

- 1 – Research: Identify one additional common Si donor atom (not P) and one additional common Si acceptor atom (not B) 20pts

III, p-type

Aluminum

Al

Acceptor

V, n-type

Arsenic

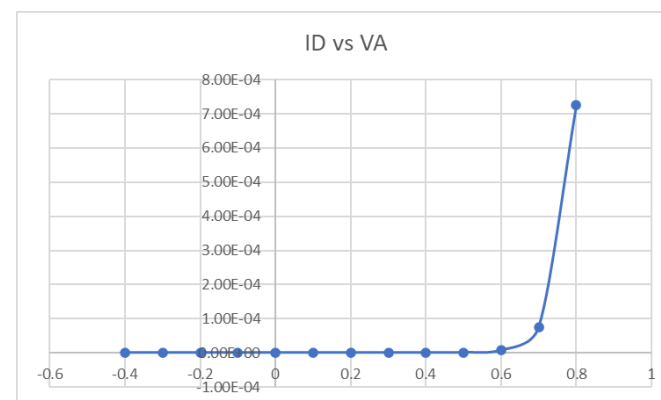
As

Donor

Al
As

- 2 – Plot the current in a P-N Diode vs V_A from -0.4V to 0.8V in 0.2V increments. Assume $I_S = 1e-11A$, $n = 1.7$, and $V_T = 26mV$ 30 pts

$$I = I_S \left[e^{\left(\frac{V_A}{nV_T}\right)} - 1 \right] = 1 \times 10^{-11} A \left[e^{\left(\frac{V_A}{1.7 \times 0.026V}\right)} - 1 \right]$$



- 3 – A device that operates at 2.4V has approximately 250M reversed biased diodes (junction diodes). If the average junction diode has: $I_s = 2e-11A$, $n = 1.5$, and $V_T = 26mV$, what is the current and power used by this device when it is powered up and idle. 30pts

$$I = 250 \times 10^6 \times I_s \left[e^{\left(\frac{V_A}{nV_T}\right)} - 1 \right]$$

$$I = 250 \times 10^6 \times 2 \times 10^{-11} A \left[e^{\left(\frac{V_A}{1.5 \times 0.026V}\right)} - 1 \right]$$

$$I = 250 \times 10^6 \times 2 \times 10^{-11} A \left[e^{\left(\frac{-2.4}{1.5 \times 0.026V}\right)} - 1 \right]$$

$$I = 5 \times 10^{-3} = 5mA$$

$$P = 5mA \times 2.4V = 12mW$$

I =
P =

- 4 - What would the idle battery life of this device be if it used a 2.4V coin battery with a 1AH capacity. 20 pts

$$t = \frac{1AH}{5mA} = 200H = 8.33Days$$