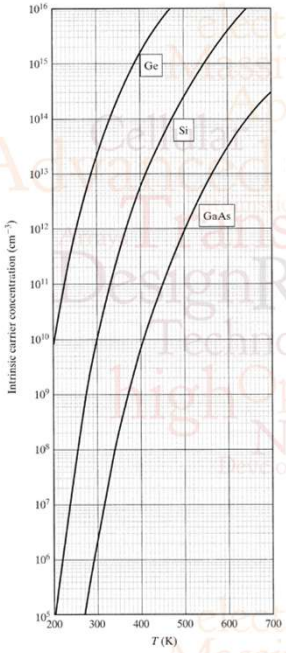
Practice Example



A Silicon sample is doped with 10^{14} boron atoms per cm^3.
(a) Calculate the carrier concentrations in the Si sample at 300 K.
(b) What are the carrier concentrations at 470 K?

$N_A = 10^{14}/cm^3 \}\ N_D \ll N_A$
$n_i = 10^{10}/cm^3 \}\ n_i \ll N_A$
$p = N_A = 10^{14}/cm^3$
$n = n_i^2/N_A = 10^6/cm^3$

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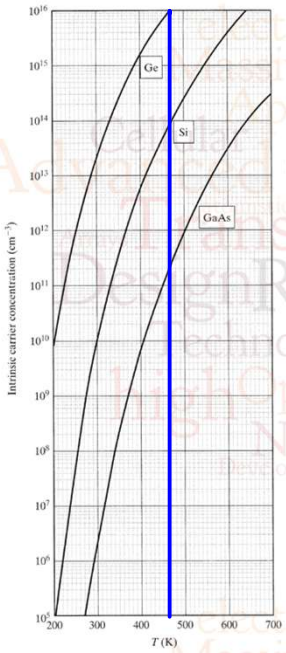
Practice Example



A Silicon sample is doped with 10^{14} boron atoms per cm^3.
(a) Calculate the carrier concentrations in the Si sample at 300 K.
(b) What are the carrier concentrations at 470 K?

$n_i(470K) = 10^{14}/cm^3 \simeq N_A$
$p = \frac{N_A}{2} + \left\{\left(\frac{N_A}{2}\right)^2 + n_i^2\right\}^{1/2}$
$= 1.62 \times 10^{14}/cm^3$
$\therefore n = n_i^2/p = 6.18 \times 10^{13}/cm^3$

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Practice Example

A Silicon sample is doped with 10^{14} boron atoms per cm^3.
(a) Calculate the carrier concentrations in the Si sample at 300 K.
(b) What are the carrier concentrations at 470 K?

Draw the energy band diagrams of the sample for the above cases.

Given, $E_g = 1.08\ eV$ and $\frac{m_h^*}{m_e^*} = 0.69$ @ $300K$ & 0.71 @ $470K$.

$p = N_A = 10^{14}/cm^3$

$E_{fi} = \frac{E_c + E_v}{2} + \frac{3}{4}kT\ln\left(\frac{m_h^*}{m_e^*}\right)$

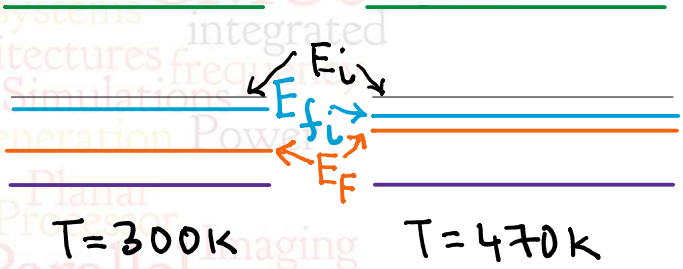
$E_{f_i} = \frac{E_g}{2} - 0.0073\ eV$

$E_{f_i} - E_F = kT\ln\left(\frac{N_A}{n_i}\right) = 0.239\ eV$

$p = 1.62 \times 10^{14}/cm^3$

$E_{f_i} = \frac{E_g}{2} - 0.0104\ eV$

$E_F - E_{f_i} = -kT\ln\left(\frac{p}{n_i}\right) = 0.0195eV$



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