

Exercise 8.1-6

Constructing Quantitative Logarithmic IV Characteristics

Question 1. Construct rather quantitatively the logarithmic IV characteristics (= $\log j - eU$ plot) of two solar cells with the j_1 and j_2 values as given in the table. Here are a few hints:

- Draw first the straight lines for the two exponential terms resulting from the master equation (i.e. omit the "-1" term) into a $\log j - eU$ plot. Note that for room temperature $kT = 0.025 \text{ eV}$ or $\exp(eU/kT) = \exp(40 \cdot eU)$. Use the given numbers for the various $j_i = j(U = 0V)$ and calculate, for example, $j_i(U = 0.5 \text{ V})$ to get a second point.
- Correct by "hand" for the "-1" term (justify your reasoning) and add "by hand" the two resulting curves to the *full characteristic*.
- Repeat the procedure for a temperature of **400 K**. Note, however, that all j_i contain the intrinsic carrier density n_i and that changing the temperature changes n_i accordingly.

	Calculated	Measured
j_1	$1.6 \cdot 10^{-14} \text{ A/cm}^2$	10^{-9} A/cm^2
j_2	$1.6 \cdot 10^{-10} \text{ A/cm}^2$	10^{-7} A/cm^2

Question 2: Determine the open circuit voltage U_{OC} for room temperature and for **400 K** and discuss your finding.

- Note: U_{OC} is the voltage where the (positive) forward current in the dark is exactly equal to the magnitude of the photo current I_{PH}



Solution