Exp.1 : Linear and Non-linear Elements

Graph 1 : Carbon resistor

|  |  |
| --- | --- |
| V (volt) | I (mA) |
| 0.2 | 0.76 |
|  0.4 | 1.54 |
| 0.6 | 2.28 |
| 0.8 | 3.04 |
|  1.0 | 3.79 |
| 1.2 | 4.54 |
| 1.5 | 5.69 |
| 1.6 | 6.06 |
| 1.7 | 6.44 |
| 1.8 | 6.79 |
|  1.9 | 7.18 |
| 2.0 | 7.56 |

 **Using the LINEST function excel to find the slop :**

 Slop = $\frac{1}{R}=3.7712 \frac{mA}{v}=3.7712×10^{-3}Ω^{-1}$

 R = $\frac{1}{slop}=\frac{1}{3.7712×10^{-3}}=265.16 Ω $

 **Or using points (0.6, 2.28), (1.6, 6.06):**

 Slop = $\frac{∆I}{∆v}$ = $\frac{(6.06-2.28 )×10^{-3}}{1.6-0.6}=3.78×10^{-3}Ω^{-1} $ $ R=\frac{1}{slop}=\frac{1}{3.78×10^{-3}}=264.55 Ω$

$∆v$

$∆I$

**V(volt)**

**I (mA)**

Graph 2 : Silicon diode

|  |  |
| --- | --- |
| V(volts) | I(mA) |
| 0.40 | 0.01 |
| 0.45 | 0.05 |
| 0.50 | 0.17 |
| 0.53 | 0.35 |
| 0.55 | 0.53 |
| 0.57 | 0.81 |
| 0.60 | 1.34 |
| 0.62 | 2.31 |
| 0.64 | 3.77 |
| 0.66 | 5.26 |
| 0.68 | 8.64 |
| 0.70 | 12.81 |

We notice that the points (0.57, 0.81), (0.66, 5.26) have different tangent lines (in orange), and the slop of second tangent line is bigger than the first one, by the equation R = $\frac{1}{slop}$ , this means that the resistance at the first point is bigger than the second point.

So, we have different values of R at different points.

**I (mA)**

**V (volt)**

Graph 3 : Light bulb with Low currents

|  |  |
| --- | --- |
| V(volts) | I(mA) |
| 0.01 | 6.01 |
| 0.02 | 11.65 |
| 0.03 | 16.46 |
| 0.04 | 21.40 |
| 0.05 | 26.0 |
| 0.06 | 30.2 |

 We notice that the relation here is linear, we see a straight line between the points.

So, Light bulb is linear component when the current and voltage are low.

**I (mA)**

**V (volt)**

Graph 4 : Light bulb with High currents

|  |  |
| --- | --- |
| V(volts) | I(mA) |
| 0.5 | 81.8 |
| 1.0 | 111.2 |
| 1.5 | 137.2 |
| 2.0 | 160.8 |
| 2.5 | 178.6 |
| 3.0 | 204.0 |

We notice that the points (1, 111.2), (2.5, 178.6) have different tangent lines (in orange), this implies different values of resistance at the two points.

So, Light bulb becomes a non-linear component with high currents and voltage.

**I (mA)**

**V (volt)**