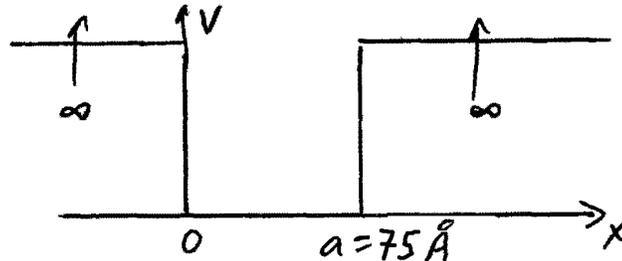


2.25 An electron is bound in a one-dimensional infinite potential well with a width of 75 \AA . Determine the electron energy levels (in eV) for $n = 1, 2, 3$.

➤ Also, if an electron drops from the third to second energy level, find the wavelength of the photon emitted.



Per (2.38), the discrete energy levels are

$$E_n = \frac{\hbar^2 n^2 \pi^2}{2ma^2} = \frac{(1.054571817 \times 10^{-34})^2 \pi^2 n^2}{2(9.1093837015 \times 10^{-31})(75 \times 10^{-10})^2} = 1.071052 \times 10^{-21} n^2.$$

$$\text{For } n = 1, E_1 = 1.071052 \times 10^{-21} (1)^2 \quad \Rightarrow \quad \underline{\underline{E_1 = 1.071105 \times 10^{-21} \text{ J} = 0.006685 \text{ eV}}}$$

$$\text{For } n = 2, E_2 = 1.071052 \times 10^{-21} (2)^2 \quad \Rightarrow \quad \underline{\underline{E_2 = 4.284442 \times 10^{-21} \text{ J} = 0.02674 \text{ eV}}}$$

$$\text{For } n = 3, E_3 = 1.071052 \times 10^{-21} (3)^2 \quad \Rightarrow \quad \underline{\underline{E_3 = 9.63995 \times 10^{-21} \text{ J} = 0.060165 \text{ eV}}}$$

In section 2.1, we are given $E = h\nu = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E}$. The energy drop from the third to second level is

$$\Delta E_{32} = E_3 - E_2 = 1.071052 \times 10^{-21} (3)^2 - 1.071052 \times 10^{-21} (2)^2 = 5.35526 \times 10^{-21} \text{ J}.$$

The corresponding wavelength of the photon emitted is

$$\lambda_{32} = \frac{hc}{\Delta E_{32}} = \frac{6.62607015 \times 10^{-34} (2.99792458 \times 10^8)}{5.35526 \times 10^{-21}} \Rightarrow \underline{\underline{\lambda_{32} = 3.70934 \times 10^{-5} \text{ m} = 37.0934 \text{ \mu m}}}.$$