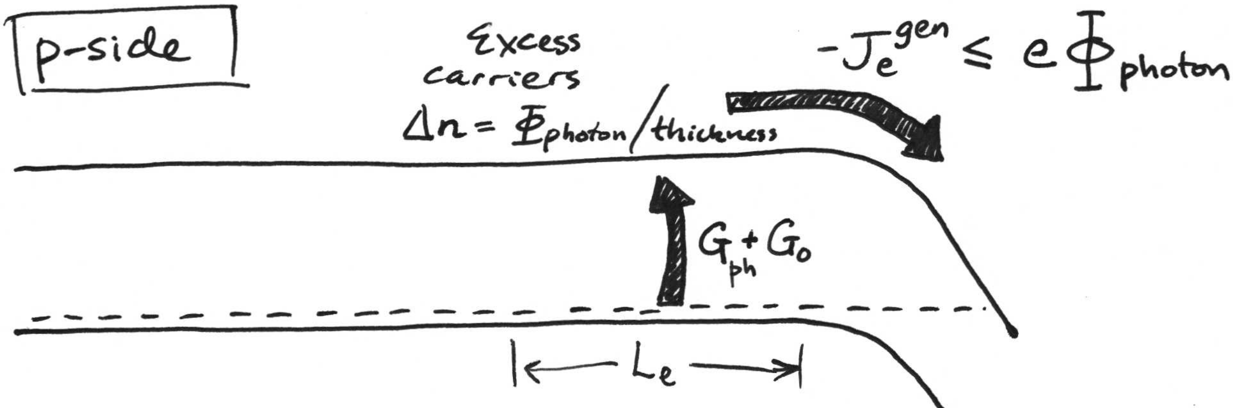
Now, illuminate the pn junction with radiation:

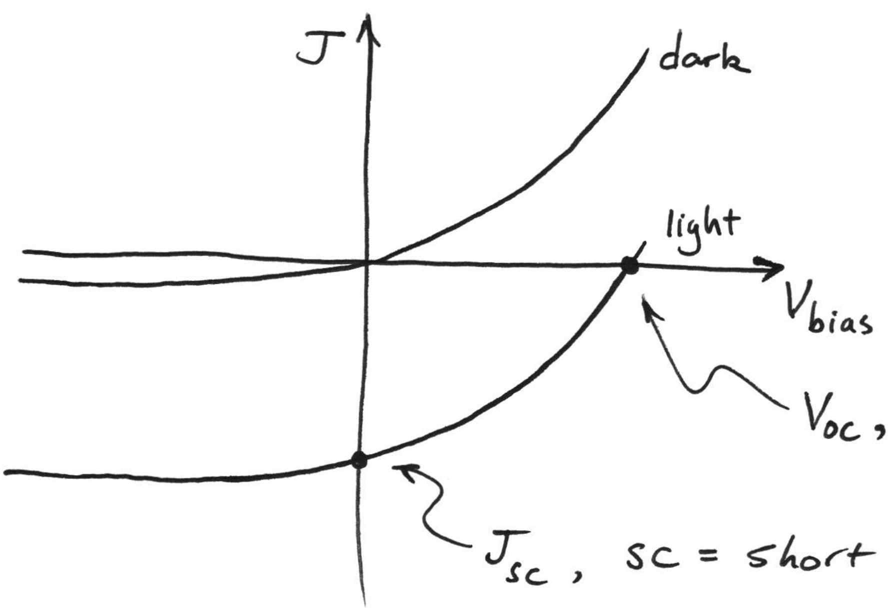


If all photons create an excess e/h pair,

& If all excess carriers are created in the p-type region within distance L_e of the junction then

$$J_e^{gen} = e\Phi_{photon} \qquad \text{IDEAL CASE}$$

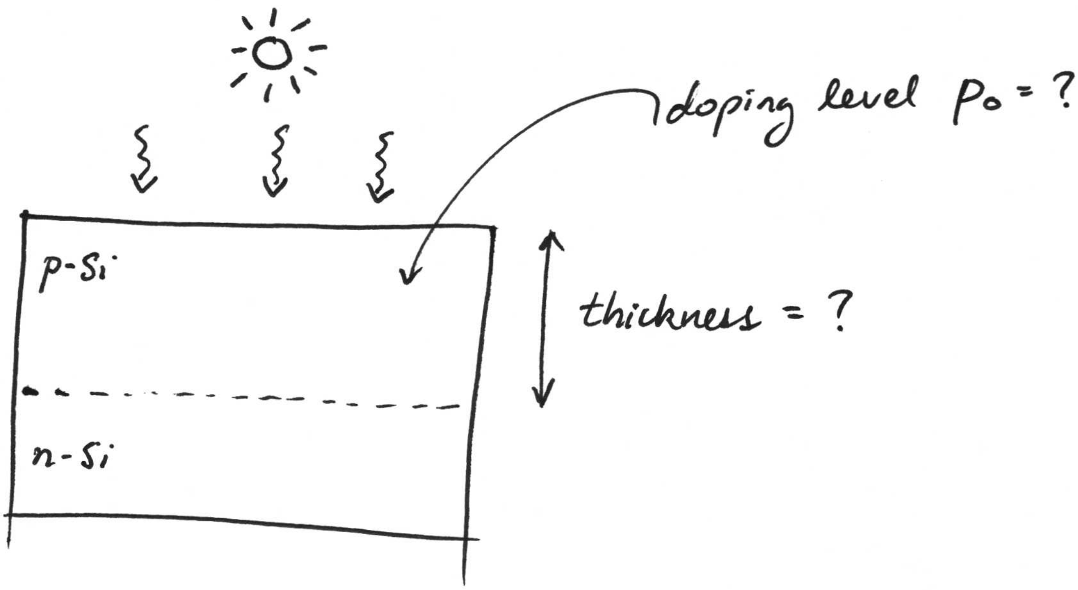
$$J = J_0\left(\exp\left(\frac{eV_{bias}}{kT}\right) - 1\right) - e\Phi_{photon}$$



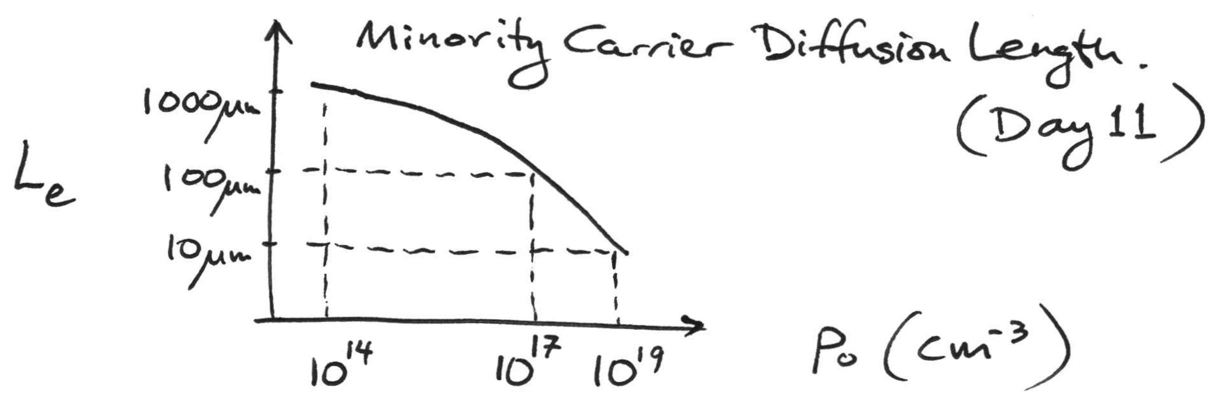
V_{oc}, oc = open circuit, no current

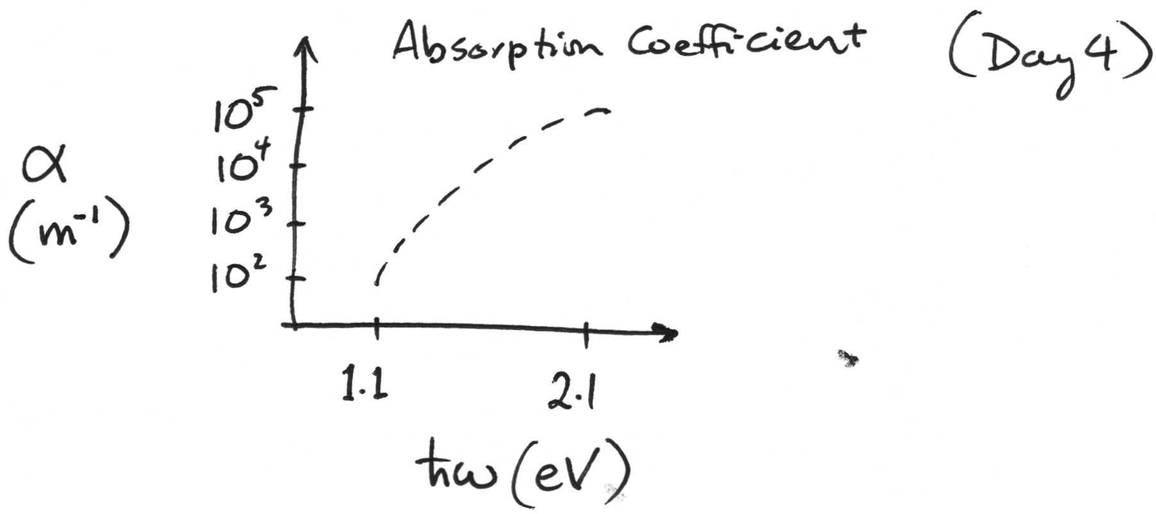
J_{sc}, sc = short circuit, no applied voltage.

Exercise

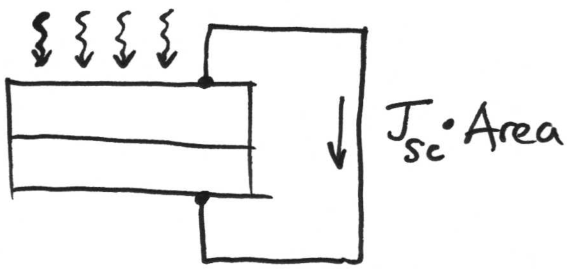


Design a solar cell where the p-side is thick enough to absorb most photons and J_{sc} is as large as possible.



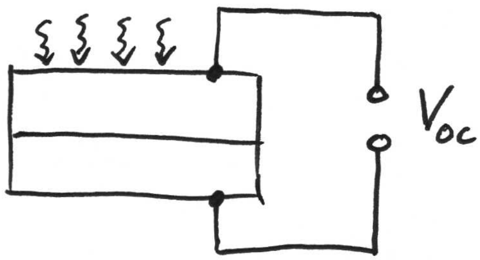


If we measure J_{sc}



And we know ~~that~~ J_o for the diode (say $10^{-12}\ A/cm^2$)

We can then predict ~~calculate~~ the expected V_{oc}



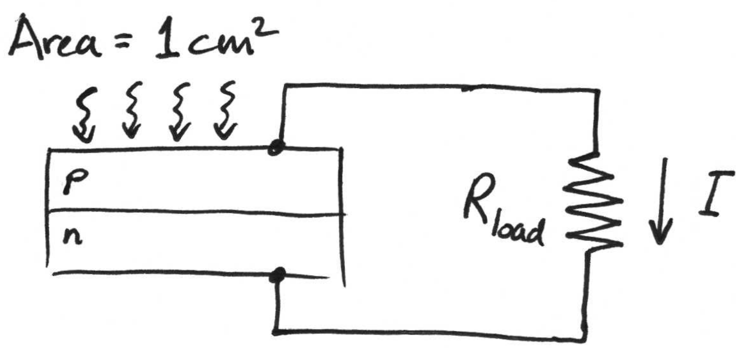
<u>Exercise</u> Assume a flux of $0.1\ W/cm^2$ with $\hbar\omega > E_g$.

Assume $EQE = 100\%$.

Assume $J_o = 10^{-12}\ A/cm^2$ & ideal diode eqn.

Predict V_{oc}.

For the solar cell in the previous example/exercise, how much electrical work can it do?

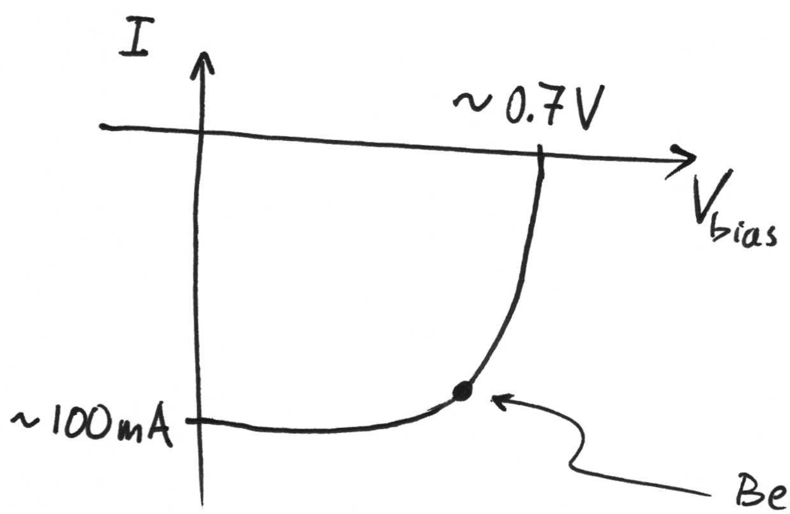


Voltage drop across R_{load} determines the forward bias on the pn junction.

Choose R_{load} to maximize

$$\text{Power} = I \cdot V = I \cdot (I R_{load})$$

voltage drop across R_{load} $= -V_{bias}$.



Best operating point (would be acheived with $R_{load} \sim 7\Omega$)