Answer on the question #63279, Chemistry / General Chemistry

Question:

Chapter 6 (6.95)

An electron is accelerated through an electric potential to a kinetic energy of 13.4 keV .

1) What is its characteristic wavelength? [Hint: Recall that the kinetic energy of a moving object is E=12mv2, where m is the mass of the object and v is the speed of the object.]

Solution:

According to de Broglie equation, the characteristic wavelength can be calculated as the Plank constant over the momentum:

$$\lambda = \frac{h}{p}$$

The momentum is:

$$p = \sqrt{2Em}$$

The mass of electron is 9.11 10^{-31} kg, Planck constant is 6.626 10^{-34} J s. One electronvolt is 1.6 10^{-19} J. Finally, we can calculate characteristic wavelength:

$$\lambda = \frac{h}{\sqrt{2Em}} = \frac{6.626 \cdot 10^{-34}(Js)}{\sqrt{2 \cdot 13.4 \cdot 10^3 \cdot 1.6 \cdot 10^{-19}(J) \cdot 9.11 \cdot 10^{-31}(kg)}} = 1.0594 \cdot 10^{-11} m$$

Answer : 1.0594 10^{-11} m