Expt.No. 03

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To Study V-I Characteristics of a Light Dependent Resistor (LDR)

AIM: To measure the photoconductive nature and dark resistance of a given light dependent resistor (LDR) and to plot the characteristics of the LDR.

APPARATUS REQUIRED:

LDR, Resistor (1 kΩ), ammeter (0-10 mA), voltmeter (0-10 V), light source, regulated power supply.

FORMULA:

By ohm's law, $V = IR$ (or) $R = \frac{V}{I}$ ohm.

[where R is the resistance of the LDR (i.e.) the resistance when the LDR is closed. V and I represents the corresponding voltage and current respectively.

PRINCIPLE:

The photoconductive device is based on the decrease in the resistance of certain semiconductor materials when they are exposed to both infrared and visible radiation.

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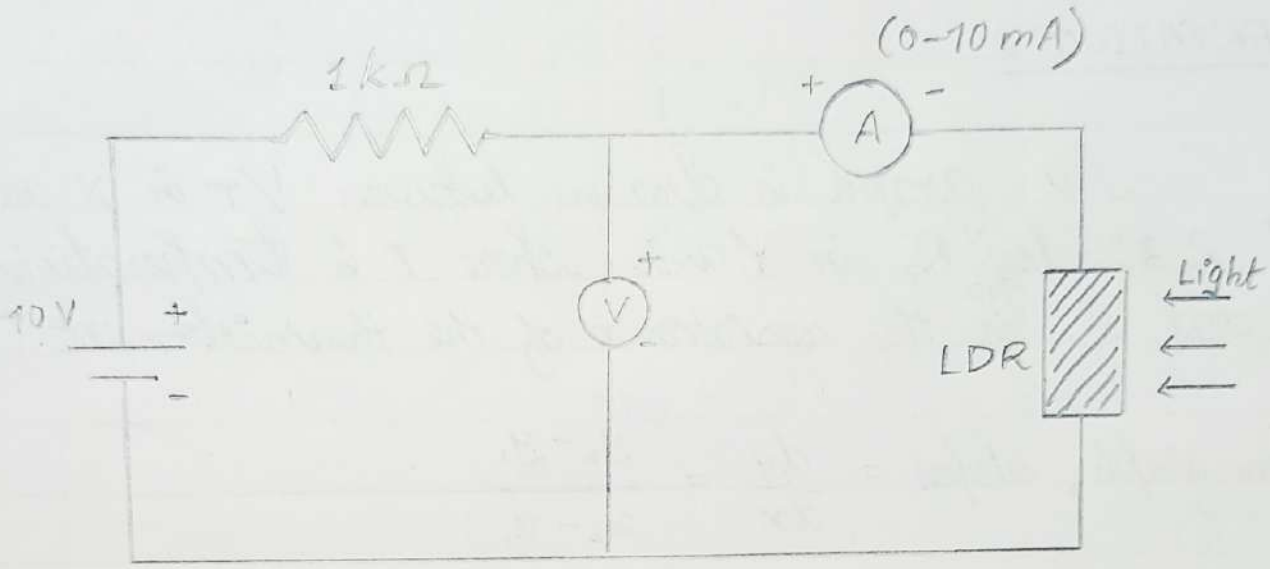
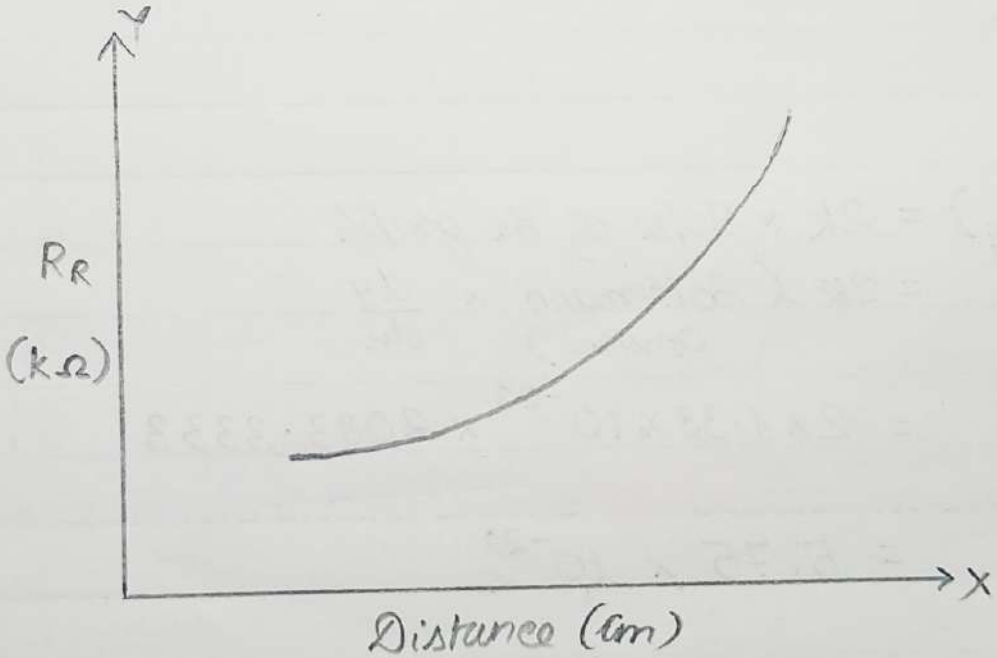


Circuit Diagram



Model Graph

To Determine the resistances of LDR at different distances :-

①

Sl.No	Distance (cm)	Voltmeter Readings (V) volt	Ammeter Readings (I) mA	R_R kΩ
1.	A = 15 cm	1	4	0.250
2.		2	6	0.333
3.		3	10	0.300
4.		4	12	0.333
5.		5	14	0.357
			Mean R_R	0.315
1.	B = 10 cm	1	8	0.125
2.		2	12	0.167
3.		3	16	0.188
4.		4	20	0.200
5.		5	24	0.208
			Mean R_R	0.178
1.	C = 5 cm	1	10	0.100
2.		2	14	0.143
3.		3	18	0.167
4.		4	23	0.174
5.		5	28	0.179
			Mean R_R	0.153

Calculations :-

A = 15 cm

$R_1 = V_1/I_1 = 1/4 = 0.250\ k\Omega$

$R_2 = V_2/I_2 = 2/6 = 0.333\ k\Omega$

$R_3 = V_3/I_3 = 3/10 = 0.300\ k\Omega$

$R_4 = V_4/I_4 = 4/12 = 0.333\ k\Omega$

$R_5 = V_5/I_5 = 5/14 = 0.357\ k\Omega$

B = 10 cm

$R_1 = V_1/I_1 = 1/8 = 0.125 k\Omega$

$R_2 = V_2/I_2 = 2/12 = 0.167 k\Omega$

$R_3 = V_3/I_3 = 3/16 = 0.188 k\Omega$

$R_4 = V_4/I_4 = 4/20 = 0.200 k\Omega$

$R_5 = V_5/I_5 = 5/24 = 0.208 k\Omega$

C = 5 cm

$R_1 = V_1/I_1 = 1/10 = 0.100\ k\Omega$

$R_2 = V_2/I_2 = 2/14 = 0.143 k\Omega$

$R_3 = V_3/I_3 = 3/18 = 0.167 k\Omega$

$R_4 = V_4/I_4 = 4/23 = 0.174 k\Omega$

$R_5 = V_5/I_5 = 5/28 = 0.179 k\Omega$

The photoconductivity is the result of carrier excitation due to light absorption and the figure of merit depends on the light absorption efficiency. The increase in conductivity is due to an increase in the number of mobile charge carriers in the material.

② Calculations (continued)

$$\text{Mean } R_R (A = 15\,cm) = \frac{0.250 + 0.333 + 0.300 + 0.333 + 0.357}{5} = \frac{1.573}{5} = 0.315\ k\Omega$$

$$\text{Mean } R_R (B = 10\,cm) = \frac{0.125 + 0.167 + 0.188 + 0.200 + 0.208}{5} = \frac{0.888}{5} = 0.178\ k\Omega$$

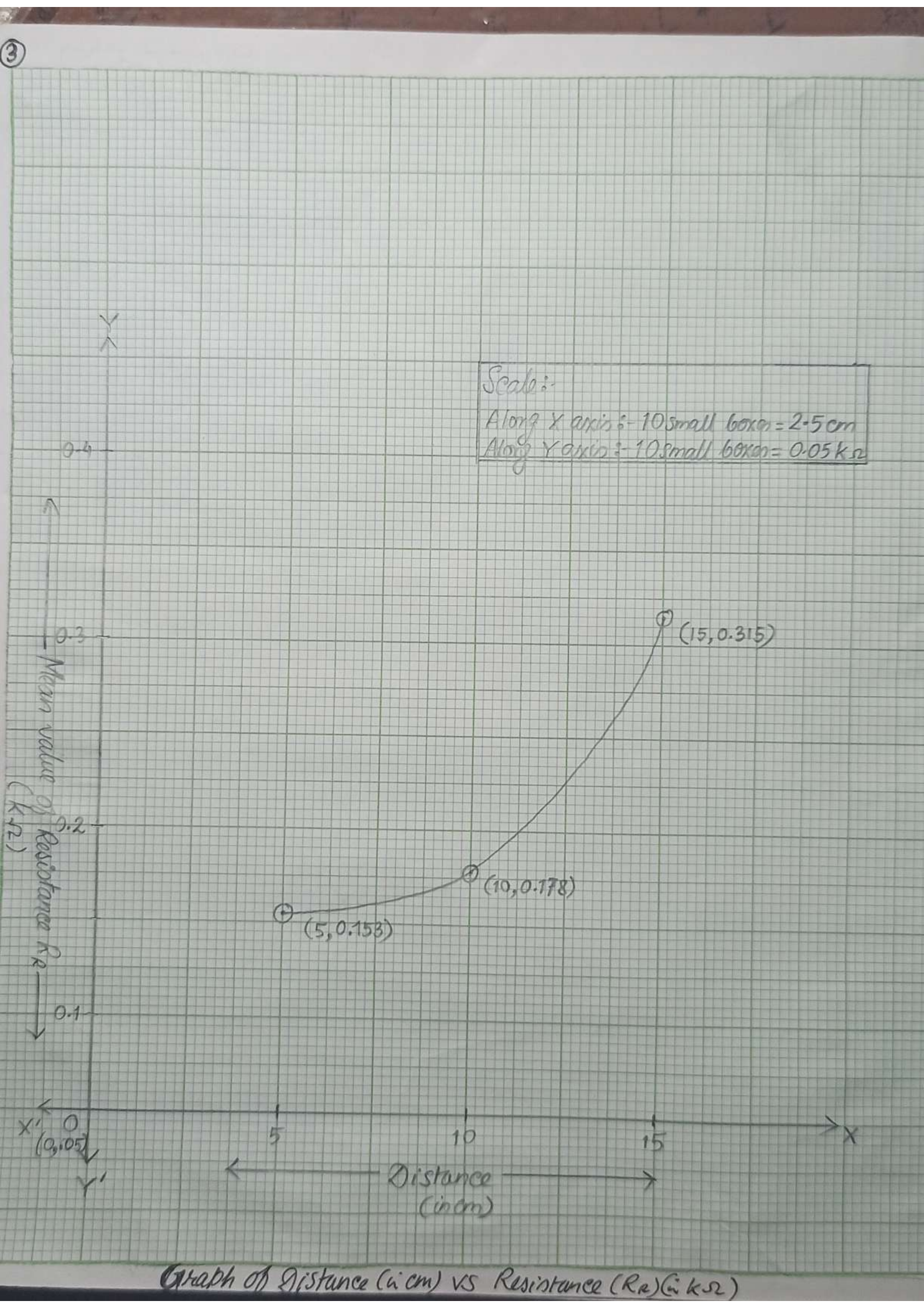
$$\text{Mean } R_R (C = 5\,cm) = \frac{0.100 + 0.143 + 0.167 + 0.174 + 0.179}{5} = \frac{0.763}{5} = 0.153\ k\Omega$$

$$\text{Voltmeter (LDR closed)} = \frac{(1+2+3+4+5)+(1+2+3+4+5)+(1+2+3+4+5)}{15} = \frac{45}{15} = 3.0\ V$$

$$\text{Ammeter (LDR closed)} = \frac{(4+6+10+12+14)+(8+12+16+20+24)+(10+14+18+23+28)}{15}$$

$$= \frac{219}{15} = 14.6\ mA$$

③



Graph of Distance (in cm) vs Resistance (R_R) (in kΩ)

Observations :-

From calculations,

Voltmeter reading when LDR is closed = 3 V

Ammeter reading when LDR is closed = 14.6 mA

④ The maximum value of resistance when intensity of light is minimum i.e. Dark Resistance = 0.357 kΩ (15 cm)

⑤ Result :-

i) Characteristic of LDR circuit :-
When a light dependent resistor is kept in dark, its resistance is very high. This is called as dark resistance. Their sensitivity varies with wavelength of light incident on them.

ii) The dark resistance of the given LDR = 0.357 K ohm

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