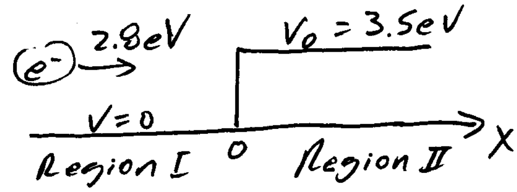
2.34 Consider an electron with a kinetic energy of 2.8 eV incident on a step potential function of height 3.5 eV. Determine the relative probability of finding the electron at a distance (*a*) 5 Å beyond the barrier, (*b*) 15 Å beyond the barrier, and (*c*) 40 Å beyond the barrier compared with the probability of finding the incident particle at the barrier edge.



Per (2.45), $K_2 = \sqrt{\dfrac{2m_o(V_o - E)}{\hbar^2}}$

$$= \sqrt{\frac{2(9.1093837\times10^{-31})(3.5-2.8)1.60218\times10^{-19}}{(1.054572\times10^{-34})^2}}$$

$$= 4.286353\times10^{9}\ \text{Np/m}$$

Per (2.46), $\psi_2(x) = A_2 e^{-K_2 x}$

Per (2.17), $|\Psi(x,t)|^2 = \psi(x)\psi^*(x)$

Relative prob $\equiv P(x) = \dfrac{|\psi(x)|^2}{|\psi(0)|^2} = \dfrac{A_2 e^{-K_2 x} A_2^* e^{-K_2 x}}{A_2 e^0 A_2^* e^0}$

$$\underline{P(x) = e^{-2K_2 x}}$$

a) $P(x = 5\,\text{Å}) = e^{-2(4.286\times10^{9})(5\times10^{-10})}$

$\underline{\underline{P(x = 5\,\text{Å}) = 0.013755 \text{ or } 1.3755\,\%}}$

b) $P(x = 15\,\text{Å}) = e^{-2(4.286\times10^{9})(15\times10^{-10})}$

$\underline{\underline{P(x = 15\,\text{Å}) = 2.602\times10^{-6} \text{ or } 2.602\times10^{-4}\,\%}}$

c) $P(x = 40\,\text{Å}) = e^{-2(4.286\times10^{9})(40\times10^{-10})}$

$\underline{\underline{P(x = 40\,\text{Å}) = 1.2814\times10^{-15} \text{ or } 1.2814\times10^{-13}\,\%}}$