Answer on Question #62784, Chemistry / General Chemistry

Problem 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 $E=1/2mv^2$, where m is the mass of the object and v is the speed of the object.]

Solution:

13.4 KeV = 1.34×10^4 eV, where 1 electron volt = 1.6022×10^{-19} joules

E = $(1.34 \times 10^4$ eV) $(1.6022 \times 10^{-19}$ J)/ (1 eV) = 2.15×10^{-15} J

mass of electron = 9.109×10^{-31} kg

v = square root (2E/m) = sq. root [$2(2.15 \times 10^{-15}$ J)/$(9.109 \times 10^{-31}$ kg) = 6.86×10^7 m/s

$E = hv/\lambda$,

Where λ = wavelength and h = Planck's constant

$\lambda = hv/E = (6.626 \times 10^{-34}$ J.s)$(6.86 \times 10^7$ m/s)/$(2.15 \times 10^{-15}$ J)

$\lambda = 2.12 \times 10^{-11}$ m

This is the wavelength of x-rays

Answer: 2.12×10^{-11} m