5.45 Consider a semiconductor at $T = 300$ K. (*a*) (*i*) Determine the electron diffusion coefficient if the electron mobility is $\mu_n = 1150$ cm^2/V-s. (*ii*) Repeat (*i*) of part (*a*) if the electron mobility is $\mu_n = 6200$ cm^2/V-s. (*b*) (*i*) Determine the hole mobility if the hole diffusion coefficient is $D_p = 8$ cm^2/s. (*ii*) Repeat (*i*) of part (*b*) if the hole diffusion coefficient is $D_p = 35$ cm^2/s.

Per Einstein relation (5.47), $\frac{D_n}{\mu_n} = \frac{D_p}{\mu_p} = \frac{k_B T}{e}$.

a)

(*i*) $D_n = \frac{k_B T \mu_n}{e} = \frac{1.380649\times10^{-23}(300)1150}{1.602176634\times10^{-19}} \Rightarrow$ **$D_n = 29.73$ cm^2/s.**

(*ii*) $D_n = \frac{k_B T \mu_n}{e} = \frac{1.380649\times10^{-23}(300)6200}{1.602176634\times10^{-19}} \Rightarrow$ **$D_n = 160.28$ cm^2/s.**

b)

(*i*) $\mu_p = \frac{D_p e}{k_B T} = \frac{(8)1.602176634\times10^{-19}}{1.380649\times10^{-23}(300)} \Rightarrow$ **$\mu_p = 309.45$ cm^2/V-s.**

(*ii*) $\mu_p = \frac{D_p e}{k_B T} = \frac{(35)1.602176634\times10^{-19}}{1.380649\times10^{-23}(300)} \Rightarrow$ **$\mu_p = 1353.86$ cm^2/V-s.**