If an electron is accelarated with P.E diff. from 'v' volt the wavelength should be

$\lambda = \frac{h}{\sqrt{2m\,KE}}$ here KE = ev (e = charge)

$$\boxed{\lambda = \frac{h}{\sqrt{2mev}}}$$

De Broglie Concept:

- according to De Broglie, EM... dual nature.

- according to De Broglie, ... show wave-like nature. (e^-, p^+, n^0)

- also, large mass matter show particle like nature.

- the wavelength of any matter can be calculated by

p = momentum
h = Planck constant

$$\boxed{\lambda = \frac{h}{p}} \quad \text{or} \quad \boxed{\lambda = \frac{h}{mv}}$$

m = mass
v = velocity

⇒ Confirmation of it's eqⁿ:

- we know that according to Planck energy eqⁿ $E = h\nu$ or $E = \frac{hc}{\lambda}$ —eq(I)

- energy eqⁿ of Einstein $E = mc^2$ —eq(II)

comparing eqⁿ (I) & (II)

$$\frac{hc}{\lambda} = mc^2$$

$\therefore \lambda = h/mc$

$$\lambda = \frac{h}{mc}.$$

$$\boxed{\lambda = \frac{h}{mc}} \longrightarrow c = \text{speed of light } (m/s) = v.$$

⇛ Bohr's theory and De Broglie eqⁿ:

- according to Bohr;

$$\underbrace{mvr}_{\text{angular momentum}} = \frac{nh}{2\pi}$$

- according to De Broglie, moving electron around the nucleus show wave-like nature.

- if an electron is regarded as a wave, the quantum condition as given by Bohr is readily fulfilled De Broglie.

- if the radius of circular orbit is 'r'; than circumference will be $2\pi r$.

So,

$$2\pi r = \frac{nh}{mv}$$

n = no. of orbit (shell)
r = Bohr's atomic radius
$\left(0.529 \frac{n^2}{Z} \text{Å}\right)$

⇛ Relation b/w wavelength and K.E:

$$\lambda = \frac{h}{\sqrt{2m(K.E)}}$$

Q:30 a 0.66 Kg ball is moving with a speed of 100 m/s. Associated wavelength will be :

⟹ $h = 6.6 \times 10^{-34}$ j/sec.

speed = 100

mass = 0.66 Kg

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

$$\lambda = \frac{6.6 \times 10^{-34}}{0.66 \times 100}$$

$$= \frac{\overset{0.1}{\cancel{6.6}} \times 10^{-34}}{\cancel{66}}$$

(very low value of λ so no, wave nature show)

$\lambda = 1.0 \times 10^{-35}$

Q:31 what is De Broglie wavelength associated with electron in 3^{rd} orbit of hydrogen.

⟶ $2\pi r = n\lambda$

$r = 0.529 \frac{n^2}{z} A^\circ$ $n = 3$

$$2 \times 3.14 \times 0.529 \times \frac{\overset{3}{\cancel{9}}}{1} = \cancel{3}\lambda$$

⟶ $6.28 \times 1.587 = \lambda$

$9.93236 = \lambda$

$\lambda = 9.9 \times 10^{-8}$

Q:32 find wavelength ratio for proton, neutron and α-rays who have same Kinetic energy?

⟹ λ_p λ_n λ_α

⟹ $\frac{h}{\sqrt{2m(KE)}}$ ⟹ $\frac{h}{\sqrt{2m(KE)}}$ ⟹ $\frac{h}{\sqrt{2m(KE)}}$

$\sqrt{4} \rightarrow 2.$

m/s.

$\therefore$, taking ratio of rel. masses.

$n^0 : p^+ : \alpha$-ray.

$1 : 1 : 1/2$

$\therefore$, ratio :- $1 : 1 : \frac{1}{2}$

$\therefore$, $\boxed{2 : 2 : 1}$

Q:33 de-Broglie wavelength associated with ball of 1kg having K.E = 0.5 J.

$\Rightarrow$ m = 1kg K.E = 0.5 J $h = 6.6 \times 10^{-34}$

$$\lambda = \frac{h}{\sqrt{2mKE}}$$

$$= \frac{6.626 \times 10^{-34}}{\sqrt{2(1)(0.5)}} \quad \sqrt{1} = 1$$

$$\boxed{= 6.626 \times 10^{-34} \text{ m}}$$

Q:34 helium molecule is moving with velocity 2.40×10^2 m/s at 300K. de-Broglie λ = ?

$\Rightarrow$ mass amu = $m \times 1.6 \times 10^{-27}$ $\lambda = \frac{h}{mv}$

$m = 4(1.6 \times 10^{-27})$

$= 6.4 \times 10^{-27}$

$$\lambda = \frac{6.6 \times 10^{-34}}{6.4 \times 10^{-27} \times 2.40 \times 10^2} = \frac{6.6 \times 10^{-34}}{\times 10^{-25}}$$

Heisenberg Uncertainity Principle:

- according to Heisenberg, it is impossible to measure (or calculate) simultaneously the position, momentum and velocity of a microscopic particle with absolute accuracy.

- if, one of them is measured with greater accuracy than other becomes less accurate.

$$\boxed{\begin{array}{c} \Delta x \cdot \Delta p \geqslant \dfrac{h}{4\pi} \\ \\ \Delta x \cdot \Delta v \geqslant \dfrac{h}{4\pi m} \end{array}}$$

m = mass of matter in kilogram.

$$\Delta E \cdot \Delta t \geqslant \frac{h}{4\pi}$$

here;

Δx = uncertainity in position
Δp = uncertainity in momentum
Δv = uncertainity in velocity.

Case 1: if $\Delta x = 0$ (exact position of e^- is known
than; $\Delta v = \infty$
(uncertainity in velocity is maximum)

Case 2: if $\Delta v = 0$ (exact velocity of e^- is known)
than; $\Delta x = \infty$
(uncertainity in position is maximum)

Q35: uncertainity in momentum of e^- is 1.0×10^{-10} kg/ms Uncertainity in position will be:

$\Rightarrow$ $h = 6.62 \times 10^{-34}$ J/sec $\Delta p = 1.0 \times 10^{-10}$ kg/m/sec.

$$\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$$

$$\Delta x = \frac{h}{4\pi p} \longrightarrow \Delta x = \frac{6.62 \times 10^{-34}}{4 \times 3.\cancel{14} \times 1.0 \times 10^{-10}}.$$

$$\Longrightarrow \Delta x = \frac{\cancel{6} \times 10^{-34}}{1 \times \cancel{12} \times 10^{-10}}$$

2

$$\Delta x = 0.5 \times 10^{-24} \Longrightarrow \therefore \boxed{5 \times 10^{-25}}$$

Q36: if uncertainity in velocity position of particle is space are 2.4×10^{-26} m/s and 10^{-7} m. find mass of particle (in grams)

$\Rightarrow$ $h = 6 \times 10^{-34}$ $\Delta v = 2.4 \times 10^{-26}$ $\Delta x = 10^{-7}$ m. m = gm?

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

$$2.4 \times 10^{-26} \times 10^{-7} = \frac{\cancel{6} \times 10^{-34}}{\cancel{4} \times 3.\cancel{14} \times m}$$

2

$$\Rightarrow m = 4.8 \times 10^{-33+34} \Longrightarrow m = 4.8 \times 10^{-1}$$

$$\therefore m = \frac{\cancel{1000}}{\cancel{4.8} \times 1\cancel{0}} \text{ gm}$$

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$\therefore$ m = 22gm

Q 37: a ball (10gm) moving with velocity of 90 m/s, if uncertainity in its velocity is 5%. find uncertainity in position.

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$\Longrightarrow$ $m = 10gm$ $\quad v = 90m/s$ $\quad \Delta v = 5\%$ $\quad \Delta x = ?$

$h = 6 \times 10^{-34}$.

$\Delta p = \frac{10}{1000} \times 90 \longrightarrow \underline{90 \times 10^{-3}}$ $\quad$ 0.9 kg m/s

now;

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

$\frac{6 \times 10^{-34}}{4 \times 3 \times 10 \times 10^{-3}}$

$\Delta v = \frac{5}{100} \times \cancel{45}\ 90$

$\boxed{4.5}$

$= \frac{1}{20} \times 10^{-31}$

$\Longrightarrow$ $\cancel{\Delta x} = \frac{\cancel{6 \times 10^{-34}}}{12 \times \cancel{90 \times 10^{-3}} \times \cancel{4}.5}$

$\Delta x \cdot 4.5 = \frac{1}{20} \times 10^{-31}$

$\boxed{\Delta x = \frac{1}{9} \times 10^{-31}}$

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