Sunday, 4 April 2021 8:11 PM

Q1 A golf ball has a mass of 40g, and a speed of 45 m/s. If the speed can be measured within accuracy of 2%, calculate the uncertainty in the position. ?

Soln: $\Delta x \cdot \Delta p = h/4\pi$ ✓

2% of 45

$\Delta x = \frac{h}{4\pi \Delta p} = \frac{h}{4\pi m \cdot \Delta v}$ ✓

2% of 45

$\Delta v = \frac{2}{100} \times 45 = 0.9$ m/s ✓

$\Delta x = \frac{6.634 \times 10^{-34}}{4 \times 3.14 \times 0.04 kg \times 0.9 m/s} = 1.46 \times 10^{-33}$ m

Q2 If the position of electron is measured with accuracy of 0.002 nm. Calculate uncertainty in momentum of electron.

Soln $\Delta x \cdot \Delta p = h/4\pi$

$\Delta p = \frac{h}{4\pi \Delta x} = \frac{6.634 \times 10^{-34} Js}{4 \times 3.14 \times 0.002 \times 10^{-9} m}$

$= 2.6 \times 10^{-23}$ kgm/s

Q3. A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 A^0. What is the uncertainty involved in the measurement of its velocity?

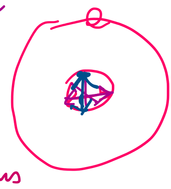
Soln: $\Delta x \cdot \Delta p = \frac{h}{4\pi}$ ✓

$\Delta v = \frac{h}{4\pi m \Delta x}$ ✓

$= 5.79 \times 10^{6}$ m/s

$\Delta x \cdot \Delta p = h$

$\Delta x_{max} \cdot \Delta p_{min} = h$



Q4 Using Uncertainty principle explain why electron cannot stay inside the nucleus.

Soln: Let electron stay inside the nucleus then Δx should be the size of the nucleus.

Δx_{max} = size of the Nucleus

$\Delta x_{max} = 10^{-15}$ m ✓✓

$\Delta p =$

$\Delta p_{min} = ?$

$\Delta x_{max} \cdot \Delta p_{min} = \frac{h}{4\pi}$

$\Delta p_{min} = \frac{h}{4\pi \Delta x_{max}}$

$\Delta x_{(MAX)} \cdot \Delta p_{(MIN)} = h/4\pi$

$\Delta E = \frac{\Delta p^2}{2m} =$ ✓

$\Delta p_{(MIN)} = \frac{h}{4\pi \Delta x_{(MAX)}} = \frac{10^{-34}}{10^{-15}}$ ✓ Js / m ✓

$\Delta p_{(min)} = 10^{-19}$ kg m/s

$\Delta E = \Delta p^2/2m = \frac{10^{-38}}{10^{-31}} = 10^{-7}$ J ✓

J = eV

few MeV

$\Delta E = \frac{10^{-7}}{10^{-19}}$ eV

$\Delta E = 10^{12}$ eV

$1 eV = 1.6 \times 10^{-19}$ J