Solution

An electron is trapped in a “quantum wire” that is L = 4 nm long. Assume that the potential seen by the electron is approximately that of an infinite square well.

1: Calculate the ground (lowest) state energy of the electron.

$$E_n = E_1 n^2 \quad \text{with} \quad E_1 = \frac{h^2}{8mL^2} = \frac{1.505\ eV \cdot nm^2}{4L^2}$$

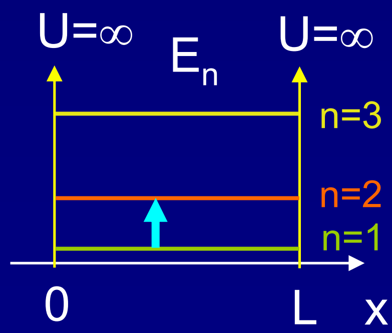
$$E_1 = \frac{1.505\ eV \cdot nm^2}{4(4nm)^2} = \boxed{0.0235\ \text{eV}}$$

Using:

$$E = \frac{h^2}{2m\lambda^2} = \frac{1.505\ eV \cdot nm^2}{\lambda^2}$$

where $\lambda = 2L$.

2: What photon energy is required to excite the trapped electron to the next available energy level (*i.e.*, n = 2)?



$$E_n = n^2 E_1$$

So, the energy difference between the n = 2 and n = 1 levels is:

$\Delta E = (2^2 - 1^2)E_1 = 3E_1 = \boxed{0.071\ \text{eV}}$