ARJUNA NEET BATCH

Atomic Structure

DPP-08

1. Calculate the wavelength associated with cricket ball of mass of 150 g travelling with a velocity of $25ms^{-1}$.

(A) 1.766×10^{-34} m (B) 7.66×10^{-9} m

(C) 4.8 m (D) 9.8×10^{-4} m

λ

$m = 150g$

$h \rightarrow$ planck's constant

$h = 6.626 \times 10^{-34}$ Js

$1J = Kg\,m^2 s^{-2}$

mass

velocity $= ms^{-1}$

$\lambda = \frac{h}{mv} \Rightarrow \frac{6.626 \times 10^{-34}}{\left(\frac{150}{1000}\right) \times 25}$

$\lambda = 1.766 \times 10^{-34}\,m$

mass $= 150g$

$= \frac{150}{1000}\,kg$

wavelength $= m.$

ARJUNA

2. What will be the wavelength of wave associated with ball of mass 0.1 kg moving with a velocity of $10ms^{-1}$?

(A) 6.626×10^{-9} m

(B) 6.626×10^{-34} m

(C) 6.626×10^{-36} m

(D) 6.626×10^{-35} m

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{0.1 \times 10}$$

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

ARJUNA

3. Calculate the wavelength (λ) of matter wave associated with small ball of mass of 100 g travelling at a velocity of 35 ms^{-1}.

m = mass = $100\,g = \frac{100}{1000}\,kg = 0.1\,kg$

velocity (v) = $35\,m\,s^{-1}$

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{35 \times 0.1}$$

$$\lambda = 1.893 \times 10^{-34}\,m$$

4. A beam of helium atoms moves with a velocity of 2×10^4 ms^{-1}. Find the wavelength of particles constituting with the beam.

$v = 2 \times 10^4 \, ms^{-1}$

(A) 4.99 pm (B) 6.8 pm

(C) 9.8 pm (D) 4.2 pm

mass of He atom = 4 amu

$1 amu = \frac{1}{N_A} g$

$1 amu = \frac{1}{6.022 \times 10^{23}} g$

$4 amu = \frac{4}{6.022 \times 10^{23}} g$

$1.66 \times 10^{-24} g$

$4 amu = 4 \times 1.66 \times 10^{-24} g$

$4 amu = 4 \times 1.66 \times 10^{-27} kg$

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

$= \frac{6.626 \times 10^{-34}}{(4 \times 1.66 \times 10^{-27})(2 \times 10^4)}$

$\lambda = 4.99 \times 10^{-12} m$

$1 Pm = 10^{-12} m$

$\lambda = 4.99 \, pm$

ARJUNA

5. Calculate the uncertainty in the velocity of an electron when the uncertainty in its position is 1.012×10^{-12} m.

ΔV ↑ e^- ↑ Δx

mass of e^- = 9.1×10^{-31} kg

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

$(\Delta p = m \Delta V)$

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

$$\Delta V \geq \frac{h}{4\pi m \Delta x}$$

$$\Delta V = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times (9.1 \times 10^{-31})(1.012 \times 10^{-12})}$$

$$\Delta V = 5.72 \times 10^{7}\ m\,s^{-1}$$

6. Calculate the uncertainty in the position of a cricket ball of mass 150 g if the uncertainty in its velocity is 3.52×10^{-24} ms^{-1}.

Δx , ΔV

$m = 150\,g$

$m = \frac{150}{1000}\,kg$

$m = 0.15\,kg$

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

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

$$= \frac{6.626 \times 10^{-34}\ kg\,m^2\,s^{-1}}{4 \times 3.14\ (0.150\,kg)(3.52 \times 10^{-24})\,m\,s^{-1}}$$

$$\Delta x = 10^{-10}\,m$$

$$\Delta x = 1\,\text{Å}$$

$$10^{-10}\,m = 1\,\text{Å}$$

ARJUNA

Δx

7. What is the uncertainty in locating the position of an electron (e^-) with speed $25 ms^{-1}$ having uncertainty of 0.1%?

$V = 25 ms^{-1}$

$V = 25 ms^{-1}$ ⇒ $\Delta V = 25 \times \frac{0.1}{100} = 2.5 \times 10^{-2} \, ms^{-1}$

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

$\Delta x \geq \frac{h}{4\pi m \cdot \Delta V}$.

mass of $e^- = 9.1 \times 10^{-31} kg$.

$\Delta x = \frac{6.626 \times 10^{-34} \, kg \, m^2 s^{-2}}{4 \times 3.14 \times (9.1 \times 10^{-31} kg)(2.5 \times 10^{-2} \, ms^{-1})}$

$\Delta x = 2.317 \times 10^{-3} \, m$.

ARJUNA

$I.E. = E_\infty - E_1$

8. The ionization energy of the electron in the lowest orbit of hydrogen atom is 13.6 eV. The energies required in eV to remove electron from three lowest orbits of hydrogen atom are

$n = 1, 2, 3$
$Z = 1$

(A) 13.6, 6.8, 8.4 (B) 13.6, 10.2, 3.4

(C) 13.6, 27.2, 40.8 (D) 13.6, 3.4, 1.51

$I.E. = E_\infty - E_1$

$I.E. = E_\infty - \left(-13.6\,\frac{Z^2}{n^2}\right)$ eV/atom

for lowest state of hydrogen atom $n = 1, Z = 1$

$I.E = 0 + 13.6\left(\frac{1}{1}\right)$

$I.E_{n=1} = 13.6$ eV

I.E for 2nd lowest orbit

$I.E. = 13.6\left(\frac{1^2}{2^2}\right)$

$I.E_{n=2} = \frac{13.6}{4} = 3.4$ eV

for $n = 3$

$I.E_{n=3} = \frac{13.6\,(1)^2}{3^2} = \frac{13.6}{9}$

$I.E_{n=3} = 1.51$ eV

ARJUNA

9. E_n = –313.6/n^2 kcal/mole. If the value of E = –34.84 kcal/mole, to which value does 'n' correspond?

orbit no.

(A) 4 (B) 3

(C) 2 (D) 1

$E_n = \frac{-313.6}{n^2}$ kcal/mol

$E = -34.84$ kcal/mol.

$-34.84 = \frac{-313.6}{n^2}$

$n^2 = \frac{313.6}{34.84} = 9$

$n = \sqrt{9} \Rightarrow \boxed{n = 3}$

ARJUNA

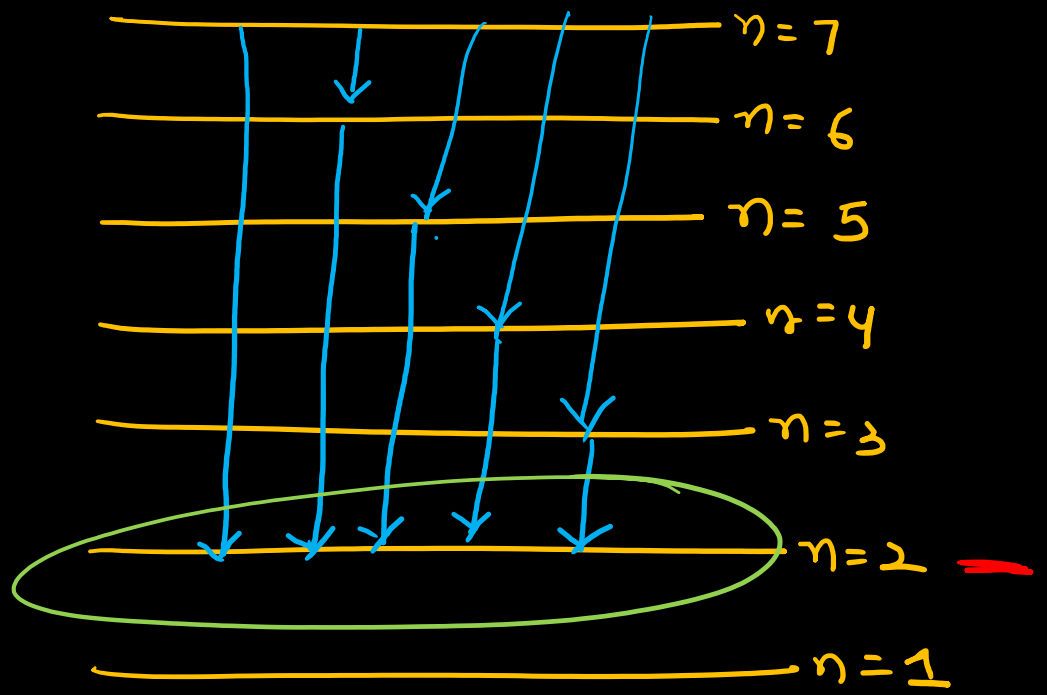
10. Number of spectral lines in Balmer series when an electron return from 7th orbit to 1st orbit of hydrogen atom are

(A) 5

(B) 6

(C) 21

(D) 15



Spectral lines in $n = 2$ are 5

ARJUNA

Thank You