# GENERAL PHYSICS LAB 2 - PHYS112

## Experiment 1: Linear and Non-Linear Circuit Elements

Student: Bayan Alkamel

Student's ID: 1231030

Partner: Malak Jamel

Partner's ID: 1221890

Instructor: Wael Karain

Section: 7

## (1)Abstract:

**Aim of the experiment:**

To find the relationship between the current passing through a circuit component and the potential difference, characteristics for different elements, also to see if it is linear or non-linear circuit components.

**The Methods:**

carbon resistor, Si diode, light bulb, wiring, variable resistance), source of current and potential difference

**The main result is:**

The relationship in carbon resistor and low-current light bulb is linear, while diode and light bulb with high current are nonlinear

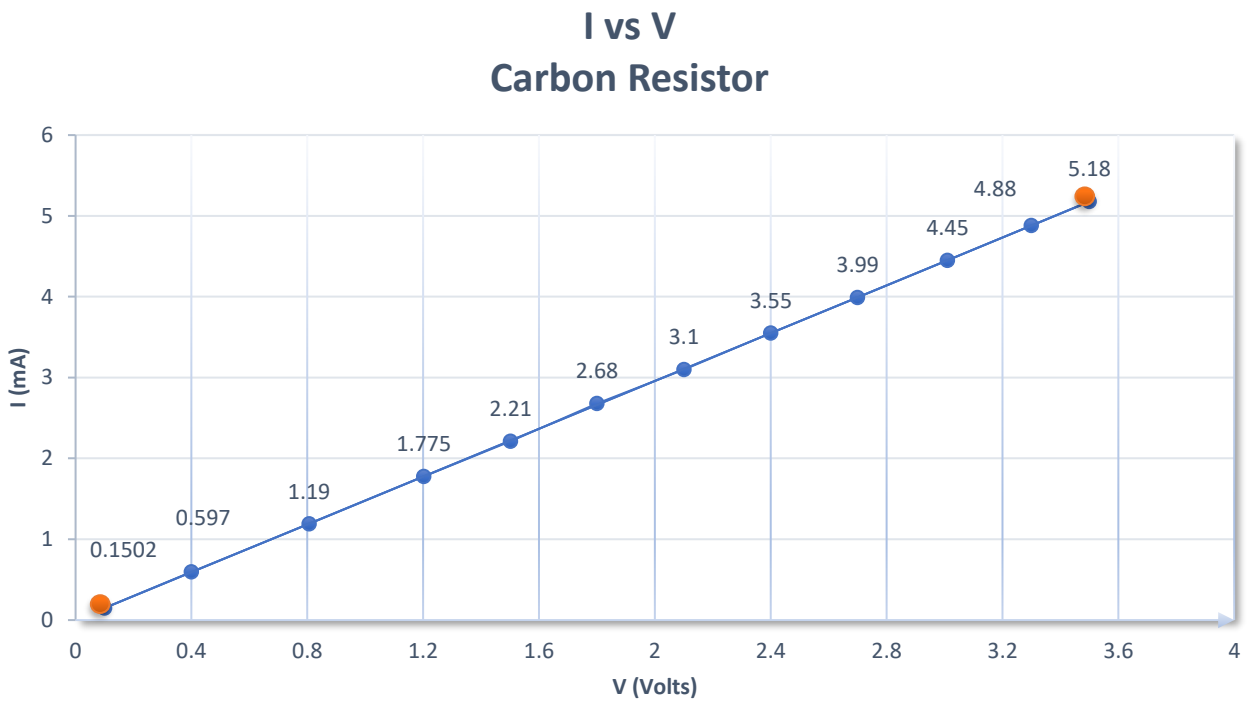
## (2)Data:

**Set V power supply = 5 Volts**

| Carbon Resistor | | Si Diode | | Light bulb (low currents) | | Light Bulb (high currents) | |
|---|---|---|---|---|---|---|---|
| V (Volts) | I (mA) | V(Volts) | I (mA) | V (Volts) | I (mA) | V (Volts) | I (mA) |
| 0.1 | 0.1502 | 0.35 | 0.9 | 0.010 | 6.9 | 0.5 | 84.2 |
| 0.4 | 0.597 | 0.40 | 0.42 | 0.02 | 12.1 | 1.0 | 117.6 |
| 0.806 | 1.19 | 0.45 | 0.51 | 0.03 | 17.6 | 1.5 | 141.9 |
| 1.202 | 1.775 | 0.50 | 0.065 | 0.04 | 23.2 | 2.0 | 158.6 |
| 1.502 | 2.21 | 0.54 | 0.167 | 0.05 | 28.6 | 2.5 | 178.5 |
| 1.8 | 2.68 | 0.58 | 0.468 | 0.06 | 34.2 | 3.0 | 193.8 |
| 2.1 | 3.1 | 0.62 | 1.246 | | | | |
| 2.4 | 3.55 | 0.65 | 1.8 | | | | |
| 2.7 | 3.99 | 0.68 | 5.23 | | | | |
| 3.0 | 4.45 | 0.70 | 8.3 | | | | |
| 3.3 | 4.88 | 0.72 | 17.6 | | | | |
| 3.5 | 5.18 | 0.74 | 31.9 | | | | |

## (3) Calculations and Graphs:

A - carbon Resistor:



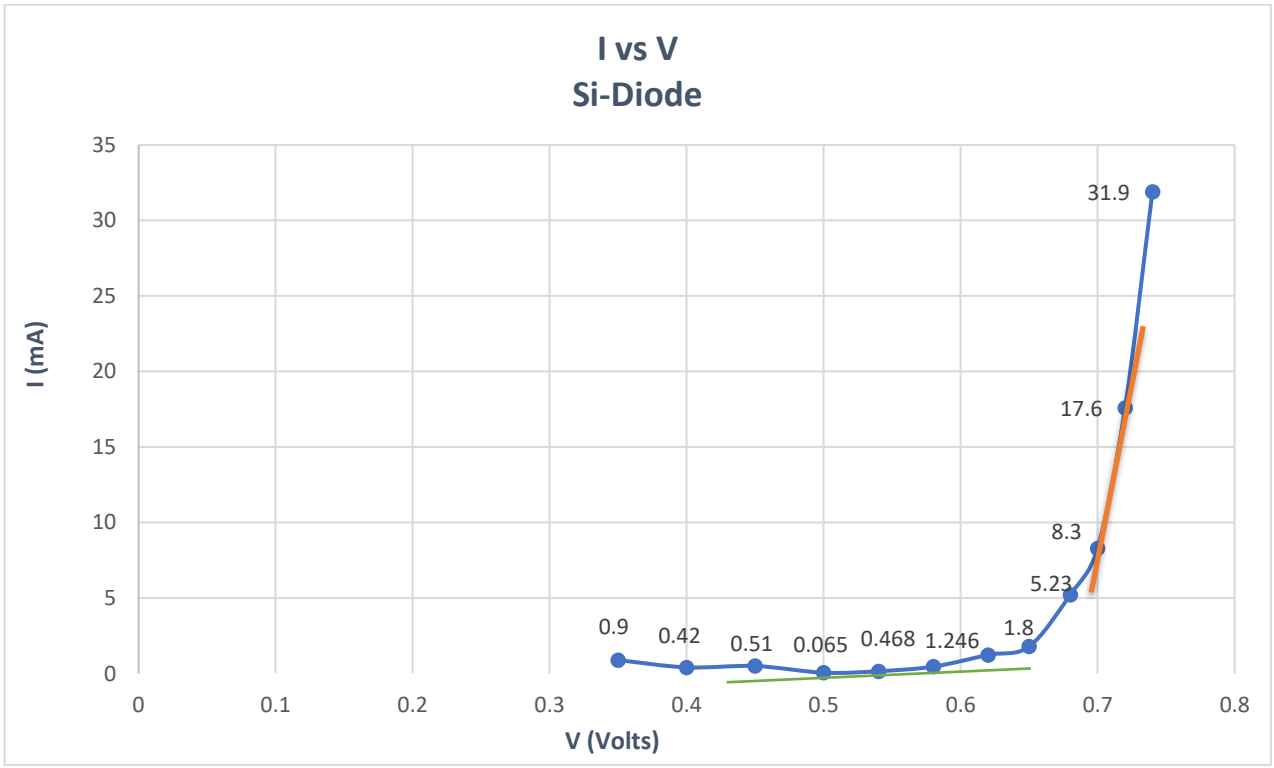

**According to the diagram above, which shows the relationship between I and V according to Ohm's law Prove that the carbon resistor is a linear element.**

**The slope at (0.1, 0.1502) and (3.5, 5.18):**

$$\frac{1}{R} = \frac{\Delta I}{\Delta V} = \frac{(5.18 - 0.1502) \times 10^{-3}}{(3.5 - 0.1)} = 1.479 \times 10^{-3} \Omega^{-1}$$

$$R = \frac{1}{1.479 \times 10^{-3}} = 675.971\ \Omega$$

B - Si Diode:




**According to the diagram above, which shows the relationship between I and V, it is proved that Si Diode does not obey Ohm's law and it is a nonlinear element.**

**The slope at (0.7, 8.3) and (0.72, 17.6):**

$$\frac{1}{R1} = \frac{\Delta I}{\Delta V} = \frac{(17.6 - 8.3) \times 10^{-3}}{(0.72 - 0.7)} = 0.465\ \Omega^{-1}$$

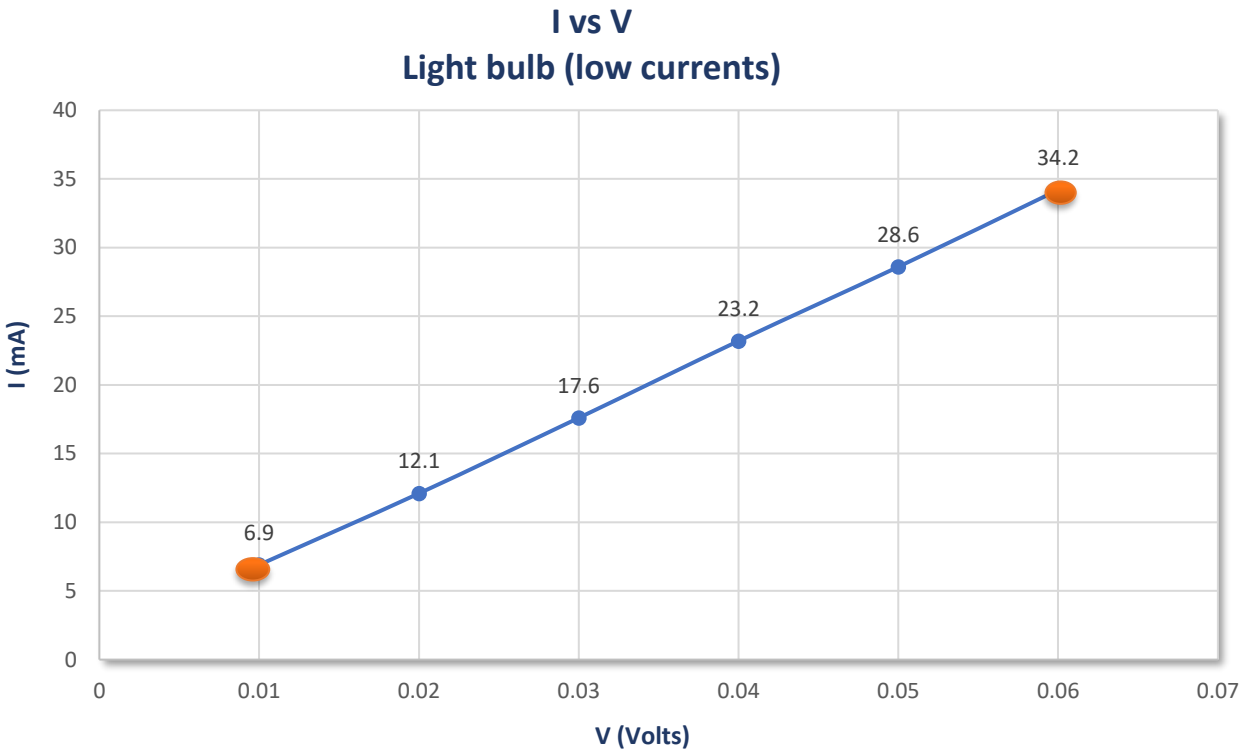
$$R1 = \frac{1}{0.465} = 2.1505\ \Omega$$

**The slope at (0.5, 0.065) and (0.58, 0.468):**

$$\frac{1}{R2} = \frac{\Delta I}{\Delta V} = \frac{(0.468 - 0.065) \times 10^{-3}}{(0.58 - 0.5)} = 5.0375 \times 10^{-3}\Omega^{-1}$$

$$R2 = \frac{1}{5.0375 \times 10^{-3}} = 198.511\ \Omega$$

C – Light bulb (low currents):



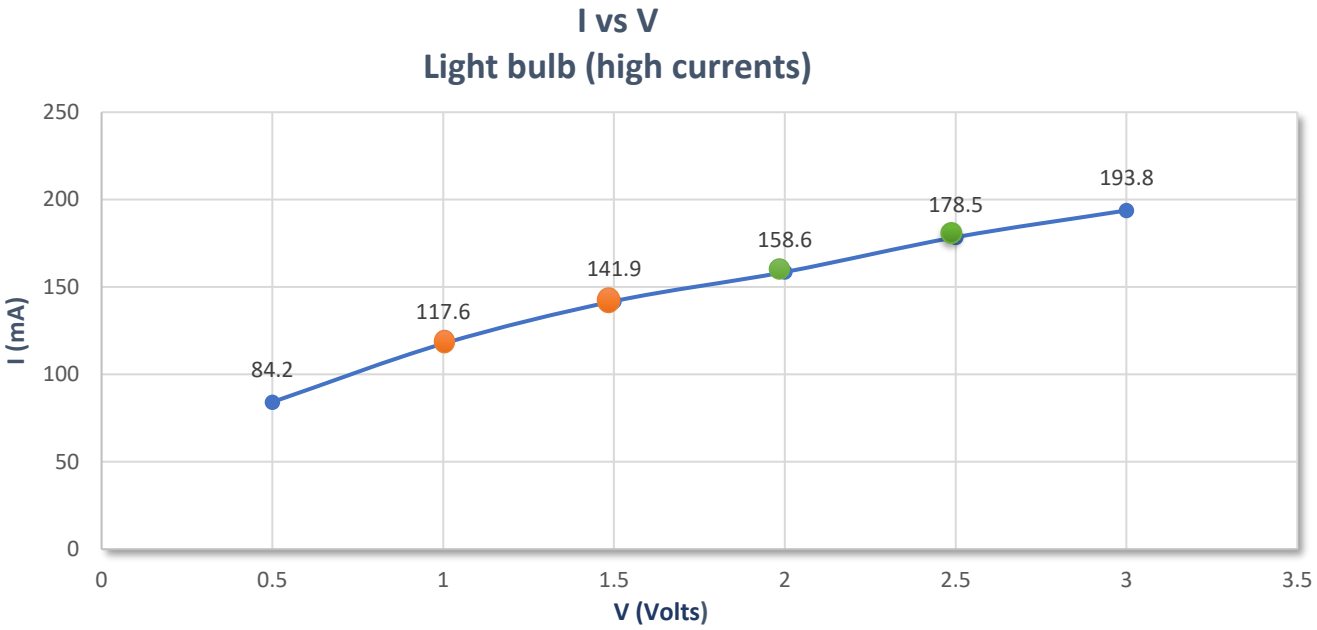

**According to the diagram above, which shows the relationship between I and V according to Ohm's law Prove that the light bulb (with low currents) is a linear element.**

**The slope at (0.01, 6.9) and (0.06, 34.2):**

$$\frac{1}{R} = \frac{\Delta I}{\Delta V} = \frac{(34.2 - 6.9) \times 10^{-3}}{(0.06 - 0.01)} = 0.546\ \Omega^{-1}$$

$$R1 = \frac{1}{0.546} = 1.8315\ \Omega$$

D – Light bulb (high currents):




**According to the diagram above, which shows the relationship between I and V the light bulb (with high currents) does not obey Ohms and it is a nonlinear element.**

**The slope at (1.0 , 117.6) and (1.5 , 141.9):**

$$\frac{1}{R1} = \frac{\Delta I}{\Delta V} = \frac{(141.9 - 117.6) \times 10^{-3}}{(1.5 - 1.0)} = 0.0486\ \Omega^{-1}$$

$$R1 = \frac{1}{0.0486} = 20.5761\ \Omega$$

**The slope at (2.0 , 158.6) and (2.5 , 178.5):**

$$\frac{1}{R2} = \frac{\Delta I}{\Delta V} = \frac{(178.5 - 158.6) \times 10^{-3}}{(2.5 - 2.0)} = 0.0398\ \Omega^{-1}$$

$$R2 = \frac{1}{0.0398} = 25.1256\ \Omega$$

## (4) Conclusions:

**Components that exhibit IV characteristics in a straight line are referred to as linear. Components that do not have IV characteristics along a straight line are referred to as nonlinear components.**

**A light bulb with low currents is a linear component because the I-V characteristic of the relationship between current and voltage is linear, but a light bulb with high currents is a non-linear component because the I-V characteristic of the relationship between current and voltage is nonlinear.**

**According to the experiment results, the resistance of carbon is a linear component because the relationship between current and voltage is linear.**

**The diode is nonlinear because the I-V characteristic of the relationship between current and voltage is nonlinear Ohm's law is known as the product of the current passing through a resistance at a constant temperature.**