

NAME: Adithyana V. Ganesan

12th V E Roll No. 11612027

SUBJECT: Physics

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Done!!

JPV

USEFUL DATA

Material	Young's modules (dynes/cm ²) (approximate values)
(i) Aluminium	7.1×10^{11}
(ii) Brass	10×10^{11}
(iii) Copper	11.7×10^{11}
(iv) Iron (pure)	20.6×10^{11}
Element/Alloy	Specific resistance (ohm cm) (approximate values)
(i) Copper	1.7×10^{-6}
(ii) Aluminium	2.65×10^{-6}
(iii) Brass	8×10^{-6}
(iv) Iron (pure)	10×10^{-6}
(v) Tin	11×10^{-6}
(vi) Manganin	45×10^{-6}
(vii) Constantan	47×10^{-6}

Surface tension of water at 20°C = 72.75 dynes / cm

Coefficient of viscosity of glycerine at 20°C = 13.4 poise

1. Coefficient of linear expansion: Iron : 12×10^{-6} per °C Copper : 17×10^{-6} per °C Brass : 18×10^{-6} per °C Aluminium : 23×10^{-6} per °C	2. Specific heat Brass : 0.092 cal / gram °C Copper : 0.093 cal / gram °C Iron : 0.120 cal / gram °C Aluminium : 0.220 cal / gram °C
3. Electrochemical equivalent of copper: 3.3×10^{-4} gram / coulomb	4. Mechanical equivalent of heat, J: 4.186 J / cal = 4186 J / kcal

SOME PHYSICAL CONSTANTS

Speed of light	c	$3.00 \times 10^8 \text{ m/s}$
Gravitational constant	G	$6.67 \times 10^{-11} \text{ N.m}^2/\text{Kg}^2$
Avogadro constant	N_A	$6.02 \times 10^{23} \text{ mol}^{-1}$
Universal gas constant	R	$8.31 \text{ J/mol}\cdot\text{K}$
Permittivity constant	ϵ_0	$8.85 \times 10^{-12} \text{ F/m}$
Permeability constant	μ_0	$1.26 \times 10^{-6} \text{ H/m}$
Planck constant	h	$6.63 \times 10^{-34} \text{ J}\cdot\text{s}$
Boltzmann constant	k	$1.38 \times 10^{-23} \text{ J/K}$
Elementary charge	e	$1.60 \times 10^{-19} \text{ C}$
Electron mass	m_e	$9.11 \times 10^{-31} \text{ kg}$
Proton mass	m_p	$1.67 \times 10^{-27} \text{ kg}$
Neutron mass	m_n	$1.68 \times 10^{-27} \text{ kg}$
Deuteron mass	m_d	$3.34 \times 10^{-27} \text{ kg}$
Bohr radius	a	$5.29 \times 10^{-11} \text{ m}$
Rydberg constant	R	$1.097 \times 10^7 \text{ m}^{-1}$

SOME CONVERSION FACTORS

Mass and Density

$$1 \text{ kg} = 1000 \text{ g} = 6.02 \times 10^{26} \text{ u}$$

$$1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$$

$$1 \text{ kg/m}^3 = 10^{-3} \text{ g/cm}^3$$

Length and Volume

$$1 \text{ m} = 100 \text{ cm} = 39.4 \text{ in.} = 3.28 \text{ ft}$$

$$1 \text{ mi} = 1.61 \text{ km} = 5280 \text{ ft}$$

$$1 \text{ in.} = 2.54 \text{ cm}$$

$$1 \text{ nm} = 10^{-9} \text{ m} = 10 \text{ \AA}$$

$$1 \text{ pm} = 10^{-12} \text{ m} = 1000 \text{ fm}$$

$$1 \text{ light-year} = 9.46 \times 10^{15} \text{ m}$$

$$1 \text{ m}^3 = 1000 \text{ L} = 35.3 \text{ ft}^3 = 264 \text{ gal}$$

Time

$$1 \text{ d} = 86\,400 \text{ s}$$

$$1 \text{ y} = 365\frac{1}{4} \text{ d} = 3.16 \times 10^7 \text{ s}$$

Angular Measure

$$1 \text{ rad} = 57.3^\circ = 0.159 \text{ rev}$$

$$\pi \text{ rad} = 180^\circ = \frac{1}{2} \text{ rev}$$

Speed

$$1 \text{ m/s} = 3.28 \text{ ft/s} = 2.24 \text{ mi/h}$$

$$1 \text{ km/h} = 0.621 \text{ mi/h} = 0.278 \text{ m/s}$$

Force and Pressure

$$1 \text{ N} = 10^5 \text{ dyne} = 0.225 \text{ lb}$$

$$1 \text{ lb} = 4.45 \text{ N}$$

$$1 \text{ ton} = 1000 \text{ kg}$$

$$1 \text{ Pa} = 1 \text{ N/m}^2 = 10 \text{ dyne/cm}^2$$

$$1 \text{ atm} = 1.01 \times 10^5 \text{ Pa} = 76 \text{ cm-Hg}$$

Energy and Power

$$1 \text{ J} = 10^7 \text{ erg} = 0.239 \text{ cal}$$

$$1 \text{ kW}\cdot\text{h} = 3.6 \times 10^6 \text{ J}$$

$$1 \text{ cal} = 4.19 \text{ J}$$

$$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$$

$$1 \text{ horsepower} = 746 \text{ W}$$

Magnetism

$$1 \text{ T} = 1 \text{ Wb/m}^2 = 10^4 \text{ gauss}$$

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EXPERIMENT - 01

AIM:- To determine the resistance per cm of a given wire by plotting for potential difference versus current.

Apparatus / Material required:-

- A wire of unknown resistance.
- Battery
- Voltmeter
- Milliammeter
- Rheostat
- Plug key
- Connecting wire
- Piece of sandpaper.

Theory:-

According to Ohm's law, the electric current flowing through a conductor is directly proportional to the potential difference across its ends, provided the physical state (pressure, temp and dimensions) of the conducting remains unchanged.

$$V = RI$$

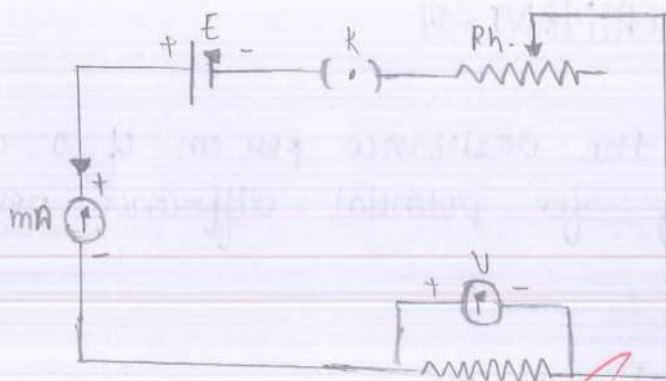
Where R is the const of proportionality and is termed as the electrical resistance of the conductor. Resistance R depends on the dimensions and material of the conductor.

The relationship b/w the resistance of a material (R) and its length (l) and area of the cross-section (A) is given by the formula:-

$$R = \frac{\rho \cdot l}{A}$$

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Circuit Diagram:



Signature

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Procedure :-

1. Clean the ends of the connecting wire with the help of sandpaper to remove any insulating coating on them.
2. Connect the resistance, rheostat, battery, key, voltmeter, and ammeter as shown in the fig.
3. Make sure that the pointers on the voltmeter and milliammeter coincide with the zero mark on the measuring scale. If not, adjust the pointer to coincide with the zero mark by adjusting the screw provided at the base using a screwdriver.
4. Note the range and the least count of the given voltmeter and milliammeter.
5. Insert the key K and slide the rheostat to the end where the current flow is minimum.
6. Note the voltmeter and the milliammeter reading.
7. Remove the key K and allow the wire to cool.
8. Again insert the key and slightly increase the voltage by moving the rheostat. Note down the milliammeter and voltmeter reading.
8. Repeat step 7 for four different adjustments of the rheostat. Document the readings in a tabular column.

Observation:

Range of ammeter = 0mA to 500mA

The least count of ammeter = 10mA .

Range of voltmeter = 0V to 5V

Observation Table:

Sr. No	Voltmeter Reading (V)	Milli-Ammeter Reading (mA)	$R = \frac{V}{I} (\Omega)$
1.	0.1	0.3	0.33
2.	0.2	0.7	0.28
3.	0.3	1.1	0.27
4.	0.4	1.5	0.26
5.	0.5	1.9	0.26

Calculations:

1. Plot a graph between the potential difference across the wire V and the current I flowing through the wire as shown.

2. Determine the slope of the graph. The resistance of the given wire is then equal to the reciprocal of the slope.

3. From the graph, $R = \frac{BC}{AB} = 0.25 \Omega$.

4. Resistance per unit length of the wire = $\frac{R}{l} = 0.25 \Omega m^{-1}$

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The least count of meter-scale = 0.1cm
length of the given wire, $l = 1m$

Error: Here R is the resistance per unit length and ΔR is the estimated error. ΔV and ΔI are the least count of voltmeter and ammeter resp.

Result:-

The potential difference across the wires varies linearly with the current.

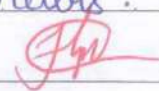
The resistance per unit length of the wire is
 $0.25 \pm 0.32 \Omega m^{-1}$

Precautions:-

1. The voltmeter should be connected in parallel and the ammeter in series with the circuit. It should be ensured that current enters at the positive terminal and leaves at the negative terminal.
2. The key should be inserted only while taking obser, as excessive flow of current causes unnecessary heating.
3. Zero error in measuring instruments.

Sources of Error:-

1. The wire used may not be of uniform area of cross-section.
2. The length of the resistance wire measured should be b/w one terminal of voltmeter and the other. The lengths of ends wound around the voltmeters.

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EXPERIMENT - 2

Aim:- To find resistance of a given wire using a meter bridge and hence determine the resistivity of its material.

Material Required:-

- A meter bridge
- A galvanometer
- A jockey
- A resistance wire
- A meter scale
- A battery eliminator.
- A resistance box.
- A one-way key.
- A screw gauge
- Connecting wires.

Theory:-

Metre bridge apparatus is also known as a slide wire bridge. It is fixed on the wooden block and consists of a long wire with a uniform cross-sectional area. It has two gaps formed using thick metal strips to make the Wheatstone's bridge.

Then according to Wheatstone's principle, we have:

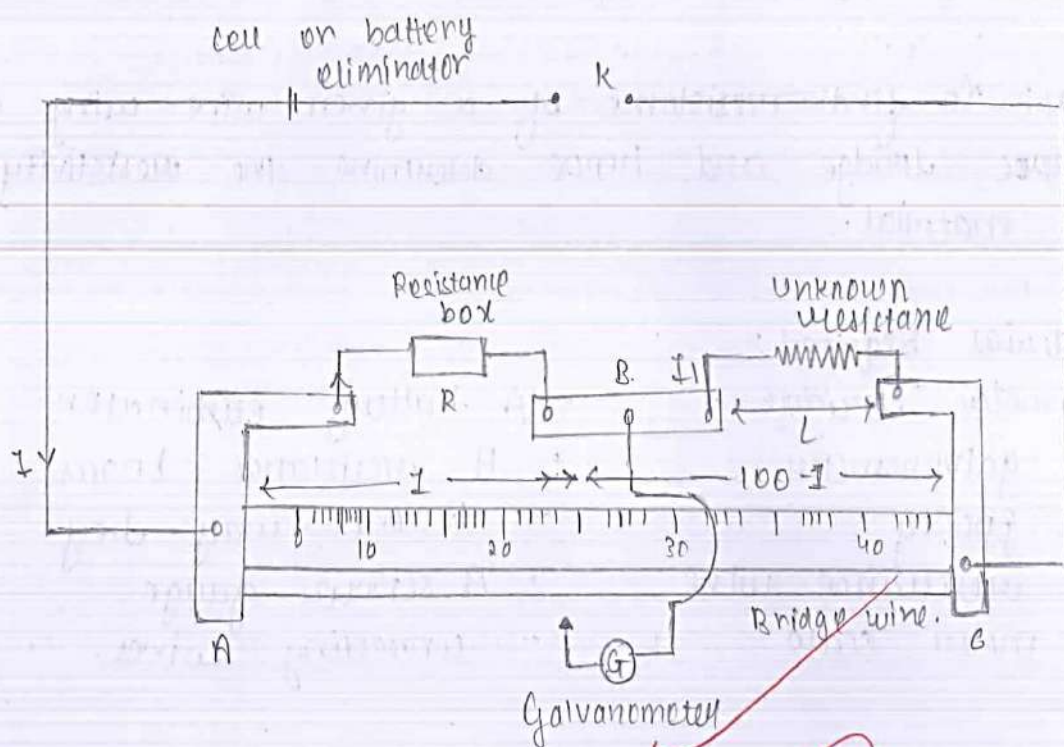
$$\frac{X}{R} = \frac{l}{100-l} \Rightarrow X = R \cdot \frac{l}{(100-l)}$$

Then the specific resistance of the material of the given wire is calculated as:

$$\rho = \frac{AX}{L} \quad (\text{where, } A = \pi r^2, \quad L = \text{length})$$

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Circuit Diagram:



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Procedure :

1. The arrangement of the apparatus should be as shown in the circuit diagram.
2. The wire whose resistance is to be determined should be connected in the right gap b/w C and B without any formation of loops.
3. Resistance should be connected b/w A and B.
4. All the other connections is shown in diagram.
5. Plug the key K in place of 2-2 resistance.
6. The jockey should be first touched gently to the ~~left~~ to the right end of the bridge.
7. The deflections in the galvanometer should be in opposite directions and if it is in one direction then the circuit connections are not correct. Note the galvanometer deflection.
8. ~~Let D~~ be the null point where the jockey is touching the wire. The movement of the jockey should be gentle from left to the right of the galvanometer.
9. Take a 12 value from the resistance box should be taken such that when the jockey is nearly in the middle of the wire, there shouldn't be any deflection.
10. Note the position of D to know the length of $AB = l$.
11. ~~Four~~ sets of observations should be taken by changing the value of resistance R.
12. Record the observations in a tabular form.
13. Stretch the resistance wire to find its length.
14. Using screw gauge measure the diameter of the wire at four different places keeping it in a mutually

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Table for unknown Resistance (X)

Sr.	Resistance from box, R (ohm)	Length AB = l (cm)	Length BC = $(100-l)$ (cm)	Unknown Resistance $X = [R(100-l)/l]$
1.	0.5	58.3	41.7	0.35.
2.	0.7	60.7	39.3	0.45.
3.	1	61.9	38.1	0.65.
4.	1.5	61.1	38.9	0.95.
5.	1.5	61.1	38.9	0.95.

Mean = 0.59 Ω

Radius of the resistance wire :

Sr. No	Main scale Reading (mm)	Circular scale reading	Total reading (diameter) (mm)	Mean D (mm)	Mean radius (D/2) (mm)
1.	0	43	0.43	0.43	0.215
2.	0	42	0.42	0.42	0.21
3.	0	43	0.43	0.43	0.215

Mean =
0.21 mm

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perpendicular direction.

15. Record the observations in the table.

Observation :-

Pitch of screw gauge = 1 mm.

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

$\therefore$ LC of the given screw gauge = 0.01 mm.

Zero error $e = -$ mm

Zero correction $C = -e = -$ mm

Calculations:-

Calculation for X :-

The value of R is determined from the position of null point D and record length in table.

Find length (100-1) cm and note down in table.

$$\text{Mean } X = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{5} = 0.59 \Omega.$$

Calculation for D :-

$$\text{Mean corrected diameter} = \frac{D_1 + D_2 + D_3}{3} = 0.21 \text{ mm} = 2.1 \text{ cm}.$$

Calculation for specific resistance:

Specific resistance of the material of the given wire,

$$\rho = \frac{AX}{L} = \frac{3.14 \times 2.1 \times 2.4 \times 0.59}{4} = 0.2042 \times 10^{-3} \Omega \text{ m}.$$

Standard value of the specific resistance,

$$\rho_0 = 0.2042 \times 10^{-3} \Omega \text{ m}.$$

Percentage error = - %

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Result :

1. The value of unknown resistance $\cdot X = 0.59 \Omega$.
2. The specific resistance of the material of the given wire $= 0.2042 \times 10^{-3} \Omega m$.
3. Percentage error = -

Precautions :

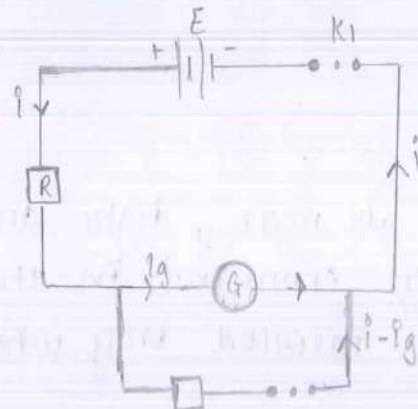
1. The connections should be neat, tight and clean.
2. Plugs should be tightly connected in the resistance box.
3. The key k should be inserted only when the observation are to be taken.
4. The null point should be b/w 45cm & 55cm.
5. There shouldn't be any loops in the wire.

Sources of Error

1. The screws of the instrument might be loose.
2. The wire might be of non-uniform diameter.
3. There might be backlash error in the screw gauge.

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Circuit Diagram:



Resistance of galvanometer.

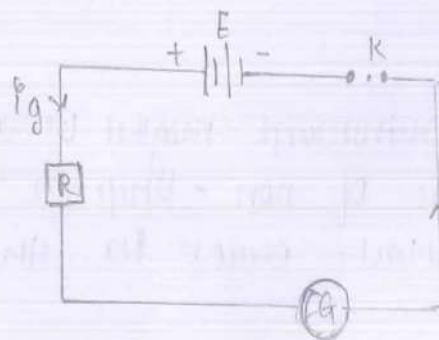


Figure of merit

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EXPERIMENT - 3

AIM:- To determine the resistance of a galvanometer by a half-deflection method and to find its figure of merit.

Apparatus / Material required:-

- A battery
- A Weston type galvanometer.
- Two one-way keys
- Rheostat.
- Screw gauge
- Metre-scale
- Ammeter.
- Connecting wires
- A piece of sandpaper.
- Two resistance boxes.

Procedure :-

1. Connect the circuit as shown in the figure.
2. Make sure that all the plugs in the resistance boxes are tight.
3. From the high resistance box remove $5k\Omega$ Key and then close the key K_1 . Adjust the resistance box to get full scale deflection on the galvanometer dial. Record the values of resistance R and θ .
4. Insert the key K_2 and keep R fixed. Adjust the value of shunt resistance S to get the deflection in the galvanometer which is exactly half of θ . Note down S . Remove plug K_2 after noting down the value of shunt resistance.
5. Take five sets of observations by repeating steps 2 and 3.

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Observation Table:

Sr NO.	Resistance	Deflection in Galvanometer	Half Deflection	Shunt Resistance	Galvano meter Resistance	Fig of merit
1.	10,000	28	14	100	101	2.2×10^{-5}
2.	11,000	26	13	100	100.9	2.2×10^{-5}
3.	12,500	24	12	100	100.8	2.2×10^{-5}
4.	14,000	22	11	100	100.7	2.1×10^{-5}

Calculations:

$$1. G = \frac{RS}{R-S}$$

$$G_1 = \frac{10,000 \times 100}{10,000 - 100} = 101 \Omega$$

$$G_2 = \frac{11,000 \times 100}{11,000 - 100} = 100.9 \Omega$$

$$G_3 = \frac{12,500 \times 100}{12,500 - 100} = 100.8 \Omega$$

$$G_4 = \frac{14,000 \times 100}{14,000 - 100} = 100.7 \Omega$$

$$2. K = \frac{E}{(R+G)\theta}$$

$$K_1 = \left(\frac{6.49}{10,000 + 101} \right) \frac{1}{28} = 2.2 \times 10^{-5} \text{ A/division.}$$

$$K_2 = \left(\frac{6.49}{11,000 + 100.9} \right) \frac{1}{26} = 2.2 \times 10^{-5} \text{ A/div.}$$

$$K_3 = \left(\frac{6.49}{12,500 + 100.8} \right) \frac{1}{24} = 2.1 \times 10^{-5} \text{ A/div}$$

$$K_4 = \left(\frac{6.49}{14,000 + 100.7} \right) \frac{1}{22} = 2.1 \times 10^{-5} \text{ A/div.}$$

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6. Calculate the galvanometer resistance and figure of merit K of galvanometer using equations.

Result :

1. The resistance of the given galvanometer by half deflection method, $G = 100 \Omega$.
2. The figure of merit of a given galvanometer, $K = 20 \mu A / \text{division}$.

Source of Error :-

1. Plugs in the resistance boxes may be loose or they may not be clean.
2. The emf of the battery may be constant.

Calculations:

The number of division in the galvanometer scale, $n=30$

1. Calculation for G

- Using the formula

$$G = \frac{RS}{R-S}, \text{ Calculate } G \text{ and note it down.}$$

- Take the mean of the value of G .

2. The calculation for K

- Using the formula

$$K = \frac{E}{(R+G)\theta}, \text{ Calculate the value of } K \text{ and write it.}$$

- Take the mean value of K and record it.

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Experiment - 4

Aim:-

To convert the given galvanometer into a voltmeter of desired range and to verify the same.

Apparatus Required:

- A galvanometer, A voltmeter 0-3V, Battery, 2 resistance box, 2 one-way keys, A rheostat, connecting wires and sandpaper

Theory:

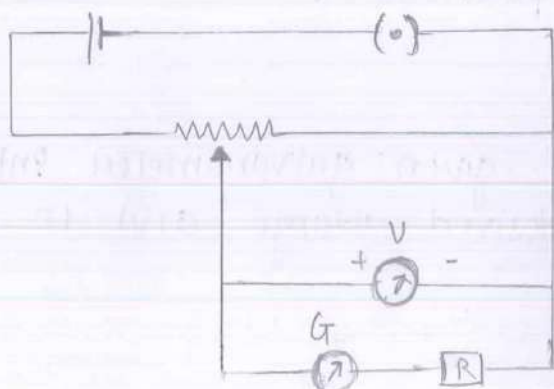
By connecting a high resistance of suitable value in series with a galvanometer, it is converted into a voltmeter. Voltmeter is always connected in parallel with the electrical component across which potential difference is to be measured.

If a galvanometer shows a full-scale deflection for a maximum current I_g , the potential difference across the galvanometer is $I_g \times G$.

If the converted galvanometer is desired to have V_0 volt, then the resistance to be joined in series with galvanometer, is given by, $R = \frac{V_0 - I_g G}{I_g}$

V_0 - range of conversion.

Circuit Diagram:



Circuit to verify conversion of
galvanometer into a
voltmeter

Observation Table:

Sr.No.	Reading of Galvanometer into voltmeter		Standard voltmeter reading (V ₂)	Standard voltmeter reading (V ₂ - V ₁)
	Deflection (D)	The potential difference in volts.		
1.	10	1	1	0
2.	15	1.5	1.5	0
3.	20	2	2	0

$$R = \frac{V}{I_g} - G$$

$$= \frac{3}{0.6 \text{ mA}} - 100$$

$$R = 4900 \Omega$$

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Procedure:

1. Connect resistance box in series combination with the galvanometer and take the plugs of resistance R .
2. Calculate the value of the series resistance R for given values of V_0 , I_g and G .
3. Now the galvanometer functions as a voltmeter of range 0-V volts.
4. Take out the plugs of calculated resistance R from the resistance box.
5. By using a key adjust the movable contact of the rheostat such that the deflection of galvanometer becomes maximum.
6. Note both the readings of the galvanometer and voltmeter.
7. Convert the readings of the galvanometer and voltmeter.
8. Find the difference in the reading. This difference is the voltmeter reading and galvanometer reading gives the error.
9. By moving the variable contact of rheostat take 5 readings the range of voltmeter from 0-3V.

Observation and Calculations:

The resistance of the given galvanometer $G = 100 \Omega$.
 The figure of merit $K = 2 \times 10^{-5}$ ampere/division.
 Number of divisions on galvanometer scale $n = 30$.
 Current for full scale deflection $= 0.6 \text{ A}$.

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Result:

To convert the given galvanometer into voltmeter of the range 0 to 10 V.

1. The value of calculated series resistance = 4900Ω
2. The value of observed series resistance = 4800Ω
3. Current for full scale deflection; $I_g = 0.6 \text{ mA}$.

Precautions:

- The resistance box used should be of high resistance.
- The rheostat should be used as potential divider.
- High resistance of the order of $10 \text{ K}\Omega$ from the resistance box should be used first and then the battery key should be closed to avoid damage.

Source of Error:

The wire may be of non-uniform area of cross section.

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EXPERIMENT-5

AIM: To find the focal length of a convex lens by plotting graphs between u and v or between $1/u$ and $1/v$.

Material Required:

- One optical bench.
- Metre scale.
- Indian needle or a knitting needle.
- Three uprights. (with clamps)
- A convex lens of less than 20 cm focal length.
- Two sharp-edged needles.
- Spirit level

Theory:

For a body positioned at a distance ' u ' from the optical centre of a thin convex lens of focal length ' f ', an inverted and real image is generated on the lens's other side at a distance ' v ' from the optical centre. The relationship between these quantities is:

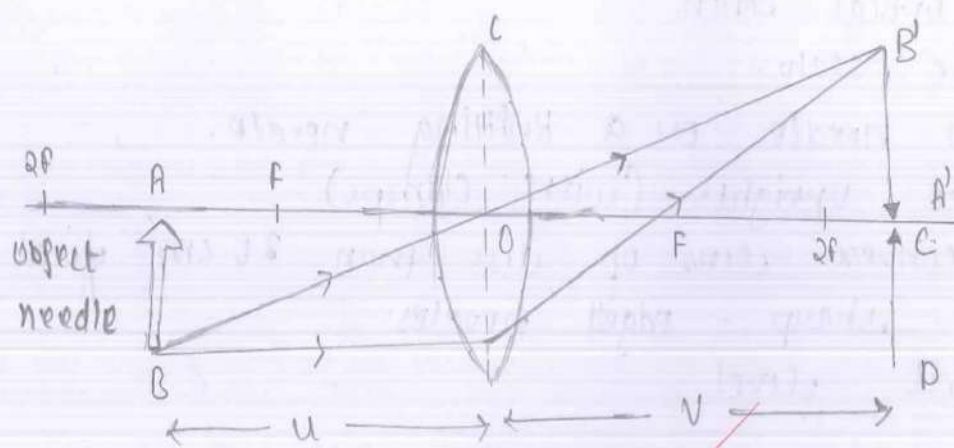
$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

From this equation, the focal length, is

$$\frac{1}{f} = \frac{u+v}{uv} \quad \Rightarrow \quad f = \frac{uv}{u+v}$$

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Ray diagram:



Focal length of the
convex lens.

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Procedure.

1. Fix the convex lens in the holder.
2. Use the lens to focus an object like a tree on a white screen or a wall.
3. Precisely focus the image of the object on the wall or screen until a sharp image is obtained.
4. Calculate the distance between the lens and the wall or screen. It will be the rough focal length of the lens.
5. Mount the holder with the lens in a locked upright, and place the upright at the 50cm mark.
6. ~~Tune~~ the orientation of the lens in such a way that its surface is perpendicular and vertical to the optical bench's length.
7. Maintain the upright fixed in the above position throughout.
8. Use the thin optical needle as the object (O).
Fix ~~it~~ on the outer, laterally movable upright close to zero ends.
9. Adjust the object needle upright, and place it at a distance close to 1.5 times the acquired approximate focal length of the lens.
10. ~~Tune~~ the height of the object needle to adjust its tip to lie on the horizontal plane through the lens's optical centre. Record the position of the index mark on the foot of

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Observation Table

Sr NO.	Position of object needle A (cm) (2a)	Lens (b) (cm) (2b)	Image needle (c) (cm) (2c)	Observed dis.		Corrected dis.		Corrected distance	
				OA = u (cm) (3a)	OC = v (cm) (3b)	$\frac{1}{u}$ (cm) (4a)	$\frac{1}{v}$ (cm) (4b)	$\frac{1}{u}$	$\frac{1}{v}$
1.	66	50	26	16	24	0.062	0.041	16	24
2.	67	50	27	17	23	0.058	0.043	17	23
3.	68	50	28	18	22	0.055	0.045	18	22
4.	70	50	30	20	20	0.05	0.05	20	20
5.	75	50	33	23	17	0.053	0.058	23	17
6.	80	50	34	24	16	0.041	0.062	24	16

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the object needle upright.

11. Close your right eye, and open the left eye. Then watch from the other terminal of the optical bench. The image's tip should be present in the middle of the lens.

12. Place the thick optical image needle in the fourth upright close to the other terminal of the optical bench.

13. Tune the height of the image needle in a way that its tip is visible in line with the image's tip when seen with the left eye open.

14. Look towards the right. The tips will be separated. The image needle tip and the image tip have parallel. Clear the parallel tip.

15. Record the position of the index mark on the foot of the image needle upright.

16. Note down the position of the index mark on the foot of the upright of the lens, the image needle, and the object needle in the second observation column.

17. Calculate the index correction for length between the tip of the object needle and the optical centre of the lens. Next, find the distance between the tip of the image needle and the optical centre of the lens, as mentioned.

18. Adjust the object needle upright towards the mirror in steps 4 cm to obtain observations.

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1 and 2. Repeat the process.

19. Adjust the object needle away from the mirror in steps of 4 cm to obtain observations 6, 5, 4.
20. Note down all the observations as shown ahead.

Observations:

The rough or approximate focal length of the convex lens = 16 cm

Calculation:

Calculation of the focal length by the graphical method:

1. $v \rightarrow u$ Graph

- Choose a suitable but the same scale to denote v along the y -axis and u along x -axis.
- As per sign conventions, v is positive and u is -ve.
- Plot the points for different values of v and u from the observation table in the second section.
- The graph is a rectangular hyperbola, as represented in the graph between u and v .
- Draw a line OA creating an angle 45° with either axis bisecting $\angle YOX'$ and reaching the curve at point A . Draw AC and AB perpendicular on the y and x' -axis, respectively.
- The values of v and u are the same for point A . The coordinates of point A should be $(2f, 2f)$, as for a convex lens, when $v = 2f$, $u = 2f$. Therefore, $AB = AC = 2f$ or $OB = OC = 2f$.

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This implies that $f = OB/2$ and $f = OC/2$
Mean value of $f = 10.1 \text{ cm}$.

2. $\frac{1}{v} \rightarrow \frac{1}{u}$ Graph

- Choose an apt but the same scale to denote $1/u$ along x' -axis and $1/v$ along y' -axis.
- As per sign conventions, $1/u$ is -ve and $1/v$ -ve.
- Plot the points for varied sets of values of $1/u$ and $1/v$ from the observation table.
- The graph evolves to be a straight line as represented in the graph between $1/v$ and $1/u$.
- The straight line slices the two axis OY and OX' at an angle 45° at points Q and P, respectively, creating equal intercepts on the axis. Calculate the distance between OQ and OP.
- Then the focal length, $f = OQ = OP = 10.1$

Result.

The focal length of the convex lens calculated from.

1. Focal length from $f = \frac{uv}{u-v}$

2. $v \rightarrow u$ graph = 10.1 cm .

3. $\frac{1}{v} \rightarrow \frac{1}{u}$ graph = 10.1 cm .

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Precautions.

- Tips of the image needle and the object needle must lie at the exact height as the lens's centre.
- Parallax must be corrected from tip to tip by placing the eye at a distance minimum of ~~30 cm~~ apart from the needle.
- The object needle must be positioned at such a distance that only an inverted and real image of the object needle is produced.
- Index correction for u and v must be applied.

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Experiment -6

Aim: To find the focal length of a convex mirror using a convex lens.

Material Required:

- An optical bench with uprights for holding lens.
- mirror and two needles.
- two needles (pins)
- a thin convex lens.
- a convex mirror.
- Index needle
- a metre scale and a spirit level.

Theory:

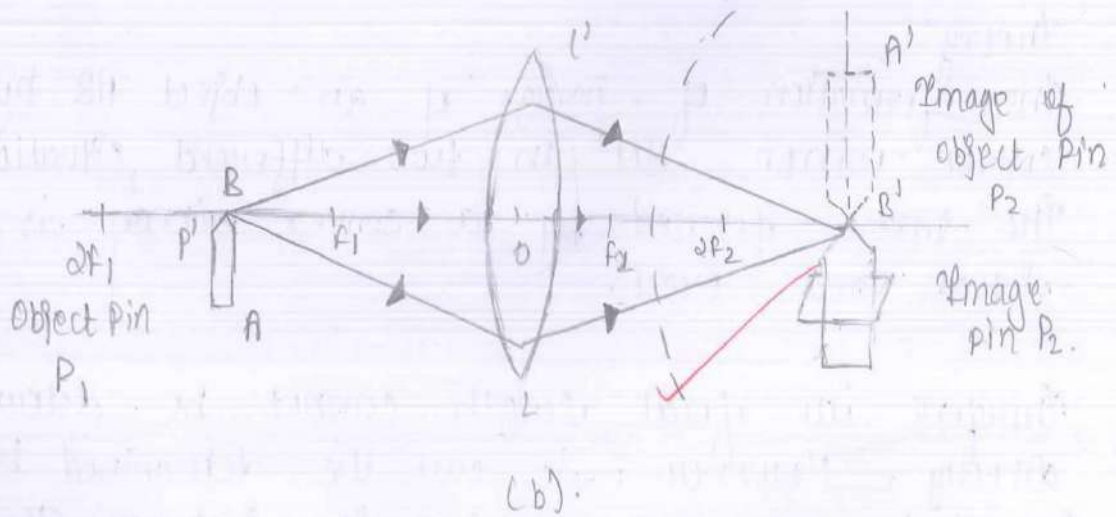
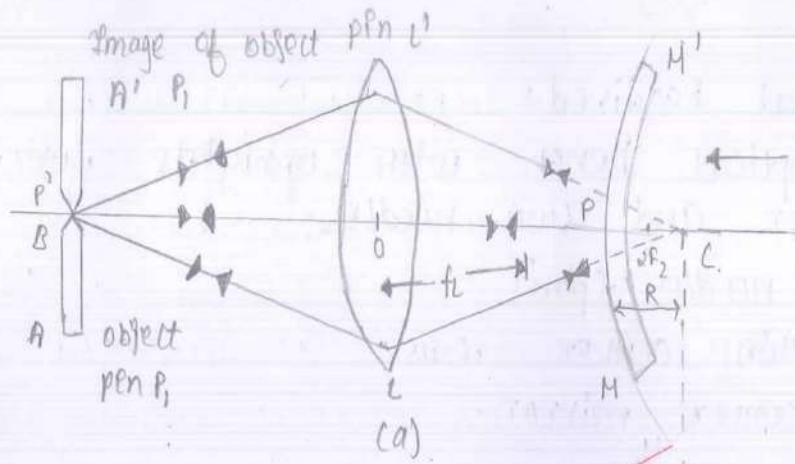
The ~~formation~~ of image of an object AB by a convex mirror MM' in two different situations.

The image formed by a convex mirror is virtual and erect.

Therefore its focal length cannot be determined directly. However, it can be determined by introducing a convex lens in between the ~~object~~ and the convex mirror.

Object AB is placed at point P' in front of a thin convex lens such that its real, inverted and magnified image A'B' is formed

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at position C on the other side of the lens.

Now a convex mirror is introduced between the convex lens and point C and so adjusted that the real and inverted image A'B' coincides with the object AB at point P'. This is possible if the light rays starting from the tip of the object, after passing through the lens, fall normally on the reflecting surface of the convex mirror and retrace their path.

Any normal ray to a spherical surface has to be along the radius of that sphere so that point C must be the centre of curvature of the convex mirror.

Therefore, the distance PC is the radius of curvature R and half of it would be the focal length of the convex mirror.

That is, $f = \frac{PC}{2} = \frac{R}{2}$

Procedure :

1. In case, if the focal length of the given thin convex lens is not known then approximate value of its focal length should be estimated first.

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2. Place the optical bench on a rigid table or on a platform. Using the spirit level, make it horizontal with the help of levelling screws provided at the base of the bench.
3. Place the uprights mounted with pin P_1 (object pin), convex lens LL' , and convex mirror MM' on the horizontal optical bench.
4. ~~Check~~ that the lens, mirror, and pin P_1 are vertically placed on the optical bench. Also verify that the tip of the pin, optical centre O of the convex lens LL' , and pole P of the convex mirror MM' lie on the same horizontal straight line, parallel to the optical bench.
5. ~~Determine~~ the index correction between upright holding of the convex mirror and image pin respectively, using an index needle.
6. Place the object pin P_1 from the convex lens LL' at a distance slightly greater than the length of the lens.
7. Adjust the position of the convex mirror MM' till the eight rays reflected back from the mirror pass through the lens and form a real and inverted image coinciding with the object pin P_1 .

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as shown. This occurs when the rays starting from the tip of pin P_1 , after passing through the lens strike the mirror normally and are reflected back along their original paths. Remove the ~~parallax~~ parallax between the image and the object pins.

8. Read the position of uprights holding the object pin P_1 , convex lens U' , and convex mirror MM' and ~~record~~ the observations in the observation table.

9. Remove the convex mirror from its upright and fix image pin P_2 on it. Adjust the height of pin such that the tip of it also lies on the principal axis of the lens. That is, the tips of the pins P_1 and P_2 and the optical centre O of the ~~convex~~ lens, all lie on a straight horizontal line parallel to the length of the optical bench.

10. You may put a small piece of paper on image pin P_2 to differentiate it from the object pin P_1 .

11. ~~Using~~ the method of parallax and without changing the position of lens U' and object pin P_1 , adjust the position of image pin P_2 on the other side of the lens so that it coincides with the real and inverted image of the object pin P_1 .

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Observation Table.

Sl NO	Upright Object pin P ₁ a (cm)	position of convex lens L' b (cm)	convex mirror M' c (cm)	Observed $R' = (-d)$ (cm)	Focal length $f = \frac{R}{2}$ (cm)
1.	80	122.8	42.8	0	21.4
2.	90	131.0	41	0	20.5
3.	70	111.2	41.2	0	20.7

Calculation:

Calculate the mean value of radius of curvature of the convex mirror, and determine its focal length.

$$f = \frac{R}{2} = 20.8 \text{ cm.}$$

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formed by the convex lens. Note the position of the image pin.

- 12- Repeat the experiment by changing the separation between the pin P_1 and lens L_1' and the mirror HM' . In this manner, take 4-5 sets of observations.

Observation:

- Focal length of the convex lens, $f = 15\text{cm}$.
- Actual length of the index needle, $I = 0.5\text{cm}$.
- Observed length of the index needle $I' = 0.5\text{cm}$
=

Calculations:

Calculate the mean value of radius of curvature of the convex mirror R , and determine its focal length $f = R/2 = 20.8\text{cm}$.

Result:

The focal length of the given convex mirror is 20.8cm . Here f is mean value of the focal length.

Precautions:

- The uprights supporting the pins, lens and mirror must be rigid and mounted vertically.
- The apertures of the given convex lens and convex mirror should be small, otherwise the image formed will be distorted.

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- Eye should be placed at a distance of about 25 cm or more from the image pin.
- Optical bench should be horizontal. The tips of pins, centre of convex lens and pole of the mirror should lie at the same horizontal level.

Sources of Error:

- The tip of the inverted image of the object pin should just touch the tip of the image pin and must not overlap. This should be ensured while removing the parallax.
- Personal eye defects may make removal of parallax tedious.
- The convex mirror should preferably be front-coated. Otherwise multiple reflections may take place.

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Experiment - 7

Aim: To determine the angle of minimum deviation for a given prism by plotting a graph between angle of incidence and angle of deviation.

Material Required:

- A drawing board.
- A white sheet of paper.
- A prism
- Drawing pins.
- Pencil
- A half meter scale
- Office pins.
- protractor
- Graph paper.

Theory:

Refraction takes place when a light ray travels from one medium to another resulting in deviation of the emergent ray from that of the incident ray.

Following is the refractive index of the material used in the prism:

$$n = \frac{\sin(A + D_m/2)}{\sin(A/2)}$$

Where D_m is the angle of minimum deviation and A is the angle of the prism.

Procedure:

1. Place the white sheet of paper on the drawing board and fix it with the help of drawing pins.

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2. xx' is the straight line which is drawn parallel to the length of the paper such that it is in the middle of the paper.
3. Mark points $O_1, O_2, O_3 \dots$ on the straight line xx' at a distance of 5 cm each.
4. $N_1O_1, N_2O_2 \dots$ are the normals that are drawn on the points $O_1, O_2 \dots$ as shown.
5. Make angles of $35^\circ, 40^\circ, \dots, 60^\circ$ by drawing straight lines $RO_1, O_2R_2 \dots$ with respect to the normals.
6. ~~To take one~~ edge of the prism for all the observation, mark any corner of the prism as A.
7. Place the prism with its refracting face AB on the line xx' and on the point O_1 and also in the middle of AB.
8. ~~Mark~~ the boundary of the prism.
9. On the line RO_1 , fix office pins vertically and them as P_1 and P_2 , the distance between these pins should not be less than 10 mm.
10. Through prism face, AC, look for the images.

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11. Close your left eye, bring it in line with the 2 images.

12. Fix the other two office pins vertically and name them as P_3 and P_4 .

13. Encircle the pricks of pins P_3 and P_4 .

14. For points, $\alpha_2, \alpha_3 \dots$ for angles $40^\circ, 45^\circ \dots 60^\circ$ repeat the steps 7 to 13.

To measure μ in a different case.

1. To get emergent rays $S_1, T_1, S_2, T_2 \dots$ draw straight lines through P_4 and P_5 .

2. Prolong the boundary of the prism to produce $T_1, S_1, \dots$ so that they meet incident rays $R_1, \alpha_1, \dots$ at points $F_1, \dots$

3. To obtain the angle of deviation $\delta_1, \delta_2, \dots$ measure the angles $\angle R_1 S_1 F_1, \dots$

4. Note these angles.

To measure angle A .

1. To get angle A , measure the $\angle BAC$ in the boundary of the prism.

2. Record the observations.

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Observation Table:

Sr No.	Angle of incidence $\angle i$	Angle of Deviation $\angle D$
1.	35°	
2.	40°	
3.	45°	
4.	50°	

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Observations:

Least count of the protractor = 1°

Angle of the prism, $A = 60^\circ$

Calculations:

To plot the graph between i and d , take i along the x -axis and d along y -axis.

Min deviation D_m can be found from the graph which ~~about~~ would be corresponding to the lowest point in the graph.

Let the value of angle of minimum deviation,
 $D_m = 42^\circ$

Then, ~~refractive~~ Index:

$$n = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin(A/2)} = 1.6$$

Result:

- The angle of min deviation, $D_m = 42^\circ$
- Refractive index of the prism, $n = 1.6$
- The graph indicates that the angle of incidence ~~increases~~, the angle of deviation first decreases to attain the minimum value of D_m and then increases as the angle of incidence increases.

Precautions:

- $35^\circ - 60^\circ$ is the angle of incidence that needs to be maintained.

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- The placement of the pins must be vertical.
- The placement of 2 pins should be such that the distance is not more than 10mm.
- To represent incident and emergent rays arrowheads must be marked.
- The angle of prism used should be the same for all the observations.

Source of Error:

- The pricks made by the pins might be thick.
- There may be an error in measuring the values of the angles.

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Experiment - 8

Aim: To draw the I-V characteristic curves of a p-n junction in forward bias and reverse bias.

Material Required:

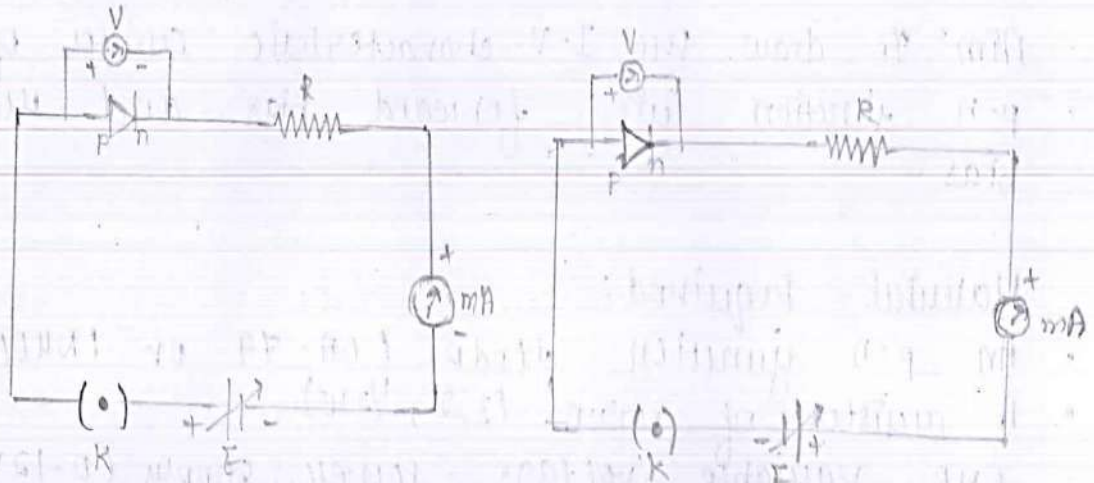
- An p-n junction diode (OA-79 or 1N4007)
- A resistor of value 3Ω , $\frac{1}{2}W$
- One variable voltage power supply (0-12V)
- Voltmeter (0-12V)
- Milliammeter (0-200mA)
- A plug key.
- Connecting wires.
- Sand paper.
- A microammeter (0-200 μ A).

Theory:

Forward bias: When an external voltage is applied to a p-n junction diode in such a way that the p-side is at a higher potential with respect to the n-side, it is said to be forward biased.

Threshold voltage or "Cut-in" voltage: When the p-side is connected to the positive terminal of the battery and the voltage is increased, initially a negligible current flows till the applied voltage crosses a certain value. After, a

Circuit Diagram:



(a) Forward biasing for a p-n junction diode.

(b) Reverse biasing for a p-n junction diode.

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characteristic voltage, the diode current increases.

Reverse bias: when the n-region of a p-n junction diode is at a higher potential with respect to the p-region, it is said to be reverse biased. In reverse bias, the p-side of the p-n junction diode is connected to the -ve of the battery.

Reverse saturation current: As the supplied voltage is increased in the reverse biased condⁿ, starting from zero value, the current increases, but soon becomes constant. This current is very small. It is called the reverse saturation current.

Procedure:

1. Note the range and least count of the given voltmeter (V), milliammeter (mA) and the microammeter (μ A).
2. Remove the insulating layers from the connecting wires and leads of diode using a sand paper.
3. Connect the variable voltage power supply, p-n junction diode, voltmeter, milliammeter, resistor and a plug key in a circuit as shown in Fig.
4. Initially when the key is open, you would note at this stage, that no current is flowing

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through the circuit. Now close the key.

5. Give a small voltage to the circuit by slight and gentle turning of the power supply knob. Note the voltmeter reading across the diode and the corresponding milliammeter reading to find the current I flowing through the diode.

6. Gradually, increase the applied voltage in the circuit and note the corresponding voltmeter and milliammeter readings in table. The value of current flowing through the diode would be ~~negligibly~~ small till the voltage across the diode exceeds the value of its cut-in or threshold voltage. After the cut-in voltage, the variation in current will be rapid.

7. Once the threshold voltage is reached, vary the diode voltage very slowly noting the corresponding current I flowing through the diode. Continue increasing voltage till the current reaches the ~~limit~~ of the milliammeter.

8. Now disconnect the circuit and make the connections as shown in fig for the reverse bias characteristics. Connect p-side of p-n junction diode to the -ve terminal of the power supply and replace milliammeter with a microammeter.

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Observation Table:-

Sr No.	Forward voltage V_f (V)	Forward current I_f (mA)
1.	0.10	0
2.	0.20	0
3.	0.30	0
4.	0.40	0.02
10.	0.75	12.45
5.	0.50	0.29
6.	0.55	7.21
7.	0.60	2.9
8.	0.65	7.63
9.	0.70	9.73

(a) Variation of forward current with voltage across the diode (forward bias)

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Gradually, increase the applied voltage in the circuit and note the corresponding voltmeter and microammeter readings in Table.

In this part of experiment, with the given supply voltage you will get only flat portion of the reverse bias characteristic curve.

Caution

Never increase the value of the voltage too much across the diode. Excessive current flow may damage the diode if it exceeds its limit. Maximum permissible current that can pass through the diode can be known from the technical data as specified by the manufacturer.

Observations

1. p-n junction diode used = 1N 583.

2. For forward biasing

(i) Range of the voltmeter = 0V to 15V.

(ii) Least count of the voltmeter scale = 0.25V

(iii) Range of the milliammeter = 0 mA to 100.0 mA.

(iv) Least count of the milliammeter scale = 0.2 mA.

3. For reverse biasing.

(i) Range of the voltmeter = 0V to 15V.

(ii) Least count of the voltmeter scale = 0.25V

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(b) Variation of reverse current with voltage across the diode (Reverse bias)

Sr No.	Reverse voltage $V_r (V)$	Reverse current $I_r (\mu A)$
1.	0	0
2.	1	0
3.	2	0
4.	3	0
5.	4	0
6.	5	0
7.	6	0
8.	7	1
9.	8	2
10.	9	5
11.	10	18
12.	11	28
13.	12	50
14.	13	70
15.	14	86
16.	15	constant

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(iii) Range of the microammeter = $10\mu A$ to $100\mu A$.

(iv) Least count of the microammeter = $0.2\mu A$.

Plotting Graph:

1. Plot a graph between forward voltage across the diode along the +ve X-axis and current flowing through the diode along the +ve Y-axis. The graph as shown represents a typical I-V characteristic of a silicon diode used. Locate the knee and determine the cut-in voltage.

2. Now plot the reverse voltage (V_r) along the -ve X-axis and the corresponding current along the -ve Y-axis as shown.

Result:

- A. The value of cut-in voltage for the given diode is
- B. The reverse saturation current for the given diode is $7\mu A$.

Precautions:

1. The connections should be neat, clean and tight.
2. Key should be used when the circuit is being used.
3. Beyond breakdown, forward bias voltage should be applied.

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ACTIVITY - 1

Aim: To measure resistance, voltage (AC/DC), current (AC) and check continuity of a given circuit using multimeter.

Apparatus and material:

- Three carbon resistors.
- One standard resistance coil.
- a battery eliminator with tapping (2V, 4V and 6V)
- a step-down transformer (6-0-6V) with two tapping (2V and 4V)
- a resistor of 100- Ω .
- a plug key and multimeter.

Theory:

Multimeter

- It is single measuring device acting as an ammeter, a voltmeter and an ohmmeter. For this reason, it is called AVO meter.
- It can measure alternating as well as direct current and alternating as well as direct voltage in addition to resistance. For this purpose, its panel is divided into five different sections. There are many ranges in each section so that it can measure from micro (10^{-6}) to mega (10^6) units.

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Rotation of a knob changes the section and 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 the knob for change in ohmmeter range, brings different resistances in circuit in series with the multimeter cell.

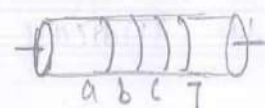
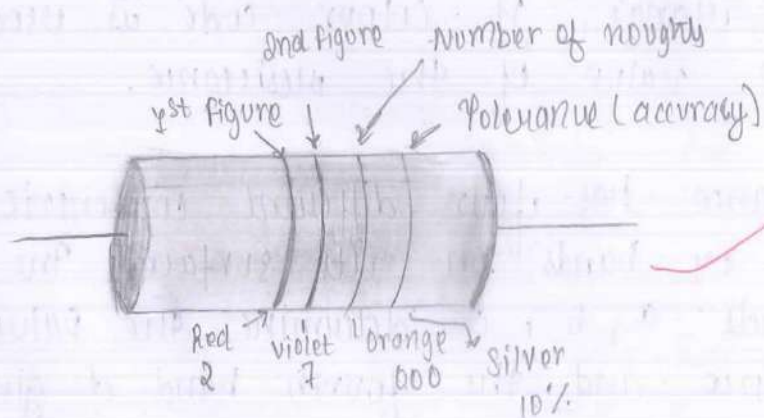
1. Carbon resistors are frequently used in electrical and electronic circuits, their values vary over a very wide range, A colour code is used to indicate the value of the resistance.

2. A carbon resistance has four different concentric coloured rings or bands on its surface. The first three bands a, b, c determine the value of the resistance and the fourth band d gives the percentage of accuracy called tolerance. The resistance of carbon resistor.

$$R = (ab \times 10^d \pm T \cdot 1) \Omega$$

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Letter (helpful to remember)	Colour	Figure (a, b)	Multiplier (c)	Colour (for fourth 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		10^{-1}		
	Silver		10^{-2}		



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3. To read the values of the carbon resistance, the following sentence is found to be of much more helpful.

B B R O Y G B V G and W
0 1 2 3 4 5 6 7 8 9

The bold face letters B, B, R, O, Y, G, B, V, G, and W in above sentence correspond to the colours Black, Brown, Red, Orange, Yellow, Green, Blue, Violet, Grey and white respectively for a and b, white for the third C, they correspond to the multipliers $10^0, 10^1, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7, 10^8, 10^9$ respectively.

4. The beside table provides the colour code for the carbon resistors.

1b) D.C. voltage:

1. Select a DC source of potential difference, 6V battery eliminator or a battery.
2. Plug the probes black in com and red in it.
3. Select DC voltage by turning the selectors which to range 10V DC volts.

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4. Touch and press other ends of probes such that red is on battery terminal marked + and black on and not the reading.

5. Insert red probe in terminals marked 4V, 2V in succession and note readings.

(c) AC VOLTS:

1. Turn the selector AC (200V)

2. Touch and press the probes other ends to two terminals of AC source of potential drop and note the readings.

3. Use red probe in terminals 4V and 2V in succession and record the readings.

Precautions:

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

2. Select the appropriate parameter current, voltage or resistance to the measured and set it on appropriate range.

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ACTIVITY-2

Aim: To assemble a household circuit comprising three bulbs, three switches a fuse and a power source.

Apparatus and material:

Apparatus:

No apparatus required in assembling a circuit.

Material:

Three bulbs (6V, 1W) each, fuse of 0.5A, main switch, a power supply (battery or eliminator), three (on/off) switches, flexible connecting wire with red and black plastic covering, a fuse wire.

Supplementary:

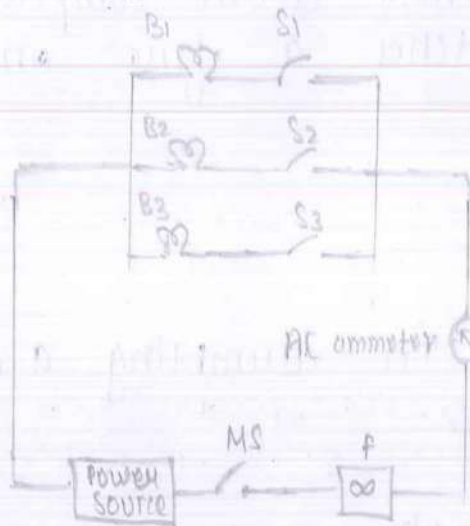
Main electric board with a two-pin socket and main switch.

Theory:

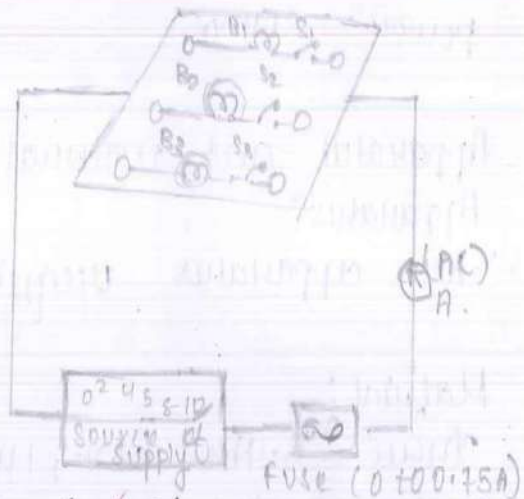
Electricity supplied to us for domestic purposes is 220 V A.C and 50 Hz. The household circuit, all appliances are connected in "parallel" with mains. The switches are connected in series with each appliance in live wire. 5A switches are required for normal appliances like

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Diagram:



(a) Circuit diagram



(b) Actual layout.

Handwritten signature

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bulbs, fluorescent tubes fans etc. 15 A sockets and switches are required for normal appliances heavy load appliances like refrigerator etc. All appliances must have three wires called live, neutral and the earth. Total power consumption 'P' at a time $P = P_1 + P_2 + P_3 \dots$

where P_1, P_2, P_3 are the powers drawn by appliances.

To protect the appliances from damage when unduly high currents are drawn fuse of little high heating, 10 to 20% higher than the current normally drawn by all appliances. For ~~for~~ further safety, a suitable value MAINS FUSE like rating 32 A is connected in series with supply source.

Procedure:

1. Connected the bulbs B_1, B_2, B_3 in series with switches S_1, S_2 and S_3 respectively and connect each set of B-S in parallel with each other.
2. Connect main supply to a step-down transformer to get required voltage from 0 to 10 V.
3. Connect the main fuse M.S in series with the power supply.

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4. Connect an AC ammeter in series with the B-S set.

5. Connect one end of power supply to one end of B-S set.

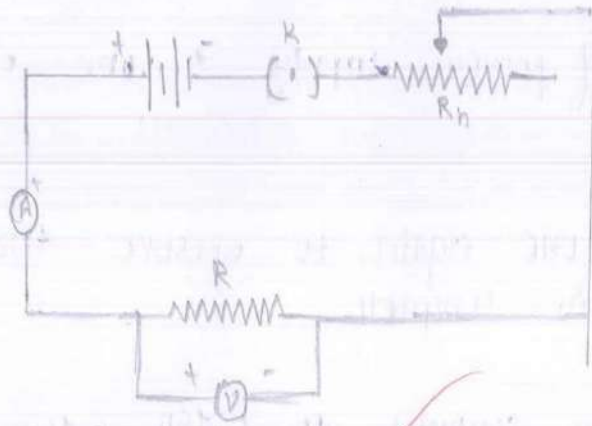
6. Check the circuit one again to ensure that household circuit is complete.

7. Gradually increase the current to 0.75A, the fuse must burn off at about 0.6.

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Diagram:



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ACTIVITY-3

Aim:- To assemble the components of a given electrical circuit.

Apparatus and Material:

Apparatus:

A voltmeter and an ammeter of appropriate range, a battery, a rheostat, one way key.

Material:

An unknown resistance or resistance coil, connecting wires, a piece of sand paper.

Procedure:

1. Connect the components in series with each other as shown in diagram then in series with the battery.
2. Connect the ammeter in series with the circuit, to measure the current.
3. Connect the voltmeter in parallel to the resistor, to measure the potential difference.
4. Connect the switch in series with the battery.
5. Assembly of the electrical components in electric circuit is complete.

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ACTIVITY-4

Aim: To identify a diode, an LED, a transistor, an IC, a resistor and a capacitor from a mixed collection of such items.

Apparatus: Multimeter

Material: Above mixed collection of items.

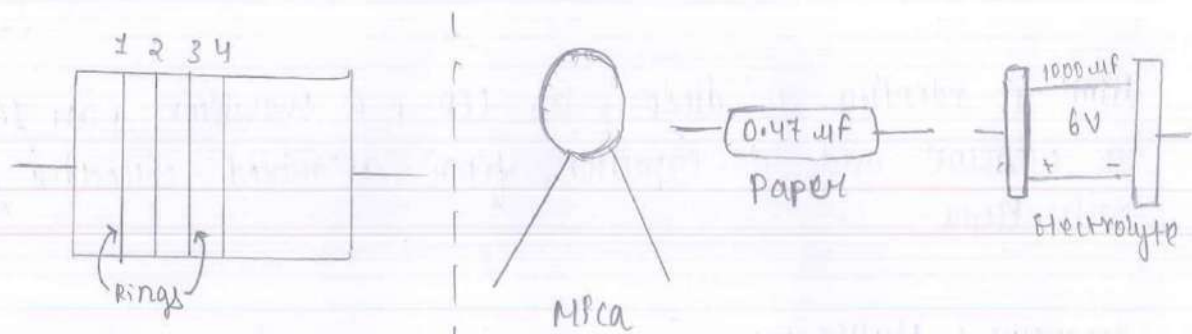
Theory:

For identification, appearance and working of each item will have to be considered.

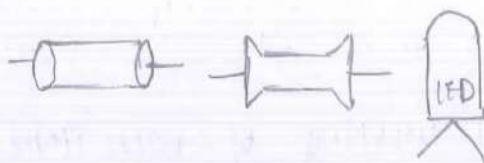
1. A diode is a two terminal device. It conducts when forward biased and does not conduct when reverse biased. It does not emit light while conducting. Hence, it does not glow.
2. A LED is also a two terminal device. It also conducts when forward biased and does not conduct when reverse biased. It emits light while conducting. Hence, it glow.
3. A transistor is a three terminal device. The terminals represent emitter (E), base (B) and collector (C).
4. An IC is a multi-terminal device in form of a chip.

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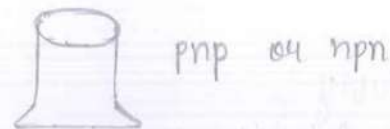
The components to be identified are shown in figure.



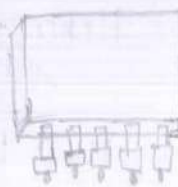
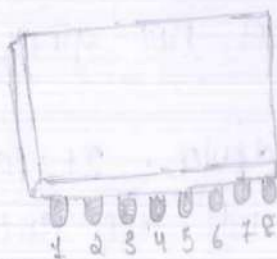
(a) Carbon resistor



(c) diodes.



(d) Transistor



(e) Integrated circuits.

Fig: Some of the commonly available Integrated circuits

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5. A resistor is a two terminal device. ~~in form of~~ it conducts when either forward biased or ~~reverse~~ reverse biased. It conducts even when operated with AC voltage.

6. A capacitor is also a two terminal device. It does not conduct when either forward biased or reverse biased. When a capacitor is connected to a DC source, then multimeter shows full scale current initially but it decays to zero quickly. It is because that initially a capacitor draws a charge.

Procedure:

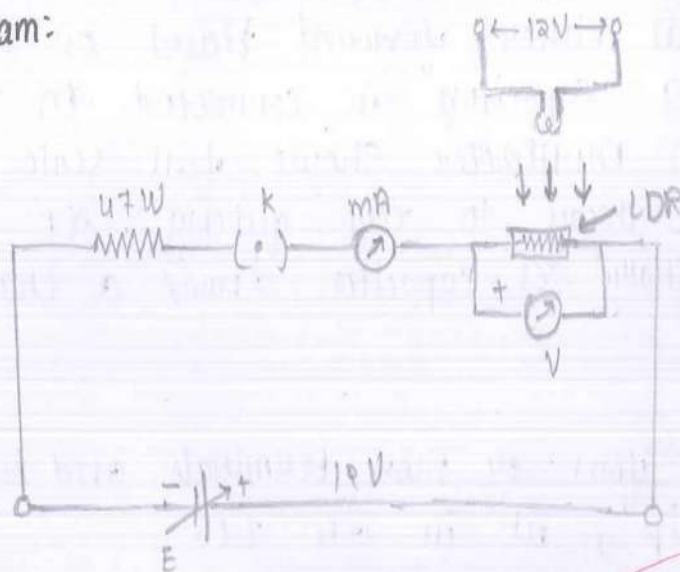
1. If the item has four or more terminals and has ~~form~~ of a chip, it is an IC.
2. If the item has three terminals, it is a transistor.
3. If the item has two terminals, it may be diode, a LED, a resistor or a capacitor. To differentiate proceed as ahead.
4. Put the selector on resistance R of multimeter for ~~checking~~ the continuity. The probe metal ends are inserted in terminals marked on the multimeter as common and P (or +ve)

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A Light Dependent Resistance (LDR).

Diagram:



A Light Dependent Resistance (LDR)

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ACTIVITY -5

Aim: To study the effect of intensity of light on LDR (Light Dependent resistor).

Apparatus:

LDR, two power supplies (2V each), key, milliammeter (0-500 mA), voltmeter (0-10V), a resistance of 47Ω , a 12V lamp, connecting wires.

Theory:

Light dependent resistor or a photoresistor is a device that is sensitive to light. Its resistance varies according to the intensity of light incident on it. It is made from a semiconductor material with light sensitive properties, one such material is, cadmium sulphide.

Snake-like tracks are made of cadmium sulphide on thin metal films. LDR has a high resistance due to the fact that majority of electrons are locked into the crystal lattice and not free to move.

As light falls on the lattice, some of the electrons get sufficient energy to break free the crystal lattice to conduct electricity. A typical

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LDR has a resistance of 1M in total darkness and a few hundred ohm resistance in bright light.

Procedure:

1. Assemble the circuit.
2. First keep the lamp switched off. Plug in the key K .
3. Observe and record voltmeter and milliammeter reading.
4. Calculate the reference measurement of LDR resistance. ~~R ensures~~ that background illumination has been taken into account.
5. Set up a 12V lamp on a fixed stand in vertical position facing LDR. Adjust LDR normally below the lamp at about 10 cm.
6. Observe milliammeter and voltmeter readings.

Conclusion:-

~~As~~ distance increases, intensity of incident light decreases and resistance of LDR increases.

Precaution:

1. LDR is placed normally to the light source so that angle of incidence of light rays remain constant and normal throughout the experiment.
2. All the connections should be made tight.

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ACTIVITY -6

Aim: To observe diffraction of light due to a thin slit.

Apparatus:

- Two razor blades.
- Adhesive tapes.
- A screen a source of monochromatic light black paper.
- A glass plate.

Theory

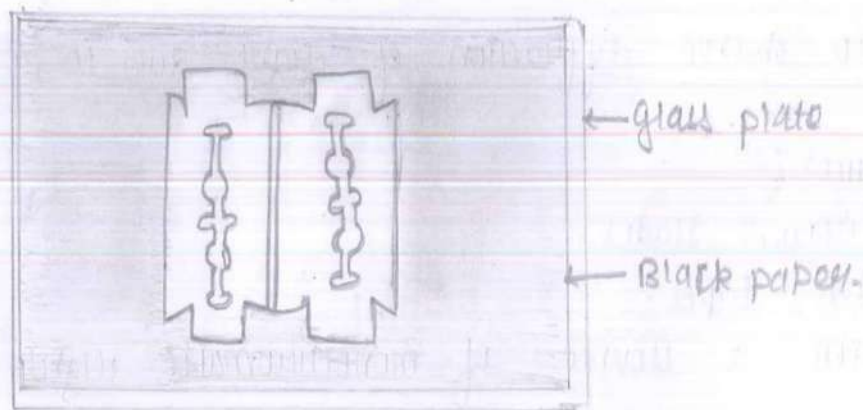
Diffraction is a phenomenon of bending of light around the corners of edges of fine opening or aperture. Diffraction takes place when order of wavelength is comparable or small to the size of slit or aperture.

The diffraction effect is more pronounced if the size of the aperture or the obstacle is of the order of wavelength of the wave. The diffraction pattern arises due to interference of light waves from different symmetrical point of the same wave front.

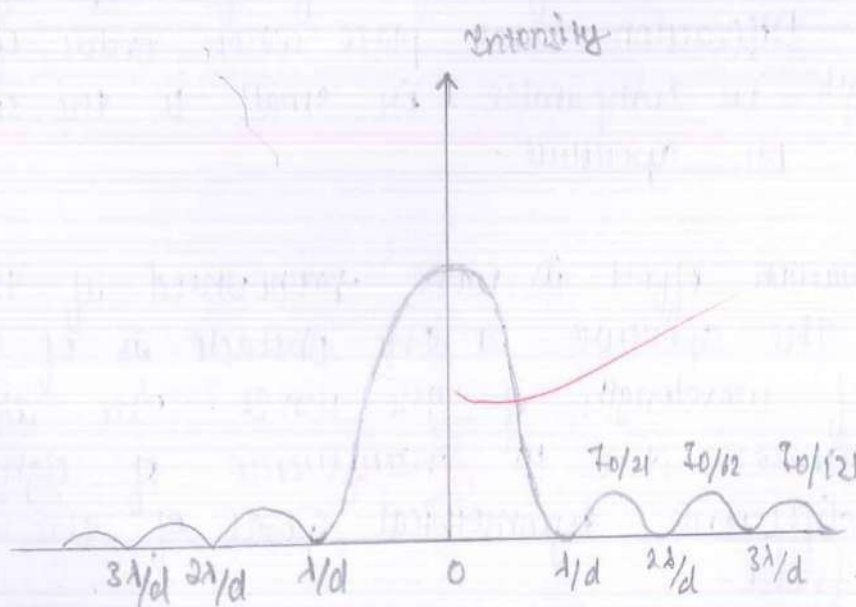
The diffraction pattern due to single slit consists of a central bright band having alternate dark and weak bright bands of decreasing

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Diagram:



A thin slit made by using two razor blades, black paper and a glass plate.



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Intensity on.

For diffraction, $d \sin \theta = n \lambda$

Here Here, d = size of aperture or slit.

θ = angle of diffraction.

n = order of diffraction

λ = wavelength of light.

Procedure:

1. Fix the black paper on the glass plate using adhesive.
2. Place two razor blades so that their sharp edges are parallel and extremely close to each other to form a narrow slit in between.
3. Cut the small slit in between the sharp edges of blades and place at a suitable distance from a wall or screen of a dark room.
4. Throw a beam of light on the slit by the laser pencil.

Conclusion:

When light waves are incident on a slit or aperture then it bends away at the corners of slit showing the phenomena of diffraction of light.

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Precaution:

1. Air gaps should not be left between glass plates and black paper.
2. The razor blades should be placed extremely closed as possible.
3. Diffraction pattern should be seen on a wall of a dark room.
4. A point source of monochromatic light like laser torch should be used.
5. A diffraction pattern of alternate bright and dark bands is seen on the wall.

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EXPERIMENT - 1

Scale Value:-

X-axis :- 1cm = 0.05V.

Y-axis :- 1cm = 0.2A.

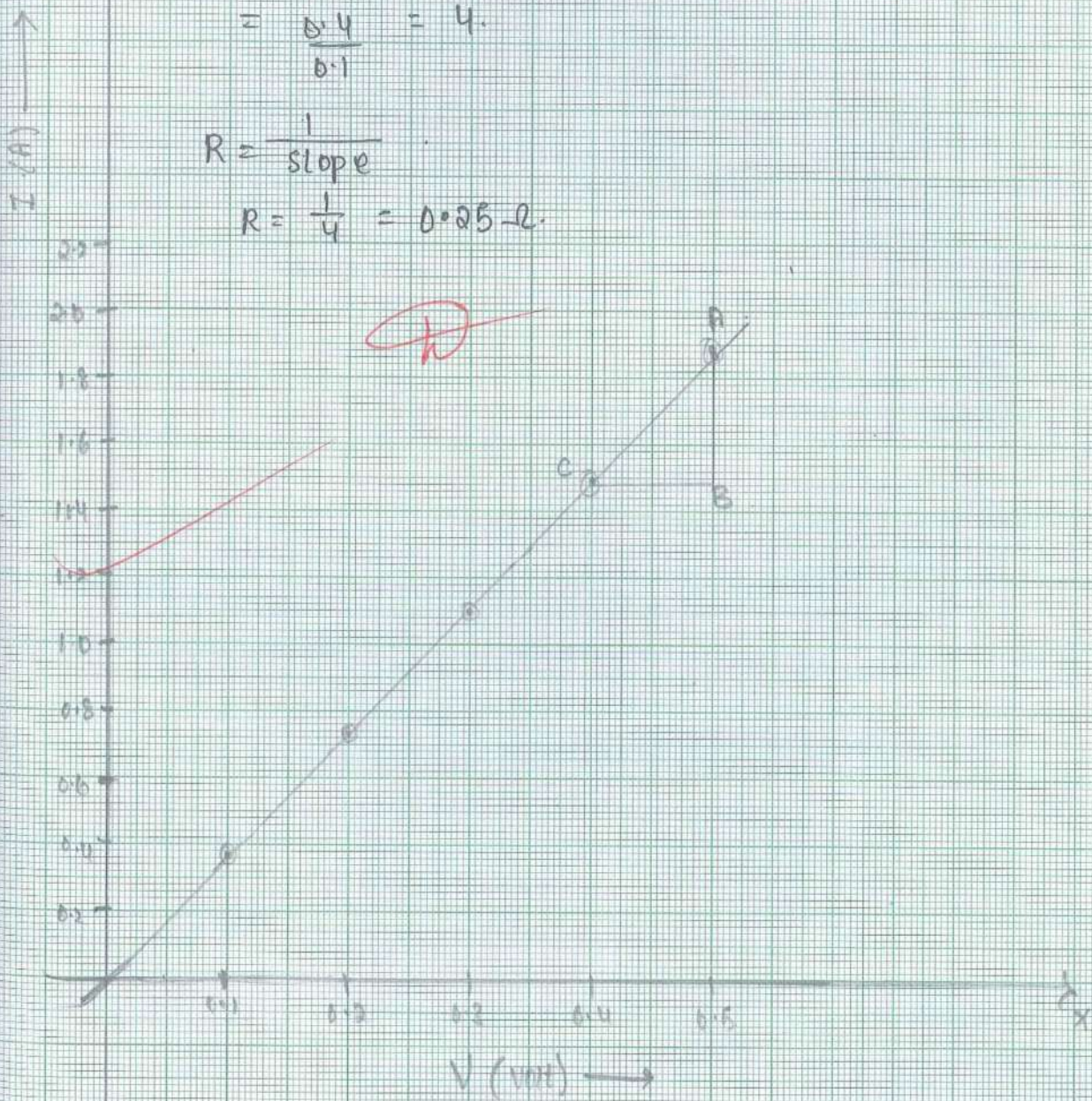
Calculation

$$\text{Slope} = \frac{AB}{BC} = \frac{1.9 - 1.5}{0.5 - 0.4}$$

$$= \frac{0.4}{0.1} = 4.$$

$$R = \frac{1}{\text{slope}}$$

$$R = \frac{1}{4} = 0.25 \Omega.$$



EXPERIMENT-5

$v \rightarrow u$

①

Scale Value

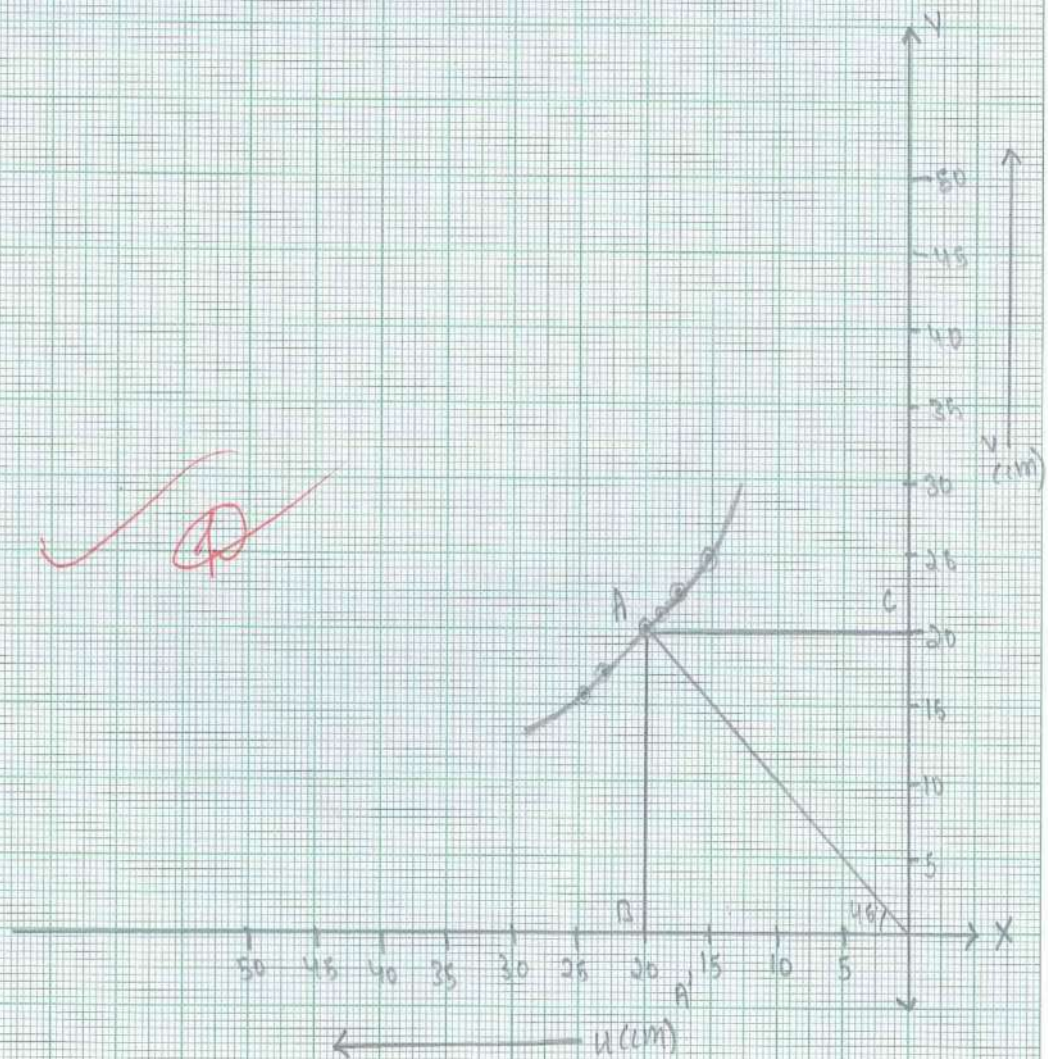
x-axis $1 \text{ cm} = \underline{5} \text{ mm cm of } u$

y-axis $1 \text{ cm} = \underline{5} \text{ mm cm of } v$

$$f = \frac{OB}{2} = \frac{OC}{2}$$

$$f = \frac{20.2}{2}$$

$$f = \underline{10.1 \text{ cm}}$$



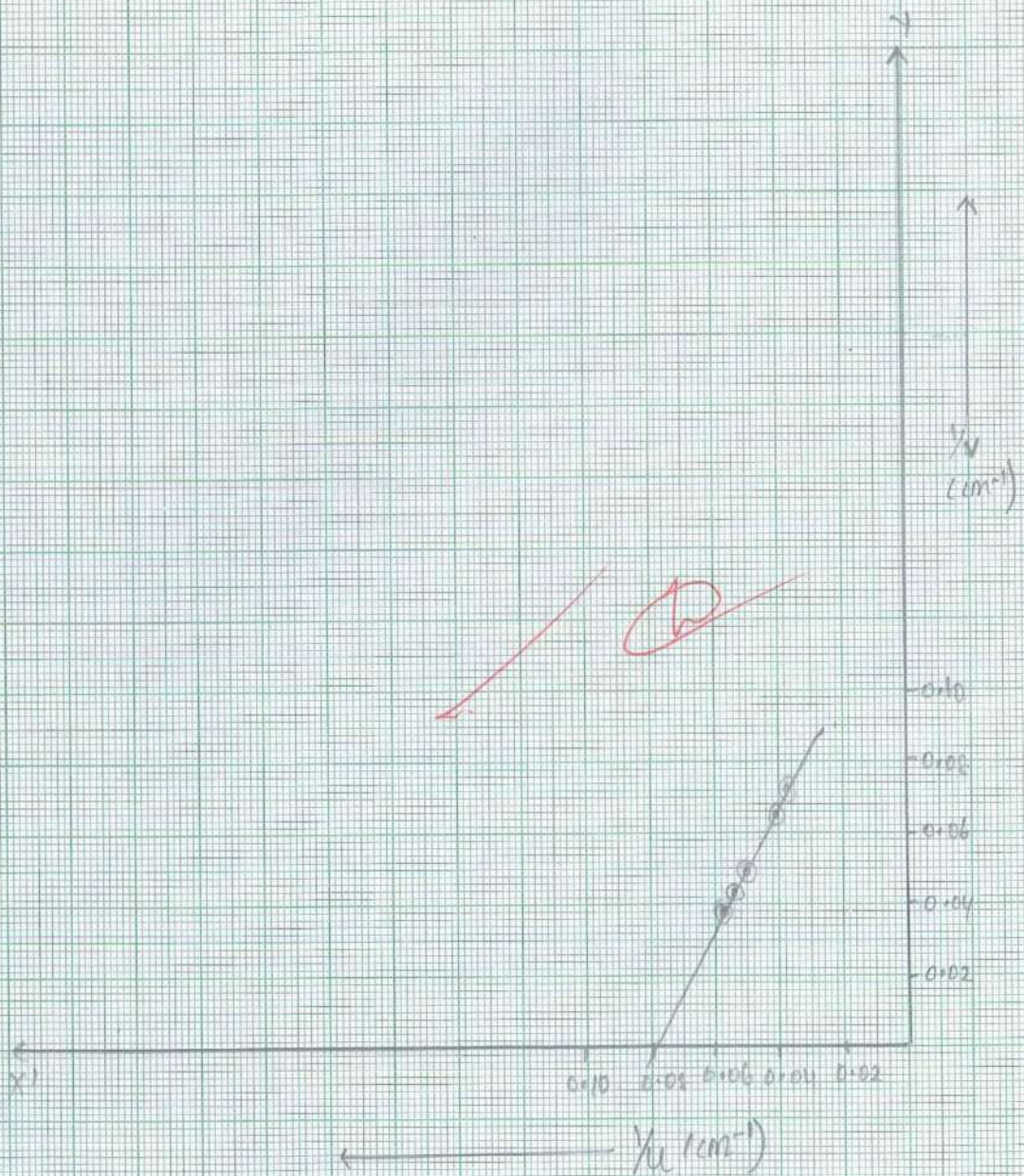
EXPERIMENT - 5 $\frac{1}{v} \rightarrow \frac{1}{u}$

Scale

$$x' - \text{axis} = 1\text{cm} = \underline{0.02} \text{ cm} \rightarrow \frac{1}{u}$$

$$y' - \text{axis} = 1\text{cm} = \underline{0.02} \text{ cm} \rightarrow \frac{1}{v}$$

$$f = \frac{1}{OP} = \frac{1}{0.9} = 10.1\text{cm}$$

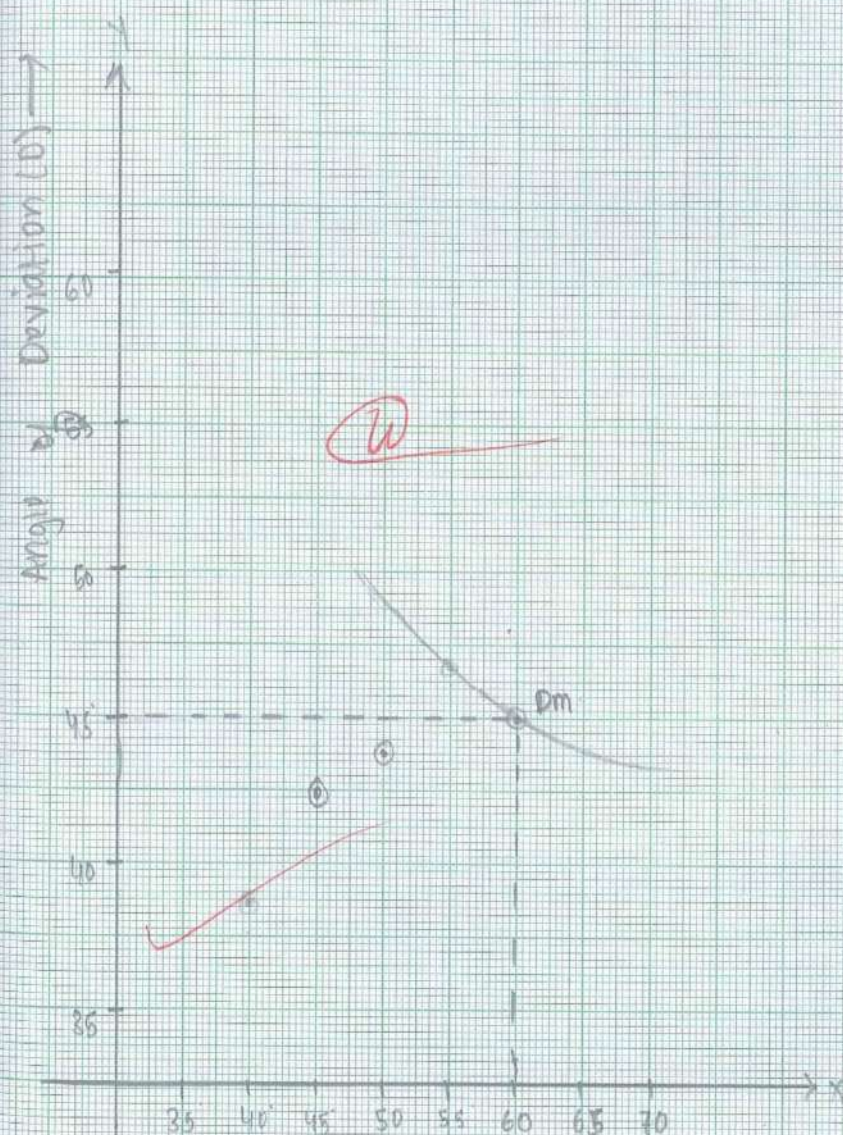


EXPERIMENT-7

Scale

X-axis = 1cm = 5°

Y-axis = 2cm = 5°



Angle of Incidence (i) $\rightarrow$

EXPERIMENT - 8

I-V characteristics
of a silicon diode

In forward biasing
& reverse biasing

