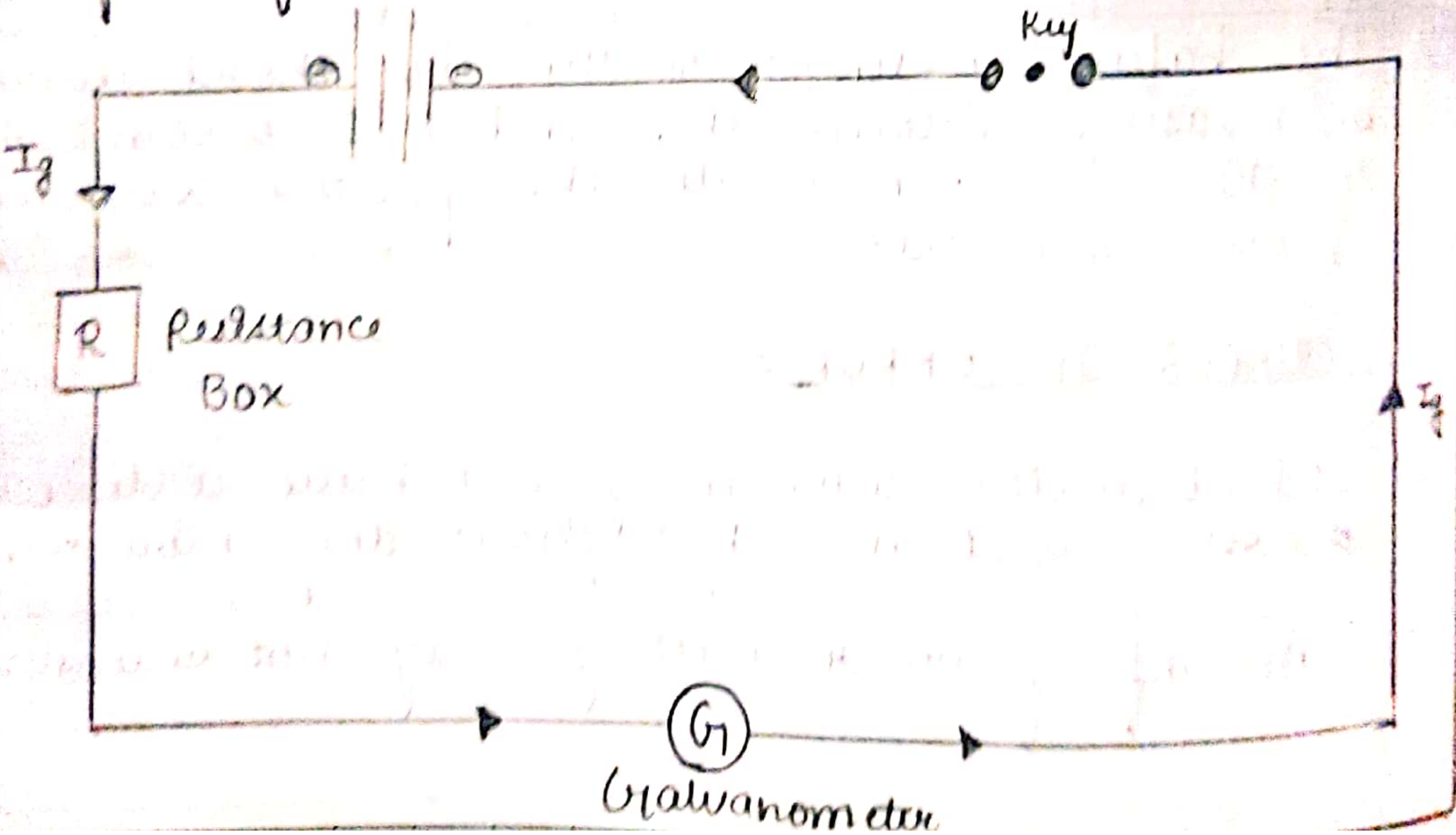
* 'E' is emf of cell & 'θ' is deflection produced with Resistance 'R'.

Circuit Diagram ⇒

(A) Resistance of Galvanometer :-



(B) Figure of merit :-



OBSERVATION TABLE ⇒

ⓐ Table for Resistance of Galvanometer by Half Deflection Method :-

S.No.	Resistance R (Ω)	Deflection in the galvanometer θ (div)	Shunt Resistance S (Ω)	Half deflection θ/2 (div)	Galvanometer Resistance $G = \frac{R \times S}{R+S}$ (Ω)
1.	8000	18	117	9	118.73
2.	9000	16	118	8	119.56
3.	10600	14	120	7	121.37

⇒ Mean Value of Galvanometer Resistance = 119.88 Ω

ⓑ Table for figure of Merit :-

S.NO.	emf of the cell E (V)	Resistance from Resistance Box R (Ω)	Deflection in Galvanometer. θ (div)	Figure of merit $K' = \frac{E}{(R+G)\theta}$ (amp/div)
1.	3	8000	18	2.053×10^{-5}
2.	3	9000	16	2.056×10^{-5}
3.	3	10600	14	1.999×10^{-5}

⇒ Mean Value of figure of merit = 2.036×10^{-5} amp/div

RESULT ⇒

① The resistance of the given galvanometer by half deflection method is $G = 119.88\,\Omega$

② Figure of merit, $K = 2.036 \times 10^{-5}$ amp/div.

PRECAUTIONS ⇒

→ All the connections and plugs of resistance box should be tight.

→ The e.m.f of the battery should be constant.

→ The value of 'R' should be large as compared to 'G'.

Sources of error ⇒

ⓐ The emf of battery may not be constant.

ⓑ The plugs of the resistance box may not be clean & tight.

ⓒ The galvanometer divisions may not be equal.

EXPERIMENT NO. 5

AIM :- To draw I-V characteristic curve of a p-n junction in forward bias and reverse bias.

APPARATUS :-

→ A p-n junction (Semi-conductor) diode, a 3 Volt battery, a 50 Volt battery, a high resistance rheostat, one 0-3 Volt Voltmeter, one 0-50 Voltmeter, one 0-100 mA ammeter, one 0-100 μA ammeter, one way key, connecting wires and pieces of sand paper.

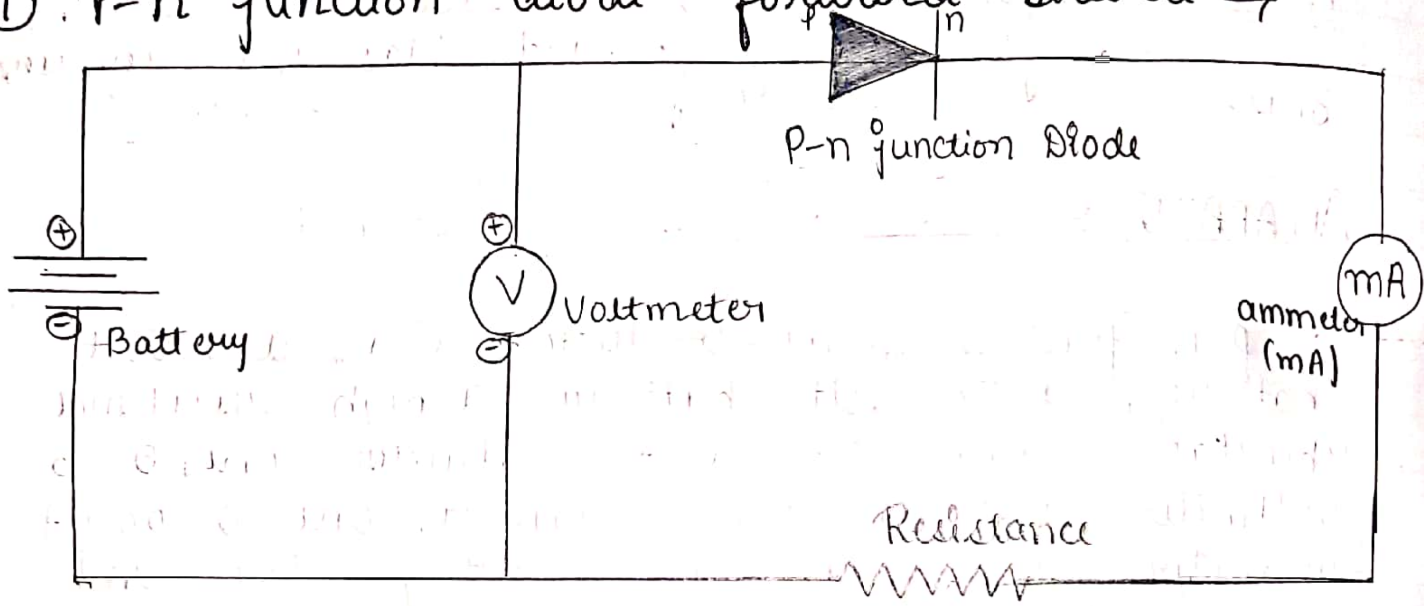
THEORY :-

* **Forward Biasing** ⇒ A p-n junction diode get forward biased when its 'P' side is connected to the positive terminal of the supply voltage and Negative terminal connected to the 'n' side.

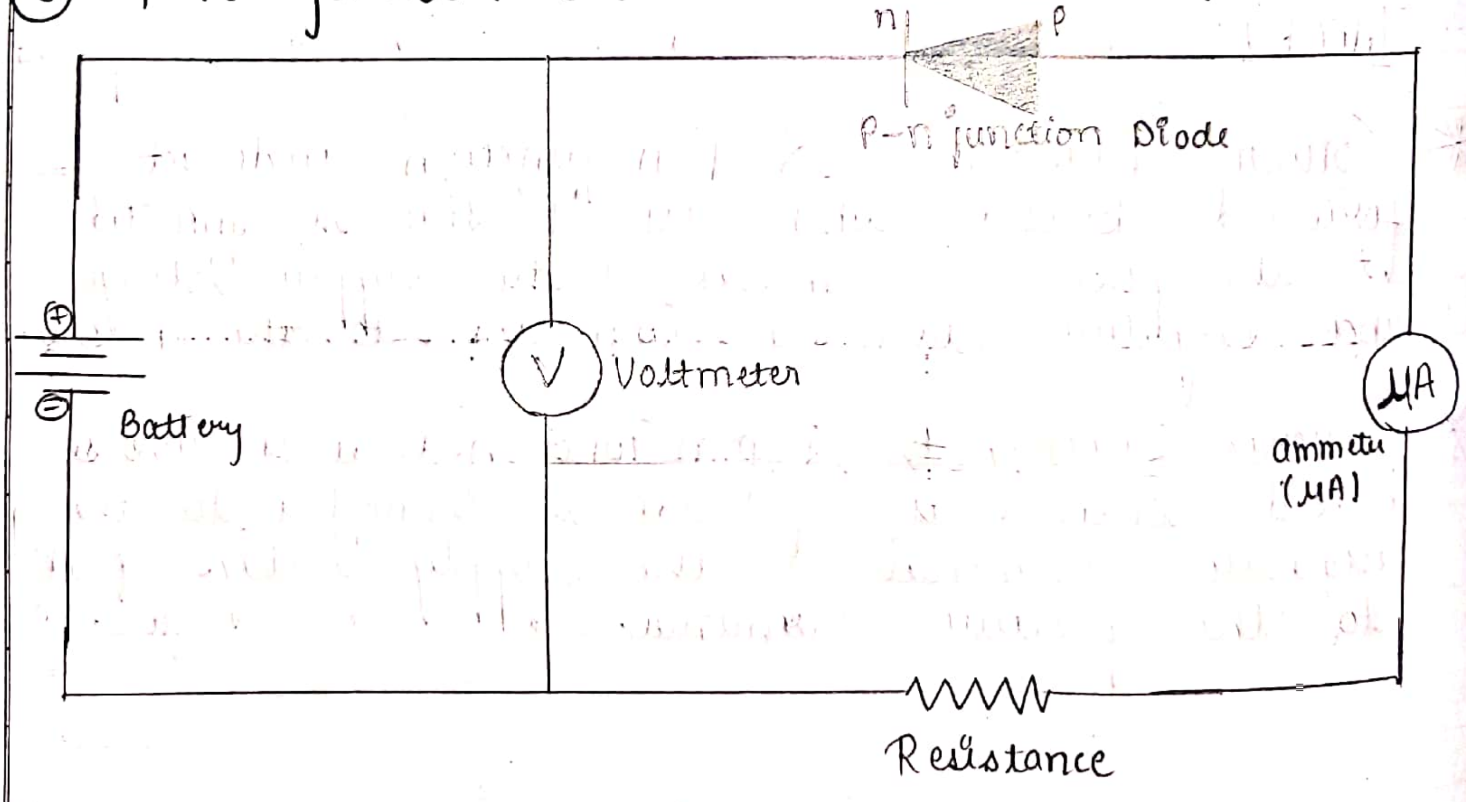
* **Reverse Biasing** ⇒ A p-n junction diode is reverse biased when its 'p' side is connected to the negative terminal of the supply voltage & 'n' to the positive terminal.

Diagram ⇒

① P-n junction diode - forward biased ⇒



② P-n junction diode - Reverse biased ⇒



* **Biasing** ⇒ Applying external potential difference on the faces of a junction is called biasing of junction.

OBSERVATION TABLES ⇒

①

SERIAL NO.	FORWARD BIAS VOLTAGE V_F (V)	FORWARD (I_F) CURRENT (mA)
1.	0	0
2.	0.1	0
3.	0.2	0
4.	0.3	0
5.	0.4	0.5
6.	0.6	1
7.	0.8	2
8.	1.0	3
9.	1.2	5
10.	1.4	7.5
11.	1.6	10

②

SERIAL NO.	REVERSE BIAS VOLTAGE V_R (V)	REVERSE I_R CURRENT (μA)
1.	0	0
2.	5.0	1
3.	7.0	2
4.	9.0	3
5.	11.0	4

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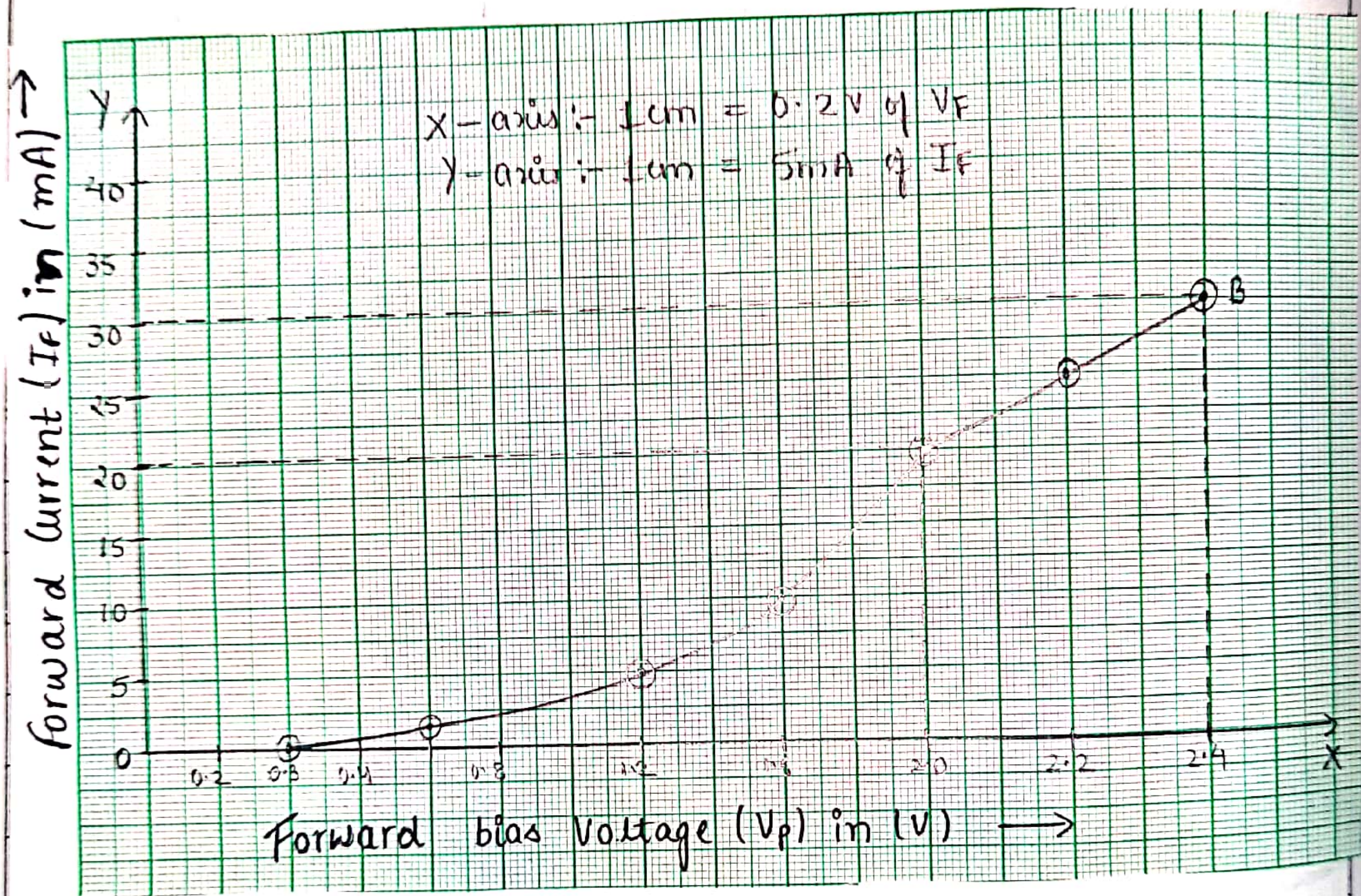
Graph 1 ⇒



CHARACTERISTIC CURVE OF JUNCTION DIODE

(FORWARD - BIAS)

6.	13.0	5
7.	15.0	7
8.	17.0	9
9.	19.0	11
10.	21.0	13
11.	23.0	15

CALCULATIONS ⇒

→ In graph of forward bias, for change from A to B.

→ resistance = $\frac{\Delta V_F}{\Delta I_F} = \frac{2.4-2.0}{30-20} = \frac{0.4V}{10mA} = 40$ Ohms

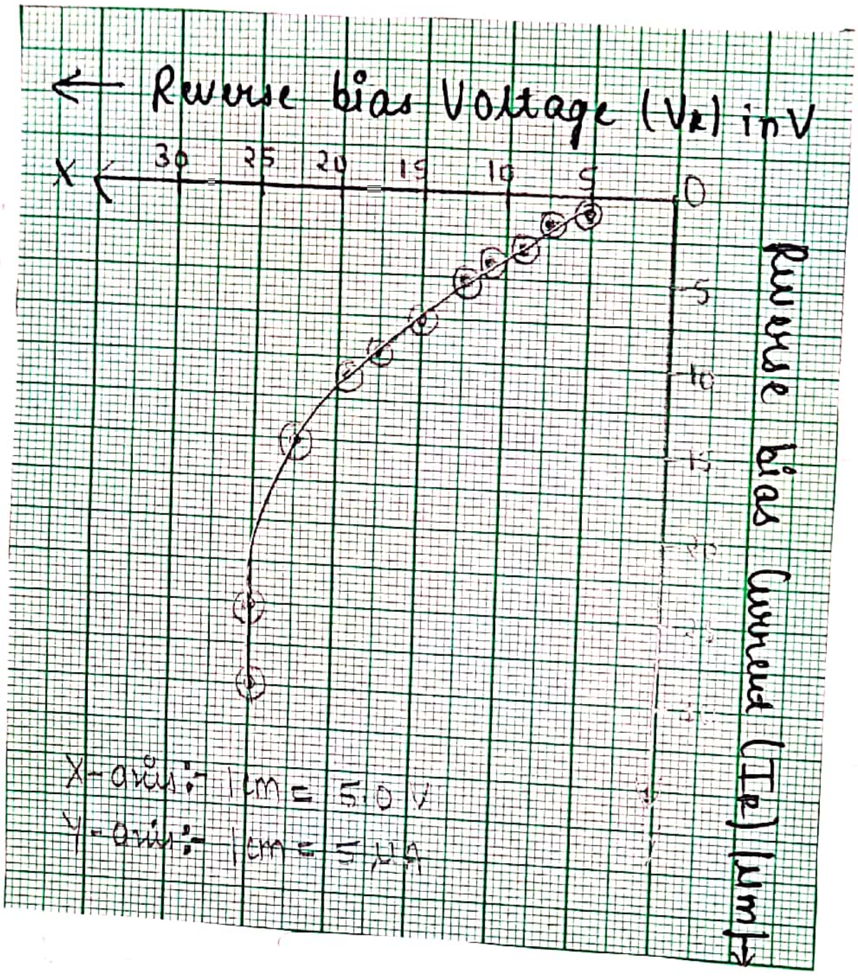
→ In graph of reverse bias, for change from A to B.

→ resistance = $\frac{\Delta V_R}{\Delta I_R} = \frac{7.0-5.0}{2-1} = \frac{2V}{1\mu A} = 2\times10^6$ Ohms

RESULT ⇒

1. Junction resistance for forward bias = 40Ω
2. Junction resistance for reverse bias = $2\times10^6\Omega$

Graph 2 ⇒



CHARACTERISTIC CURVE OF JUNCTION DIODE

(REVERSE BIAS)

Date

Expt. No. 5 Page No. 23

PRECAUTIONS ⇒

→ The Variation in V should be done in step of 0.1 V.

→ All Connections should be neat, clean & tight.

→ Key should be used in circuit and opened when the circuit is not being used.

SOURCES OF ERROR ⇒

(a) The junction diode supplied may be faulty.

(b) Forward & Reverse bias Voltage beyond breakdown should not be applied.

Teacher's Signature

ACTIVITY NO. 4

AIM ⇒ To identify a diode, an LED, a resistor & a capacitor from a mixed collection of such items.

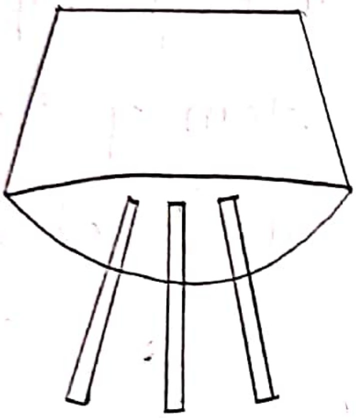
APPARATUS ⇒ Collection of items such as:-
- ⟶ Junction diode.
- ⟶ LED
- ⟶ Transistor
- ⟶ Integrated circuits.
- ⟶ Resistors.
- ⟶ Capacitor.

OBSERVATIONS (with naked eye) ⇒

S.No.	No. of legs of the item	Inference
1.	More than three	Integrated circuits
2.	Three	Transistor
3.	Two	May be Resistors, LED, Capacitor, Junction Diode.

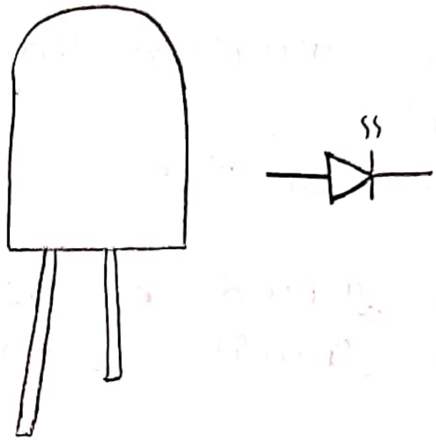
Diagram of Collection of Items ⇒

(1)



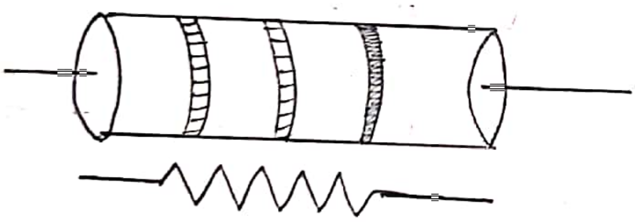
TRANSISTOR

(2)



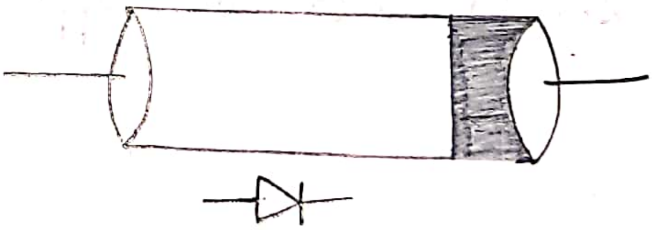
LED

(3)



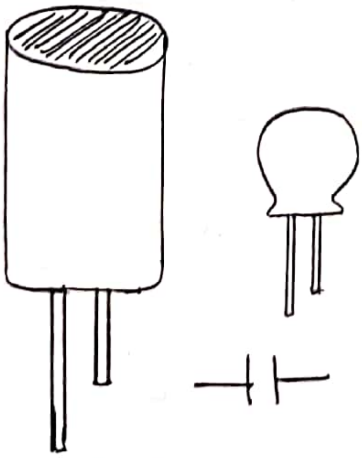
RESISTOR

(4)



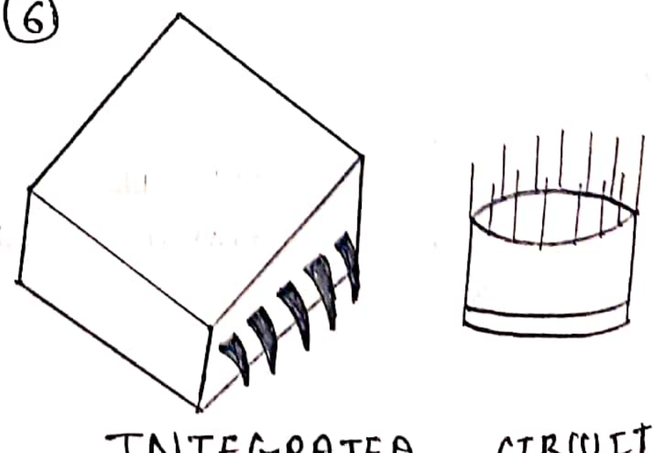
JUNCTION DIODE

(5)



CAPACITOR

(6)



INTEGRATED CIRCUIT

ACTIVITY No. 5

AIM ⇒ Use of multimeter to see the unidirectional flow of current in case of a diode and an LED and check whether a given electronic component (e.g. diode) is in working order.

APPARATUS ⇒
1. Multimeter.
2. Junction Diode.
3. LED.
4. Resistor.
5. Capacitor.

THEORY ⇒

☆ **Diode ⇒** It is a two terminal device. It conducts when forward biased and not conduct when reverse biased. It does not emit light while conducting. Hence, it does not glow.

☆ **LED (Light emitting diode) :→** It is also two terminal device. It also conducts when forward bias and does not conduct when reverse biased. It emits light while conducting. Hence it glow.

☆ **Resistor ⇒** It is two terminal device. It conducts when either forward or reverse biased.

OBSERVATION TABLE ⇒

S.NO.	Possible Current flow	Name of the device
1.	Unidirectional emit no light	Diode
2.	Unidirectional emit light	LED
3.	Both direction (steady)	Resistor
4.	Initial high but decays to zero	Capacitor

⇒ With multimeter ⇒

S.No	Possible deflection before & after interchanging the Probes	Inference
1.	Same Constant deflection	Resistor
2.	Large deflection, which gradually falls to zero	Capacitor
3.	Small deflection in one Case & large deflection in Other.	Junction Diode

4.	Small deflection in one case & large deflection in other with light	LED

Date ______

Expt. No. 6 Page No. 28

EXPERIMENT NO. 6

AIM :- To determine angle of minimum deviation by plotting a graph b/w angle of incidence & angle of deviation.

APPARATUS :-
1. Drawing board.
2. White sheet of paper.
3. Pencil.
4. Glass triangular prism.
5. Drawing pins.
6. Bell pins.
7. metre scale.
8. Graph paper & protractor.

THEORY :-

→ When a light ray enters the prism it bends towards base of the prism. The angle at which light ray bends in prism is called angle of deviation and it is represented as D or δ. The value of 'D' depends on 'I' of prism with large angle.

→ The value of 'D' is large for small value of 'I'. When 'I' increases 'D' decreases initially to 'Dm'. This is called the angle of minimum deviation. After the value of 'D' increases.

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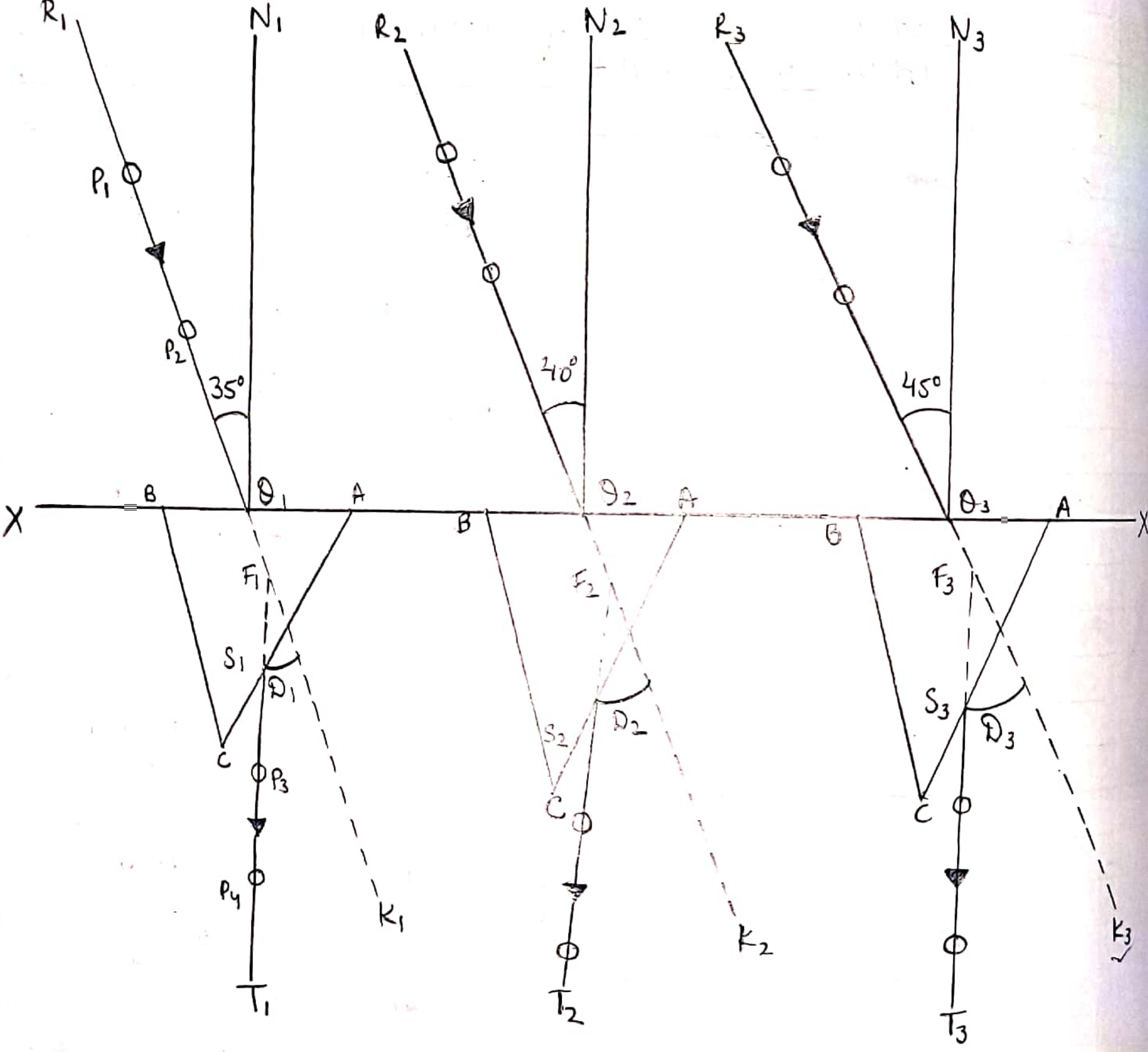
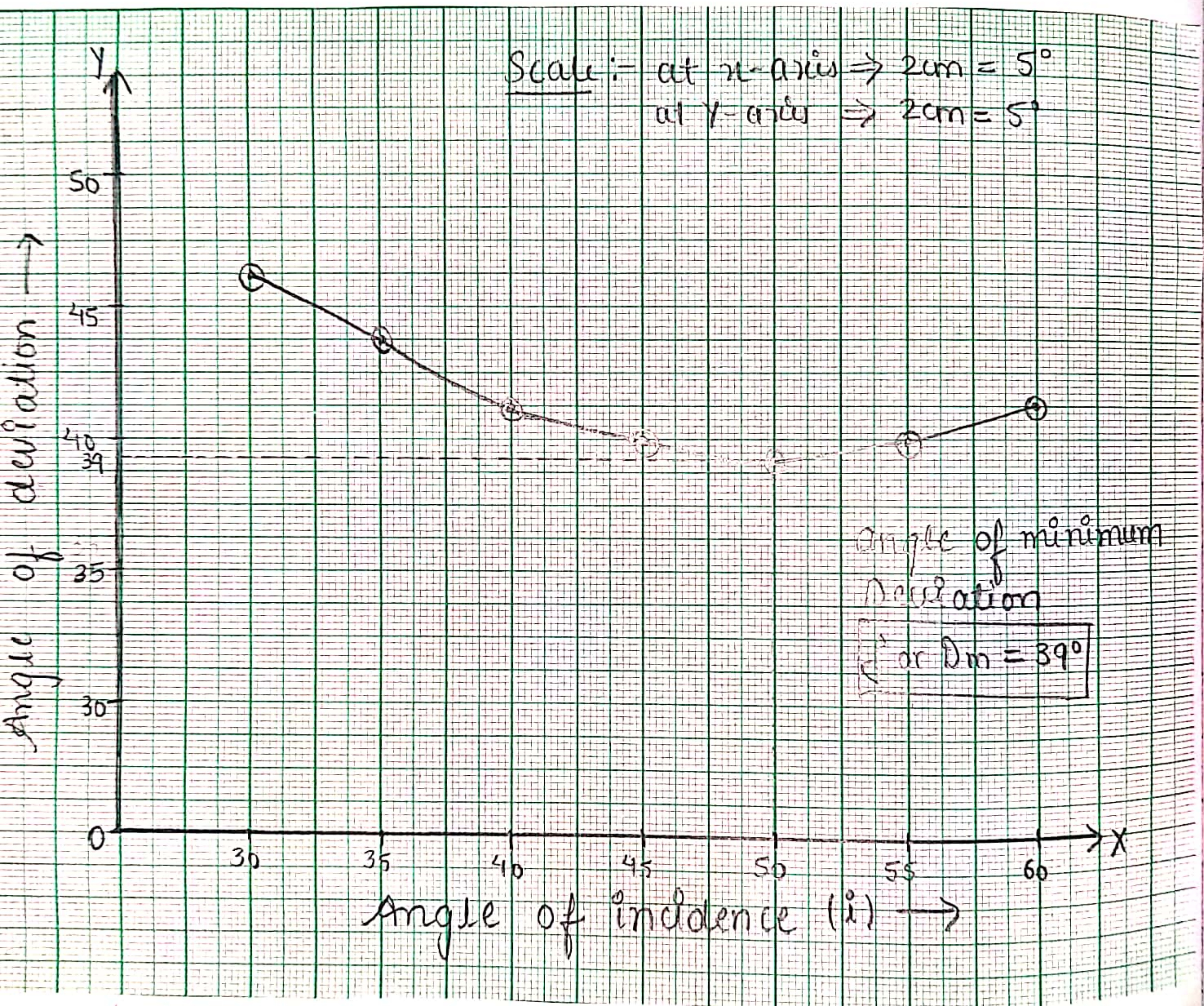


→ REFRACTION THROUGH PRISM AT DIFFERENT ANGLES



GRAPH BETWEEN ANGLE OF INCIDENCE AND ANGLE OF DEVIATION

Date ______

Expt. No. 6 Page No. 29

⇒ $\mu = \frac{A}{2}$ or $i = \frac{A + D_m}{2}$

⇒ OBSERVATIONS ⇒

S.No.	Angle of Incidence (i)	Angle of Deviation ($\angle D$)
1.	30°	46°
2.	35°	44°
3.	40°	42°
4.	45°	40°
5.	50°	39°
6.	55°	40°
7.	60°	41°

⇒ RESULT ⇒

→ Angle of minimum Deviation, $D_m = 39°$

⇒ PRECAUTIONS ⇒

(i) The angle of incidence should be b/w 35° – 60°.
(ii) The pins should be fixed vertical.
(iii) The same angle of prism should be used of or all the Observations.

⇒ SOURCES OF ERRORS ⇒ Pin Pricks may be thick.

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Date ________

Expt. No. 7 Page No. 30

EXPERIMENT No. 7

AIM ⇒ To find the focal length of a convex lens by plotting graphs between 'u and v' or b/w 1/u and 1/v.

APPARATUS ⇒
1. A convex lens of small focal length.
2. Three uprights.
3. Two needles.
4. Optical bench.
5. Half metre scale.
6. Lens stand.
7. Screen.

THEORY :-

→ focal length of a convex lens is calculated by using the formula :-

- $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ or $f = \frac{uv}{u-v}$

→ Approximate focal length of convex lens can be found by using a distant object. The image of distant object is formed at the focus of a convex lens.

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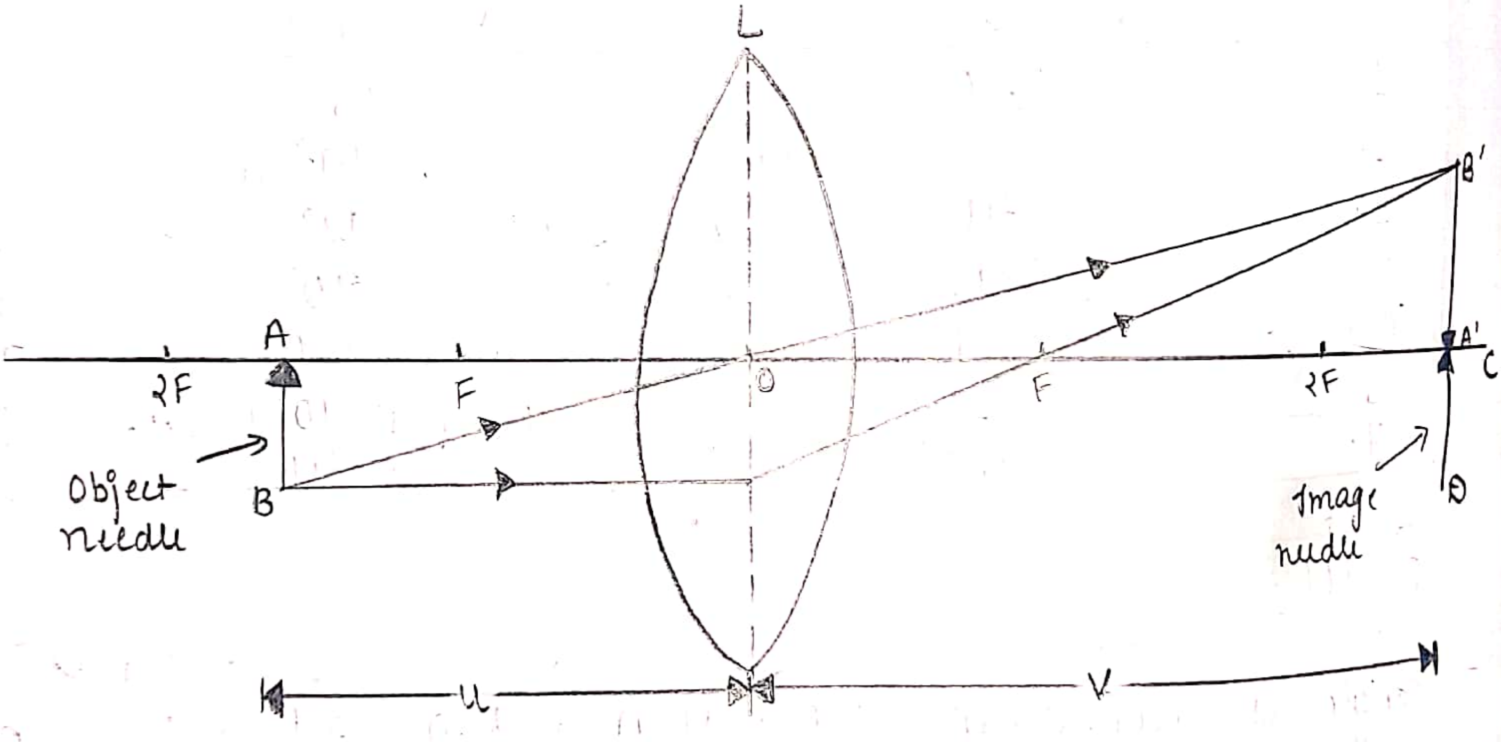


→ FOCAL LENGTH OF CONVEX LENS

u-v Graph

→ Scale :-

→ at X-axis ⇒ 1 cm = 1 cm

→ at Y-axis ⇒ 1 cm = 1 cm

→ Two ⊥ are from 'C' to x-axis & y-axis.

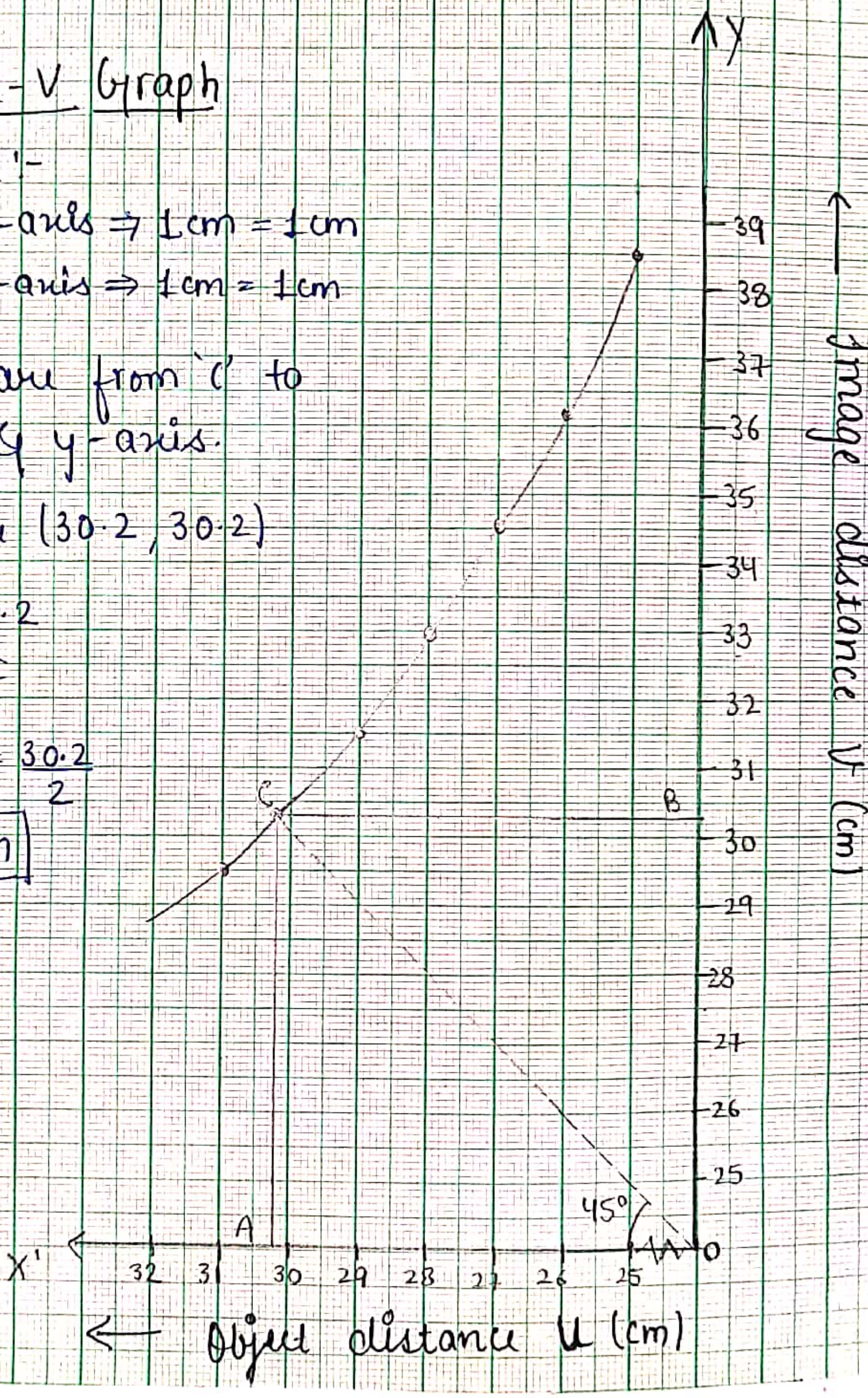
→ Coordinate (30.2, 30.2)

→ $u = v = 30.2$

→ $u = v = 2f$

→ $f = \frac{CA}{2} = \frac{30.2}{2}$

→ **$f = 15.1$ cm**



GRAPH - 1

OBSERVATION TABLE ⇒

S.No.	Position of Object needle 'A' (cm)	Lens 'O' (cm)	Image needle 'C' (cm)	Observed Distance OA = 'u' (cm)	OC = 'v' (cm)	$\frac{1}{u}$	$\frac{1}{v}$	$f = \frac{uv}{u-v}$ (cm)
1.	30	60	90.2	30	30.2	0.0333	0.0331	15.04
2.	31	60	91.5	29	31.5	0.0344	0.0317	15.6
3.	32	60	93	28	33	0.0357	0.0303	15.14
4.	33	60	94.5	27	34.5	0.0370	0.0289	15.14
5.	34	60	96.2	26	36.2	0.0384	0.0276	15.13
6.	35	60	98.5	25	38.5	0.04	0.0259	15.15

→ Approximate focal length of convex lens = 15 cm

→ Mean $f = \frac{(f_1 + f_2 + f_3 + f_4 + f_5 + f_6)}{6}$

$$f = \frac{91.2}{6} \text{ cm} = 15.2 \text{ cm}$$

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$\frac{1}{u} - \frac{1}{v}$ Graph

→ X-axis :- 1cm = 0.01cm

→ Y-axis :- 1cm = 0.01cm

→ OP = OQ = 0.065

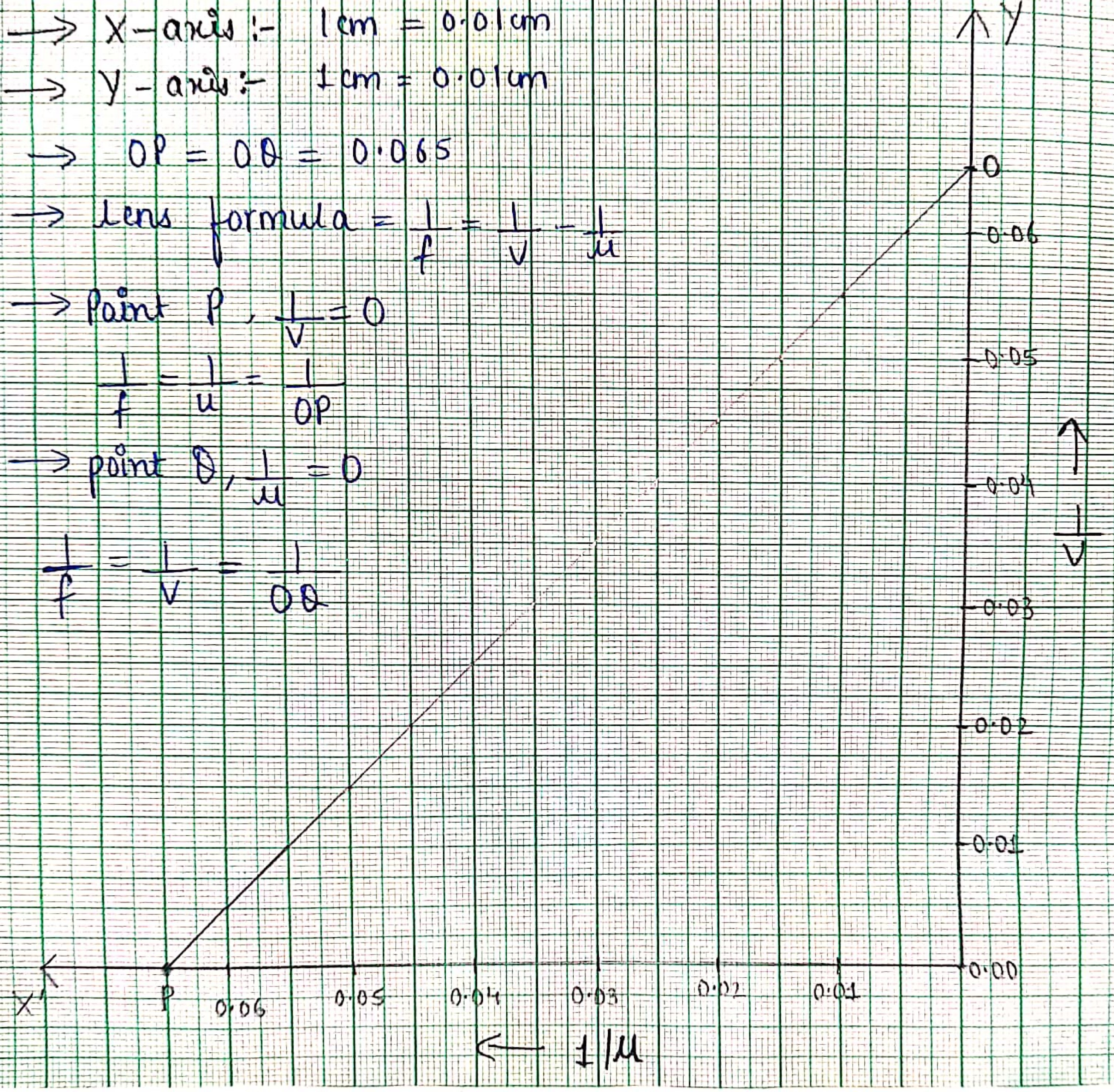
→ Lens formula = $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

→ Point P, $\frac{1}{v} = 0$

$$\frac{1}{f} = \frac{1}{u} = \frac{1}{OP}$$

→ point Q, $\frac{1}{u} = 0$

$$\frac{1}{f} = \frac{1}{v} = \frac{1}{OQ}$$



RESULT :-

→ The focal length by :-

☆ The u-v Graph = 15.1 cm
☆ The u-v Graph = 15.2 cm (by U-V method)
☆ The $\frac{1}{u} - \frac{1}{v}$ Graph = 15.38 cm.

PRECAUTIONS :-

1. Index correction for u & v should be applied.
2. The Object needle should be placed at such as distance that only real, inverted image of it is formed.
3. Tip of the Object and image needles should lie at the same height as the centre of the lens.

SOURCES OF ERROR ⇒

a) The uprights may not be the Vertical.
b) Parallax removal may not be perfect.

EXPERIMENT No. 8

AIM ⇒ To determine refractive index of a glass slab using travelling microscope.

APPARATUS ⇒
1. A glass slab.
2. Travelling microscope.
3. Marker.
4. Convex lens.
5. Lycopodium powder.

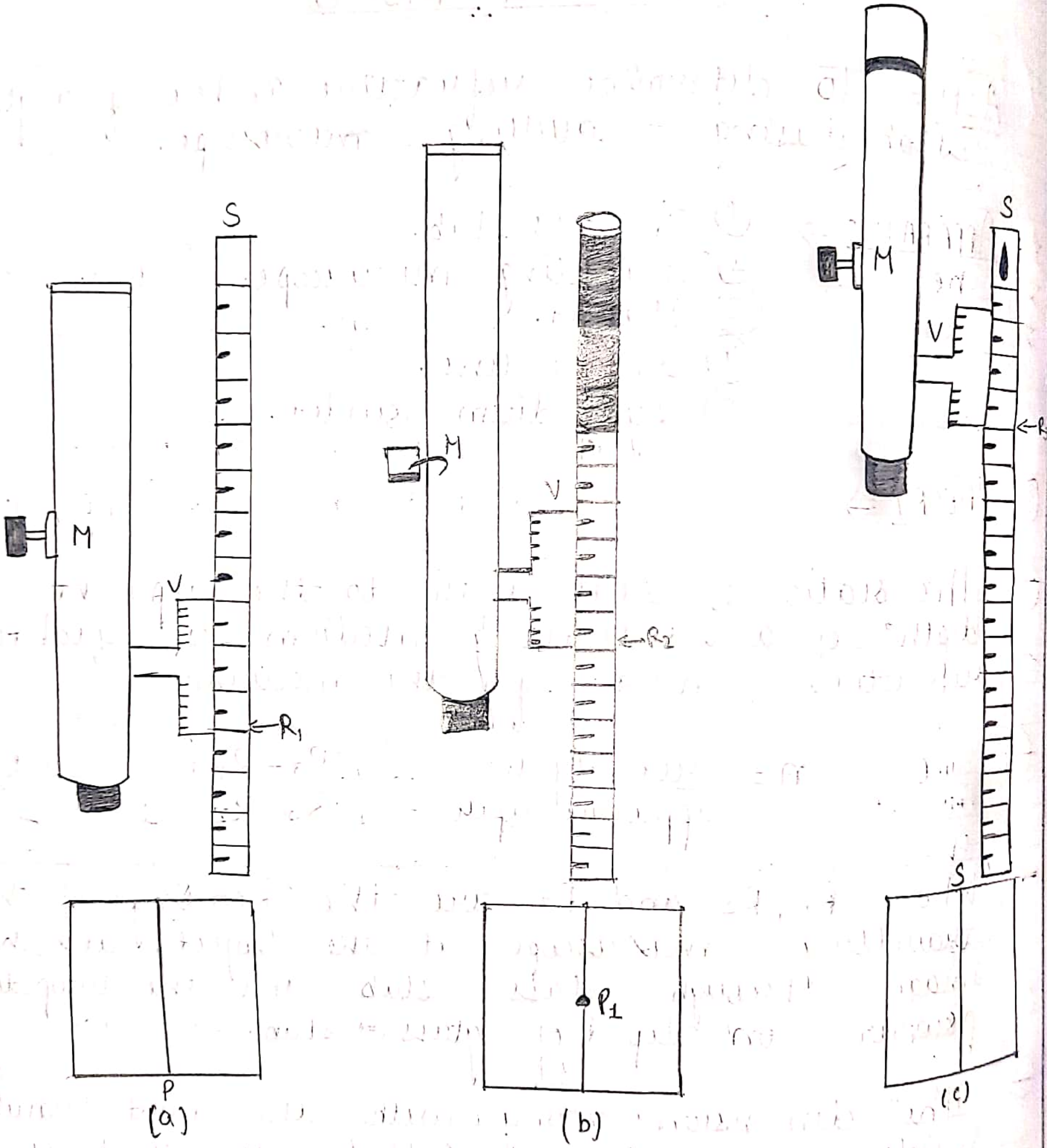
THEORY ⇒

→ The ratio of real depth to the apparent depth of a refracting medium is equal to refractive index of the medium.

→ i.e $n = \frac{\text{real depth}}{\text{apparent depth}} = \frac{R_3 - R_1}{R_3 - R_2}$

→ Where R_1, R_2 and R_3 are the Readings of the travelling microscope at the Object, at the image through glass slab and the lycopodium powder on top of glass slab.

→ The dimension along with the light travels inside the slab is called its thickness.



→ REAL AND APPARENT THICKNESS

OBSERVATIONS ⟹

→

S. No.	Cross-mark made on the paper (R_1) cm.			Mark on page through glass slab (R_2) cm.			Particles on top of glass surface (R_3) cm		
	MSR	VSR	Total	MSR	VSR	Total	MSR	VSR	Total
1.)	3.85	0	3.85	4.35	7	4.357	5.26	36	5.286

S. No.	Real depth ($R_3 - R_1$) cm	Apparent depth ($R_3 - R_2$) cm	Refractive Index $n = \frac{R_3 - R_1}{R_3 - R_2}$
1.)	1.436	0.929	1.54

RESULT ⟹

→ Refractive Index of glass slab = 1.54.

PRECAUTIONS ⟹

① In microscope, the parallax should be properly removed.

② The microscope should be moved in upper direction only to avoid back lash error.

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Date

Expt. No. 8 Page No. 35

(3) The microscope scale may not be properly caliberated, do it carefully.

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ACTIVITY No. 6(A)

(A) **AIM** ⇒ To study the nature and size of the image formed by a convex lens on a screen by using a candle and a screen (for different distance of the candle from the lens).

APPARATUS ⇒
1. An Optical bench with 3 uprights.
2. a Convex lens with holder.
3. a burning Candle.
4. a Card-Board Screen.

THEORY ⇒

→ Lens formula ⇒ $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

→ Where at
$u = \infty$, $v = f$
$u = -2f$, $v = 2f$
$u = -f$, $v = \infty$

→ $u < (-f)$, v becomes negative, (image formed Virtual).

→ As the Object (burning Candle) is moved from infinity towards the convex lens, its image (position of screen) moves from lens focus towards infinity.

→ For Candle distance less than focal length, image becomes Virtual and does not come on screen.

Images formed by Convex lens :-

S.No.	Position of Objects	Position of Image	Size of image	Nature of Image
1.	b/w f & lens	On the same side as Object	Enlarged	Virtual & erect.
2.	at f (focus)	at Infinity	Highly enlarged	Real & Inverted
3.	b/w f & 2f	Beyond 2f	Enlarged	Real & Inverted
4.	at 2f	at 2f	Same size as object	Real & inverted
5.	Beyond 2f	B/w f & 2f	Diminished	Real & Inverted
6.	at Infinity	at f (focus)	Highly dimished	Real & Inverted

CONCLUSION ⇒

→ This change in position, nature & size of the image is according to theoretical predications.

ACTIVITY NO. 6(B)

(B) AIM ⇒ To study the nature and size of the image formed by concave mirror on a screen by using a candle and a screen (for different of the candle from the mirror).

APPARATUS ⇒
1. An Optical bench with 3 upright.
2. a concave mirror with holder.
3. burning candle
4. a card-board screen.

THEORY ⇒

→ Mirror formula ⇒ $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

→ Where $u = \infty$, $v = -f$
$u = -2f$, $v = -2f$
$u = -f$, $v = \infty$

→ $u < (-f)$, 'v' becomes positive, image becomes virtual.

→ Hence as the object (burning candle) is moved from infinity towards the concave mirror, its image (position of screen) moves from mirror focus towards infinity.

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→ The two cross each other at distance 2f i.e at the Centre of curvature of the mirror. For candle distance less than focal length, image becomes Virtual and does not come on screen.

Images formed by Concave mirror :-

S.No.	Position of Object	Position of Image	Size of Image	Nature of Image
1.	Within focus (b/w Pole & focus)	Behind the mirror	enlarged	Virtual & erect
2.	at focus (F)	at infinity	Highly enlarged	Real & Inverted
3.	B/w F and C	Beyond C	enlarged	Real & Inverted
4.	at C	at C	equal to object	Real & Inverted
5.	Beyond C	b/w F & C	Diminished	Real & inverted
6.	at Infinity	at focus (F)	Highly diminished	Real & Inverted.

→ CONCLUSION ⇒

→ This change in position, nature and size of the image is according to theoretical predications.