1. $n_i^2 = N_c N_v \exp\left[\frac{-E_g}{kT}\right] \Rightarrow n_i = \sqrt{2.8\times10^{19}\times4.7\times10^{17}\times\left(\frac{550}{300}\right)^3\exp\left(\frac{-1.12\times1.6\times10^{-19}}{1.38\times10^{-23}\times550}\right)}$

$= 3.16\times10^{14}\ cm^{-3}$

According to the question, we have $N_d = (1-0.05)\cdot n_0$ since the total electron concentration has both the electron concentration that comes from the donor and the electron concentration that the semiconductor itself produces which is just the intrinsic excitation.

$n_0 = n_{0i} + N_d$ here $n_{0i} \neq n_i$ and $n_{0i} = 0.05\, n_0$

Also we have $n_0 = \frac{N_d - N_a}{2} + \sqrt{\left(\frac{N_d - N_a}{2}\right)^2 + n_i^2}$ $N_a = 0$

So then $\begin{cases} n_0 = \frac{1}{0.95} N_d \\ n_0 = \frac{N_d}{2} + \sqrt{\left(\frac{N_d}{2}\right)^2 + n_i^2} \end{cases} \Rightarrow N_d = 1.4\times10^{15}\ cm^{-3}$

2. ① Decrease Temperature

② Decrease Ionized Impurity