Answer on Question #67636, Physics / Atomic and Nuclear Physics

An electron is confined to a one-dimensional region in which its ground-state (n = 1) energy is 2.00 eV. (a) What is the length of the region? (b) How much energy is required to promote the electron to its first excited state?

Find: a – ? ΔE – ?

Given:

$n_1=1$

$n_2=2$

$E_1=2.00\ eV=2.00\times1.6\times10^{-19}\ J$

$m=9.10\times10^{-31}\ kg$

$h=6.63\times10^{-34}\ J\times s$

Solution:

Energy of electron:

$$E_n = \frac{h^2}{8a^2m}n^2 \ (1)$$

$$Of\ (1) \Rightarrow a = \sqrt{\frac{h^2n_1^2}{8Em}} \ (2)$$

$$Of\ (2) \Rightarrow a=0.4\times10^{-9}\ m$$

$$Of\ (1) \Rightarrow \Delta E = \frac{h^2}{8a^2m}(n_2^2 - n_1^2) \ (3)$$

$$Of\ (3) \Rightarrow \Delta E=11.32\times10^{-19}\ J$$

$1\ eV – 1.6\times10^{-19}\ J$

$\Delta E – 11.32\times10^{-19}\ J$

$\Delta E=7\ eV$

Answer:

(a) $0.4\times10^{-9}\ m$

(b) 7 eV