

Chapter 35 Problem 17 †

Given

$$L = 10.0 \text{ nm} = 10.0 \times 10^{-9} \text{ m}$$

Solution

Find the ground-state energy of an electron in an infinite square well.

The energy levels of an infinite square well are given by the formula

$$E_n = \frac{n^2 h^2}{8mL^2}$$

The ground-state corresponds to $n = 1$. Substituting in the appropriate values gives

$$E_1 = \frac{(1)^2 (6.63 \times 10^{-34} \text{ J} \cdot \text{s})^2}{8(9.11 \times 10^{-31} \text{ kg})(10.0 \times 10^{-9} \text{ m})^2} = 6.03 \times 10^{-22} \text{ J}$$

Convert this to electron volts gives

$$E_1 = (6.03 \times 10^{-22} \text{ J}) \left(\frac{1.0 \text{ eV}}{1.6 \times 10^{-19} \text{ J}} \right) = 3.77 \times 10^{-3} \text{ eV} = 3.77 \text{ meV}$$

†Problem from Essential University Physics, Wolfson