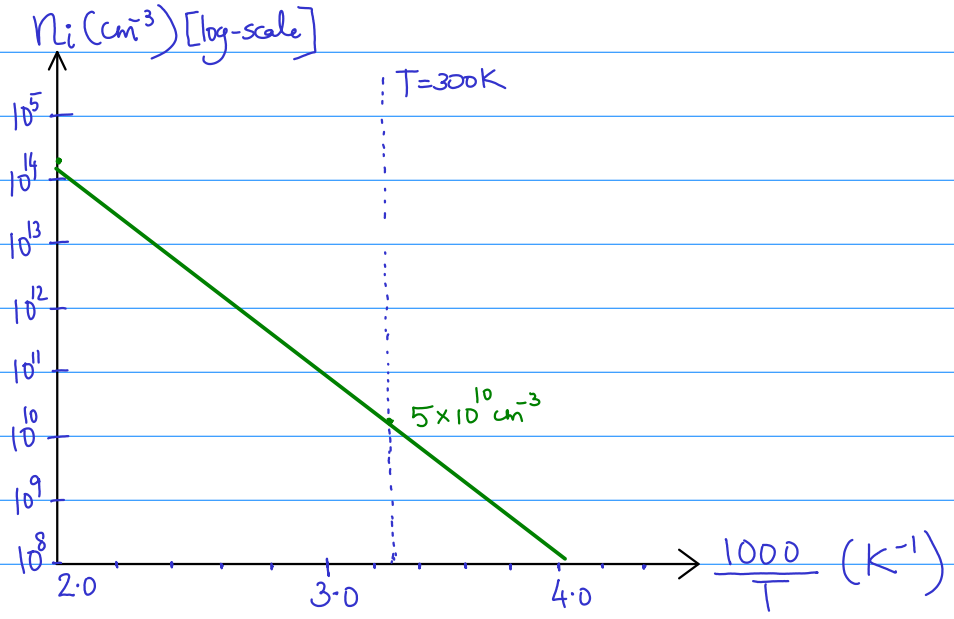
Tutorial #03

(Week: 10-14 Jan. 2022)

Q1. A silicon sample is doped with 10^{17} As atoms cm^{-3}. What is the equilibrium hole density at 300 K? Where is E_F relative to E_c? [Assume: $n_i = 1.5 \times 10^{10}\ cm^{-3}$ and $N_c = 1 \times 10^{19}\ cm^{-3}$]

Q2. A silicon bar 0.1 cm long and 100 μm^2 in cross-sectional area is doped with $10^{17}\ cm^{-3}$ phosphorus atoms. Calculate the electron density at 300K. Find the current at 300K with 10V applied. [Assume: Drift velocity of electrons at 300K = $100\ cm^2 V^{-1} s^{-1}$.

Q3. The following figure shows variation of intrinsic charge-carrier density n_i with the temperature. Use the data to estimate the band-gap of the semiconductor.



Q4. Justify why holes are found at the top of the valance band, whereas electrons are found at the bottom of the conduction band.

Q5. A silicon sample is doped with $6 \times 10^{15}\ cm^{-3}$ donor atoms from one end and with $2 \times 10^{15}\ cm^{-3}$ acceptor atoms from other end. Find the position of Fermi energy level w.r.t. corresponding band edge (E_c or E_v) at 300K.

[Assume: $N_c = N_v = 1 \times 10^{19}\ cm^{-3}$ at 300K]