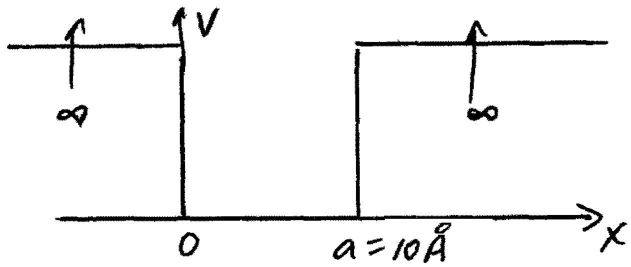
2.26 An electron is bound in a one-dimensional infinite potential well with a width of 10 Å. (*a*) Calculate the first three energy levels that the electron may occupy. (*b*) If the electron drops from the third to the second energy level, what is the wavelength of a photon that might be emitted?



a) Per (2.38), $E_n = \dfrac{\hbar^2 n^2 \pi^2}{2 m a^2}$ $\quad n = 1, 2, 3, \ldots$

$$E_n = \frac{(1.054571817 \times 10^{-34})^2 \pi^2 n^2}{2(9.1093837015 \times 10^{-31})(10 \times 10^{-10})^2} = 6.0246674 \times 10^{-20} n^2$$

$$E_1 = 6.024667 \times 10^{-20}\ \text{J} = 0.3760302\ \text{eV}$$

$$E_2 = 4E_1 = 2.40987 \times 10^{-19}\ \text{J} = 1.50412\ \text{eV}$$

$$E_3 = 9E_1 = 5.422201 \times 10^{-19}\ \text{J} = 3.38427\ \text{eV}$$

b) Use $E = h\nu = \dfrac{hc}{\lambda} \Rightarrow \lambda = \dfrac{hc}{E}$

$$\Delta E = E_3 - E_2 = 5.422201 \times 10^{-19} - 2.40987 \times 10^{-19}$$

$$\lambda_{32} = \frac{6.62607 \times 10^{-34} (2.997925 \times 10^{8})}{(5.422201 - 2.40987) \times 10^{-19}}$$

$$\lambda_{32} = 6.59438 \times 10^{-7}\ \text{m} = 659.438\ \text{nm}$$