Heisenberg Uncertainty Principle

Course on Atomic Structure for Class XI

akhilesh • Lesson 11 • Sept 13, 2021

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$$\underline{1.5 \times 13.6} - \underline{\underline{13.6}} = KE$$

$$0.5 \times 13.6\ eV = KE$$

$$\lambda = \sqrt{\frac{150}{0.5 \times 13.6}}\ \mathring{A}$$

(51)

$n\lambda$

6λ

$n = 6$

Maximum '3'

$-l$ to $+l$

$l = 3$

$\boxed{n = 4}$

43 Li^{2+}

13.6×9

$13.6 \times 8 = KE$

45

$m_\alpha = 4\, m_p$

$$\lambda_\alpha = \frac{h}{\sqrt{2 \cdot m \cdot KE}}$$

$$\frac{1}{\sqrt{4 m_p \cdot E}} = \frac{1}{\sqrt{m \cdot 4 E}}$$

Illusion of reality

Key to the cosmos

Q. A photon of $\lambda = 310\,nm$ was absorbed by an e^- at rest. find λ of e^- after absorption of photon.

$$\lambda = \sqrt{\frac{150}{4}}$$

$$E = \frac{1240\,nm \cdot eV}{310}$$

$$= 4eV$$

Q. A photon of energy 6 eV was absorbed by an e^- at rest find its 'λ'.

$$\lambda = \sqrt{\frac{150}{6}} = 5\ \text{Å}$$

$$E = \frac{hc}{\lambda}$$

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

A 60

B 6

C 7

D 70

$\sqrt{\frac{150}{4 \times 10^4}} \times 10^{-10}$

4. The wavelength of electrons accelerated from rest through a potential difference of 40 kV is $x \times 10^{-12}$ m. The value of x is________________. (Nearest integer)

Given: Mass of electron = 9.1×10^{-31} kg

Charges on an electron = 1.6×10^{-19} C

Plank's constant = 6.63×10^{-34} Js

$\sqrt{37.5} \times 10^{-12}$ m

$\sim 6 \times 10^{-12}$

(A) 2

(B) 20

(C) 4

(D) 40

no. of photons $= \dfrac{1000}{hc/\lambda} =$ no. of e^-

5. A source of monochromatic radiation of wavelength 400 nm provides 1000 J of energy in 10 seconds. When this radiation falls on the surface of sodium, $x \times 10^{20}$ electrons are ejected per second. Assume that wavelength 400 nm is sufficient for ejection of electron from the surface of sodium metal. The value of x is ________ . (Nearest integer)
($h = 6.626 \times 10^{-34}$ Js)

$$\frac{1\cancel{00} \times 4\cancel{00} \times \cancel{10^{-9}}\ 10^{-5}}{6.626 \times 10^{-34} \times 3 \times 10^{8}}$$

$= 2$

Heisenberg Uncertainity principle :→

It is impossible to determine the exact position and exact momentum of small particle like e^-, p etc, simultaneously

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

$$dx \cdot dp = \frac{h}{4\pi}$$

$$dx \cdot dV = \frac{h}{4\pi m}$$

Uncertainity in position (error)

Uncertainity (error) in momentum

for minimum error

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

Q. find error in position of a particle moving with speed $10^7 m/sec \pm 10^5$

Given mass of particle $\frac{6.62}{\pi} \times 10^{-30}$ kg

A) $10^{-4}/4$ (C) $10^{-9}/4$

B) $10^{-5}/4$ (D) None.

$2.5 A^\circ$

10^{-6}

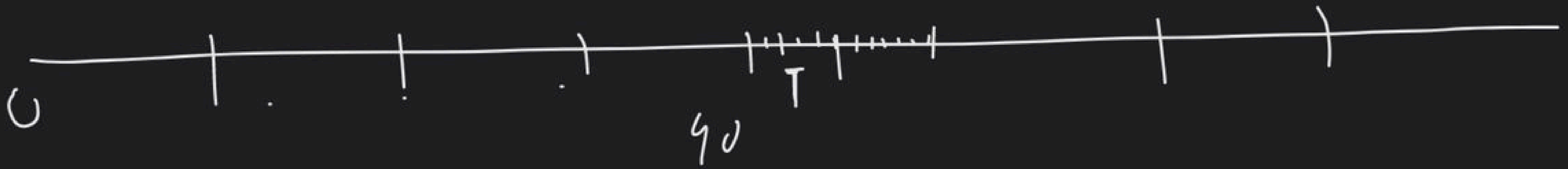
$$\Delta x \cdot 10^5 = \frac{6.62 \times 10^{-34}}{4\pi \frac{6.62}{\pi} \times 10^{-30} \text{ kg}}$$

(A) 57
B) 58
C) 59
D) 60

58

6. An accelerated electron has a speed of 5×10^6 ms^{-1} with an uncertainty of 0.02%. The uncertainty in finding its location while in motion is $x \times 10^{-9}$ m. The value of x is________. (Nearest integer)

[Use mass of electron $=9.1\times10^{-31}$ kg, $h=6.63\times10^{-34}$ Js, $\pi=3.14$]



44 — 45

|||

50kg

50.01
50.001
50.001

$$dx \cdot dp = \frac{h}{4\pi}$$

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

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

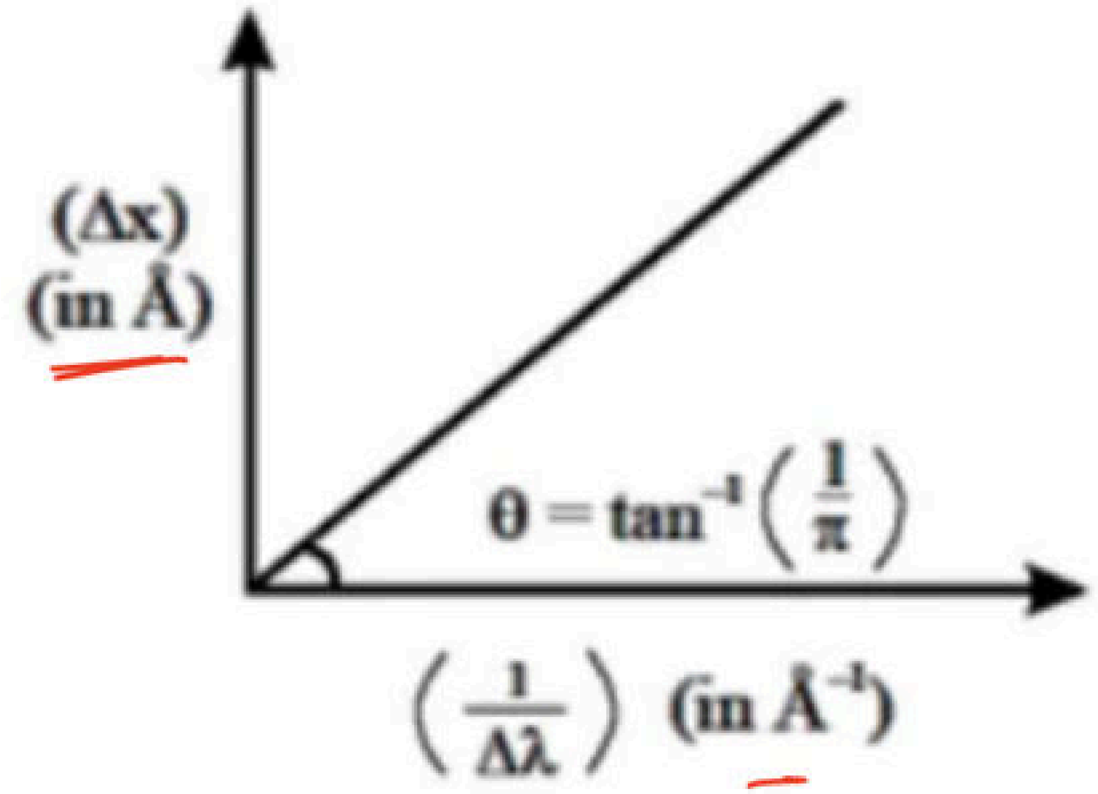
$$dp = -\frac{h}{\lambda^2} d\lambda$$

$$\boxed{dx \left(\frac{h}{\lambda^2} d\lambda \right) = \frac{h}{4\pi}}$$

$$K.E = \frac{1}{2} m v^2$$

$$dx = \frac{\lambda^2}{4\pi} \frac{1}{d\lambda}$$

144. A graph is plotted between uncertainty in position and inverse of uncertainty in wavelength for an electron. We get a straight line passing through origin. Calculate voltage through which electron is accelerated with -



$4 = \frac{150}{V}$

$V = 37.5$

$\frac{\lambda^2}{4\pi} = \frac{1}{\pi}$

$\lambda = 2\,A^{o} = \sqrt{\frac{150}{V}}$

(A) 150 V (B) 75 V (C) 37.5 V (D) 300 V

8 9 10

1mm

5000

1mg

1mg 5/-

~~1kg~~ gm 10/-

9.80 Sec

9.84 Sec

9.87 Sec

9.80

9.80

0.-1 49—58

5-1 52—58

The Solvay Conference (colorized version).

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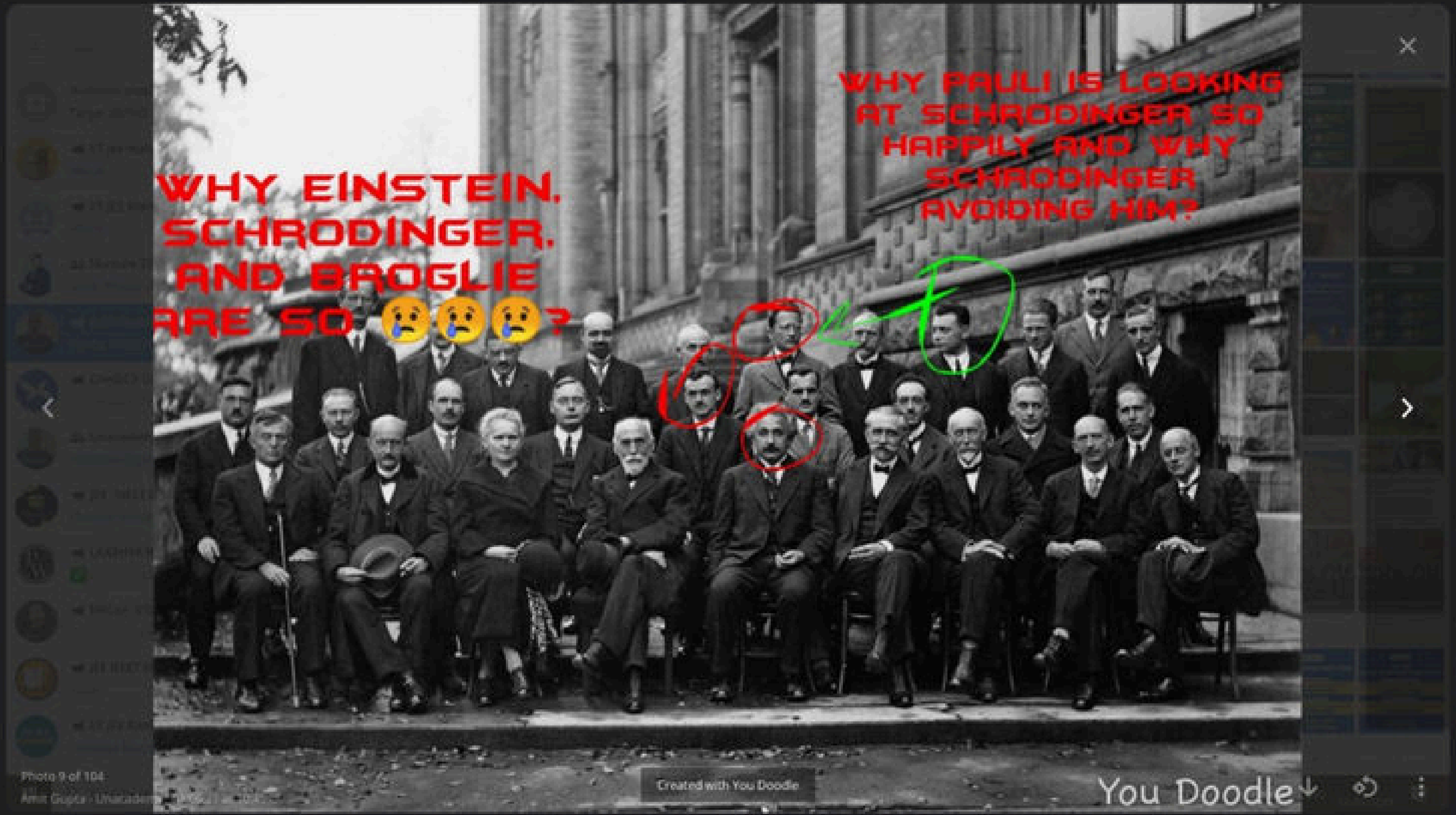
4 • Asked by Sayak

Please help me with this doubt



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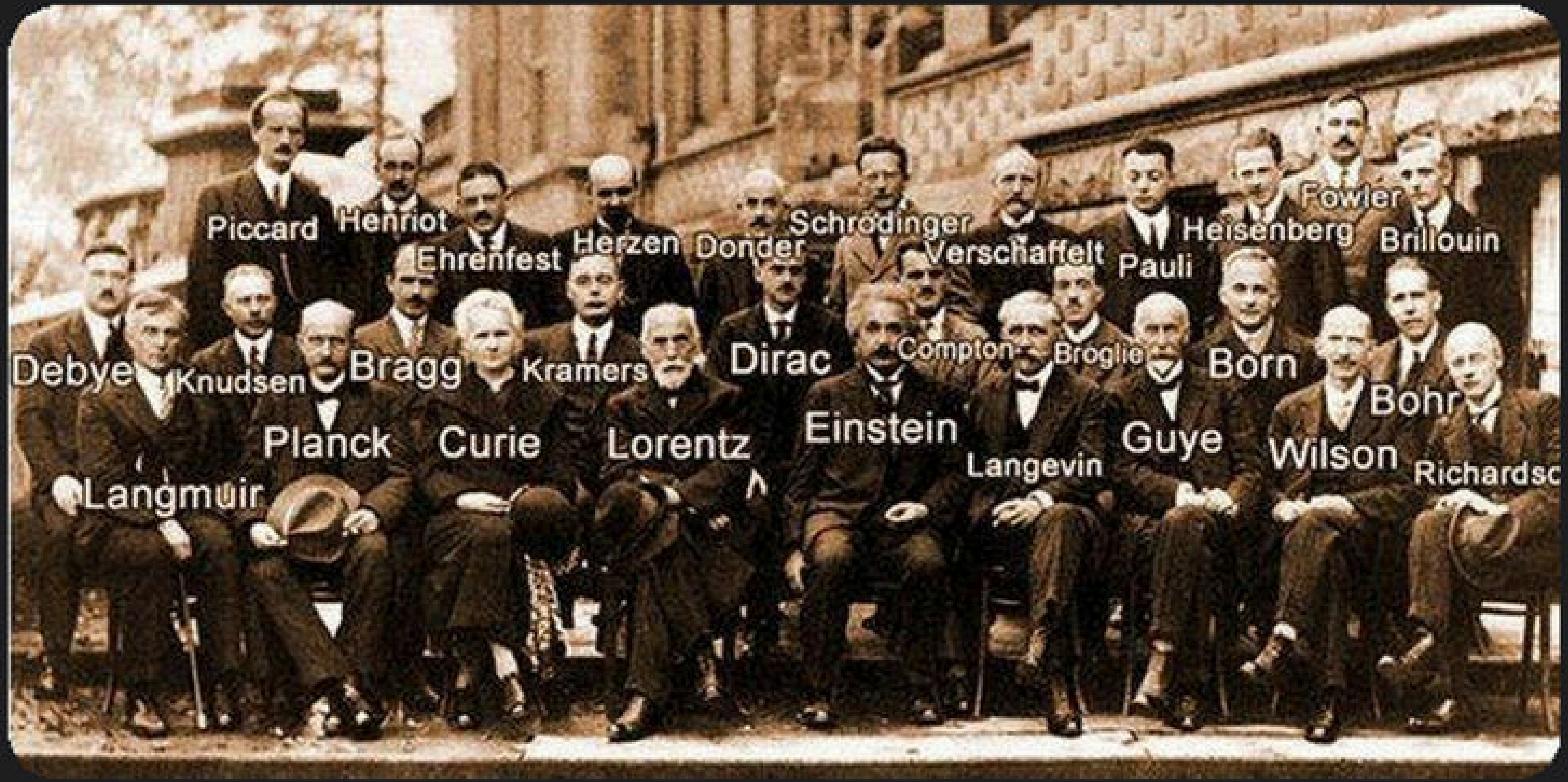
10 • Asked by Arnavgupta

SIR YE DEKHO



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▲ 8 • Asked by Dhruv

Sir pls help me out with this problem I am getting wrong answer as -0.6