Chapter 35 Problem 15 †

Given

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

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

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

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

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

Convert this to electron volts gives

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

†Problem from Essential University Physics, Wolfson