There is an n-type of silicon which contains a concentration of donors: 10^{15} cm^{-3}.
The n-type of silicon and aluminum were brought together and alloyed at 600 ^{O}C. At the alloying temperature, a p/n junction was formed with an acceptor concentration which equals a solid solubility at the alloying temperature of 600 ^{O}C.

1) Calculate the Fermi level positions (E_{ip}-E_{FP}) at 328K in the p region. (1 point)
$E_{ip:}$ Intrinsic fermi level on the p-side, $E_{FP:}$ Fermi level on the p-side of a p/n junction.

2) Calculate the Fermi level positions (E_{Fn}-E_{in}) at 328K in the n region. (1 point)
$E_{Fn:}$ Fermi level on the n-side of a p/n junction, $E_{in:}$ Intrinsic fermi level on the n-side

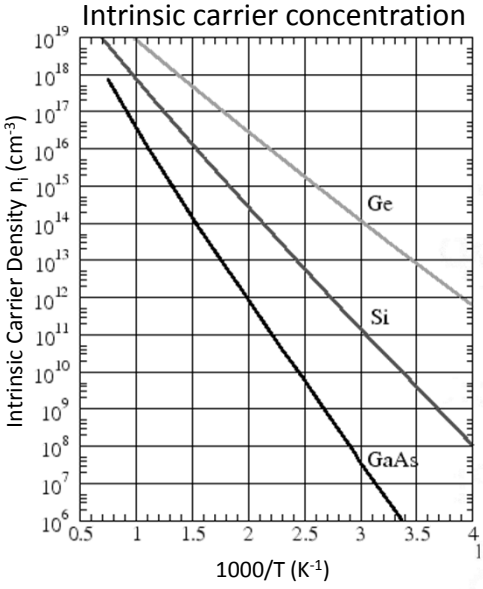
3) Calculate the contact potential V_{bi} (voltage drop across the depletion region under equilibrium conditions). (0.5 points)

4) Draw an equilibrium band diagram for the junction and put the numbers of E_{ip}-E_{FP}, E_{Fn}-E_{in}, and qV_{bi} in the diagram. (0.5 points)

5) Calculate the depletion region (W) under equilibrium conditions. Assume a Si step junction operated at 328K. (1 point)

Physical constants
Boltzmann constant 8.62 x 10^{-5} eV/K
Permittivity of free space = 8.85 x 10^{-14} farad/cm
Si dielectric constant = 11.8
Electronic charge = 1.60 x 10^{-19} coul

Intrinsic carrier concentration



Solid solubilities of impurities in Si