

- 1) [13 points] A certain semiconductor has an energy gap of 0.9 eV and a quantum density of $1 \times 10^{25} \text{ m}^{-3}$ at a temperature of 300 K. The law of mass action is $n_e n_h = n_Q^2 e^{-\epsilon_g/kT}$.

a) [6 points] What is the density of free electrons in a pure (undoped) crystal at $T = 300 \text{ K}$?

$$n_i =$$

- b) [7 points] If the crystal were doped with impurities that set the electron density at $1 \times 10^{24} \text{ m}^{-3}$, what would be the hole density?

$$n_h =$$

- 2) [7 points] Compute the entropy of 120 *identical* atoms located on 10^4 surface sites of a solid (assuming single occupancy.)

$$S =$$