6.6 Consider a one-dimensional hole flux as shown in Figure 6.4. If the generation rate of holes in this differential volume is $g_p = 10^{20}$ cm^{-3}-s^{-1} and the recombination rate is 4×10^{19} cm^{-3}-s^{-1}, what must be the gradient in the particle current density to maintain a steady-state hole concentration?

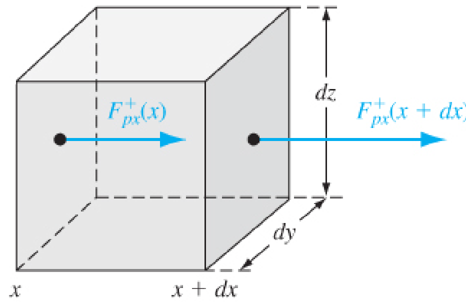

Figure 6.4 | Differential volume showing x component of the hole-particle flux.

Per (6.18), $\dfrac{\partial \rho}{\partial t} = \dfrac{-\partial F_p^+}{\partial x} + g_p - \dfrac{p}{\tau_{pt}}$.

'steady-state' implies $\dfrac{\partial \rho}{\partial t} = 0$. Using (6.35) $R_p = \dfrac{p}{\tau_{pt}}$, this leaves

$$\frac{\partial F_p^+}{\partial x} = g_p - \frac{p}{\tau_{p0}} = g_p - R_p = 10^{20} - 4 \times 10^{19} \quad \Rightarrow \quad \underline{\frac{\partial F_p^+}{\partial x} = 6 \times 10^{19} \ \#/\text{cm}^3\text{-s}}.$$