Answer on Question #62783, Chemistry / General Chemistry

Problem 6.51

1) Using Heisenberg's uncertainty principle, calculate the uncertainty in the position of a 1.40 −mg mosquito moving at a speed of 1.50 m/s if the speed is known to within ±0.01m/s.

2) Using Heisenberg's uncertainty principle, calculate the uncertainty in the position of a proton moving at a speed of (5.50 ±0.01)×10^4m/s. (Take the mass of a proton m=1.673×10^{-27}kg.)

Solution:

The formula goes:
$\Delta x > h/4\pi m\Delta v$
Where Δx = the uncertainty
h = 6.626 x 10-34 J-s (Plank's constant)
m = mass of object
Δv = the degree of certainty you are given

1)
To convert 1.40mg to kg, we must divide 1.40 by 1,000,000. This gives us 1.40 x 10^{-6}. Now we plug and chug.
$\Delta x > 6.626 \times 10^{-34} / 4\pi(1.40 \times 10^{-6})\ (0.01)$
$\Delta x \geq 3.77 \times 10^{-27}$ meters (pretty exact location for a mosquito)

2)

$\Delta x \geq h/4\pi(m\Delta v)$

So,

$\Delta x \geq 6.626 \times 10^{-34} / 4\pi\ (0.01\ m/s)\ (1.67310^{-27}\ kg)] = 3.16 \times 10^{-6}$ meters.

Answer: 1) 3.77×10^{-27} meters; 2) 3.16×10^{-6} meters