38.21. **Model:** The energy of a confined particle in a one-dimensional box is quantized.
Solve: The energy of the nth quantum state of a particle in a box is $E_n = n^2E_1$, where E_1 is the lowest energy level. The energies 12 eV, 27 eV, and 48 eV have the ratios 4:9:16. Thus, they are the $n = 2$, $n = 3$, and $n = 4$ states of an electron that has $E_1 = 3$ eV $= 4.8 \times 10^{-19}$ J. The lowest energy level is

$$E_1 = \frac{h^2}{8mL^2} \Rightarrow L = \sqrt{\frac{h^2}{8mE_1}} = \sqrt{\frac{\left(6.63\times10^{-34}\ \text{J s}\right)^2}{8\left(9.11\times10^{-31}\ \text{kg}\right)\left(4.8\times10^{-19}\ \text{J}\right)}} = 3.54\times10^{-10}\ \text{m} = 0.354\ \text{nm}$$