EE230: Homework-2
Plotting and Data Analysis Exercise

Prateek Garg, 20D070060

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1 Overview of the experiment

1.1 Aim of the experiment

To plot current versus voltage in a semilog graph from given current voltage characteristics and obtain ideality factor "n" by visual inspection of semi-log graph.

1.2 Methods

"n" is defined in the following equation

$$I = I_o(e^{\frac{qV}{nk_BT}} - 1)$$

k_B = Boltzmann constant, T = temperature, q = elementary charge.
I = current, I_o = reverse saturation current, V = applied voltage Taking logarithm on I, we get

$$ln(I) = ln(I_o(e^{\frac{qV}{nk_BT}} - 1)),$$

$$ln(I) = ln(I_o) + ln(e^{\frac{qV}{nk_BT}} - 1),$$

$$ln(I) = ln(I_o) + \frac{qV}{nk_BT} + ln(1 - e^{\frac{-qV}{nk_BT}}),$$

As V becomes large, $e^{\frac{-qV}{nk_BT}} \to 0$ so $ln(1 - e^{\frac{-qV}{nk_BT}}) \approx ln(1) = 0$
So when V is large enough

$$ln(I) = ln(I_o) + \frac{qV}{nk_BT}$$

2 Design

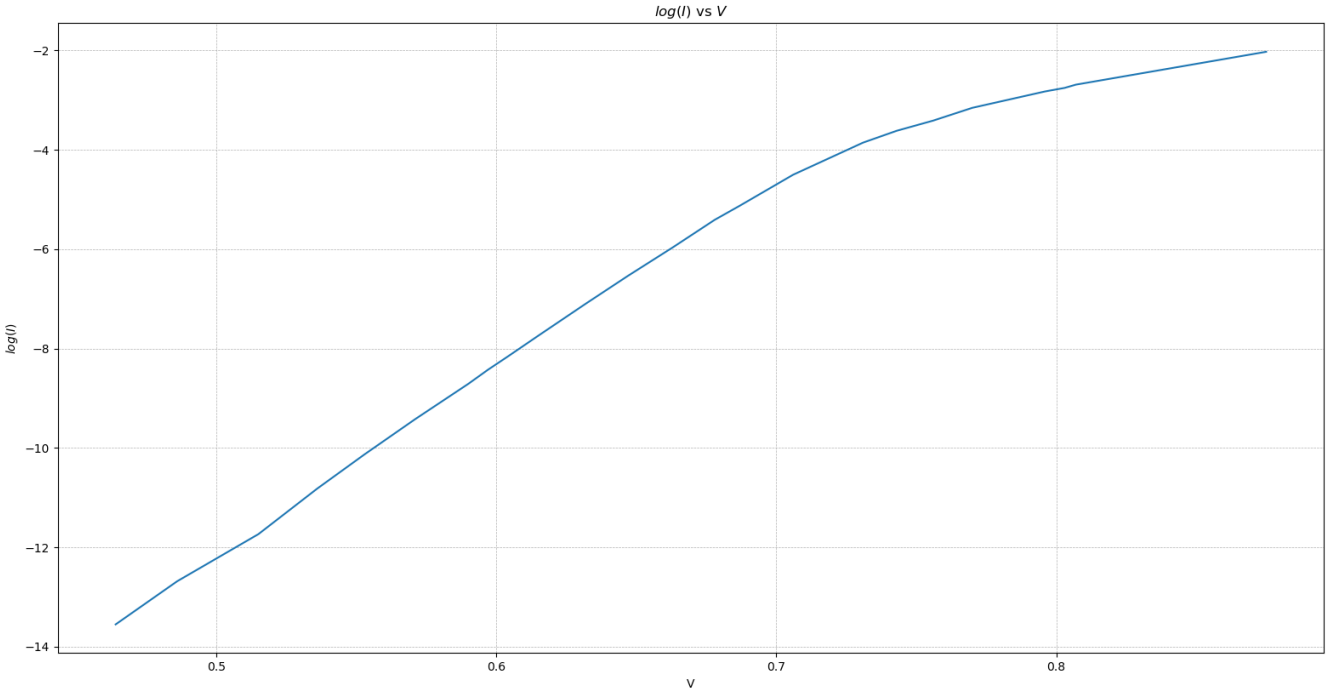
Taking two points V_1 and V_2 we can estimate n.

$$ln(I_1) - ln(I_2) = \frac{q(V_1 - V_2)}{nk_BT}$$

$$n = \left(\frac{q}{k_BT}\right) \cdot \left(\frac{V_1 - V_2}{ln(I_1) - ln(I_2)}\right)$$

k_B = Boltzmann constant, T = temperature, q = elementary charge.

3 Simulation results



4 Experimental results

Taking last 2 values from the dataset,
$(V_1, I_1) = (0.807, 0.0681)$ and $(V_2, I_2) = (0.875, 0.132)$
$T = 300K$, $q = 1.6 \times 10^{-19}C$ $k_B = 1.38 \times 10^{-23}$
and using them in the derived expression we get,

$$n = 3.95$$

5 Experiment completion status

All the sections were completed.