42. (a) Measured from the top of the valence band, the energy of the donor state is $E = 1.11\,\text{eV} - 0.11\,\text{eV} = 1.0\,\text{eV}$. We solve E_F from Eq. 42-6:

$$\begin{aligned} E_\text{F} &= E - kT\ln\left[P^{-1} - 1\right]) \\ &= 1.0\,\text{eV} - (8.62\times10^{-5}\,\text{eV/K})(300\,\text{K})\ln\left[(5.00\times10^{-5})^{-1} - 1\right] \\ &= 0.744\ \text{eV}\ . \end{aligned}$$

(b) Now $E = 1.11\,\text{eV}$, so

$$\begin{aligned} P(E) &= \frac{1}{e^{(E-E_\text{F})/kT} + 1} = \frac{1}{e^{(1.11\,\text{eV} - 0.744\,\text{eV})/[(8.62\times10^{-5}\,\text{eV/K})(300\,\text{K})]} + 1} \\ &= 7.13\times10^{-7}\ . \end{aligned}$$