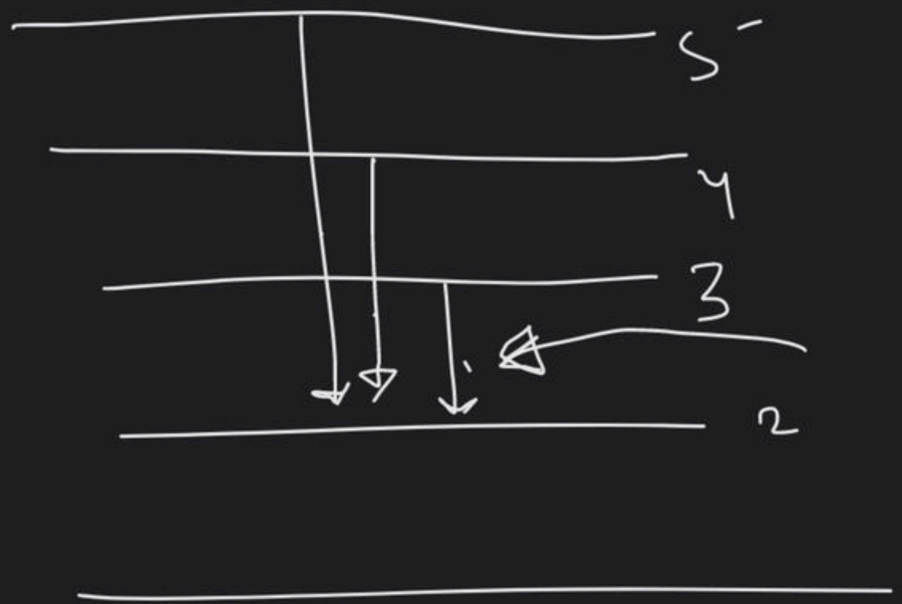
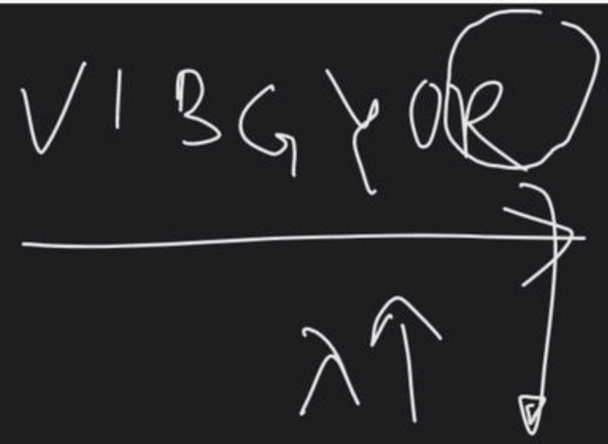
Radial Wave Function

Course on Atomic Structure for Class XI

akhilesh • Lesson 14 • Sept 20, 2021





(B), (C)

$5 \rightarrow 2$

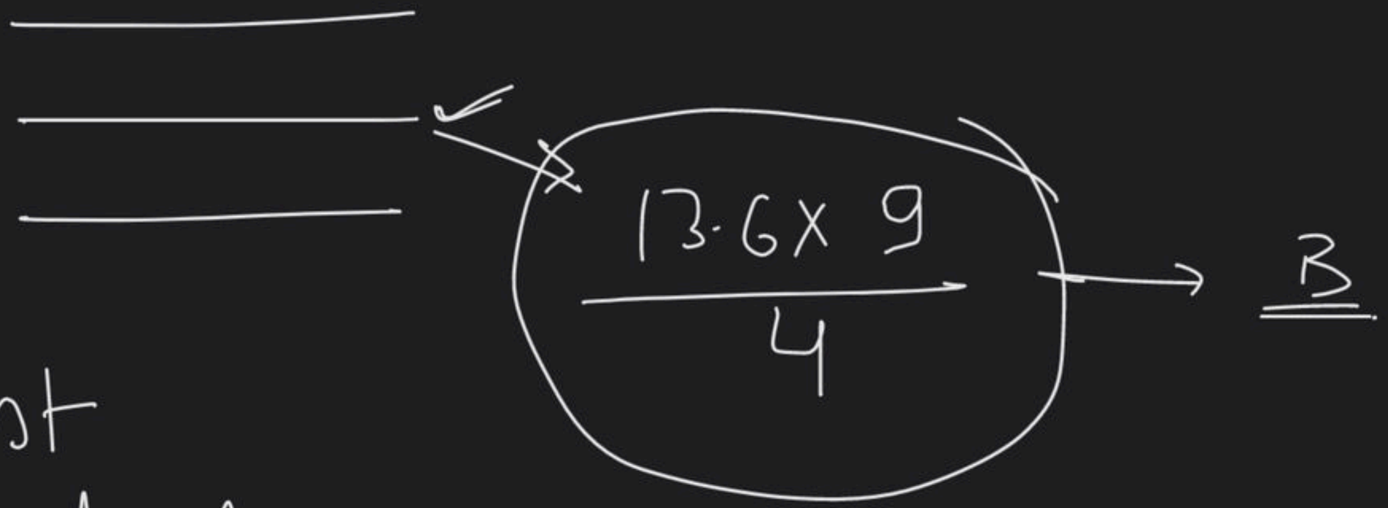
355

$$E_{abs} = E_1 + E_2$$

$$\frac{hc}{\lambda_1} = \frac{hc}{\lambda_2} + \frac{hc}{\lambda_3}$$

$$\frac{242\ \text{kJ}}{N_A} = \frac{hc}{\lambda}$$

13.C



dust particle

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

$$KE = \frac{3}{2} kT$$

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

$m_e < m_p < m_n$

A

visible photon

4000 — 7500 Å

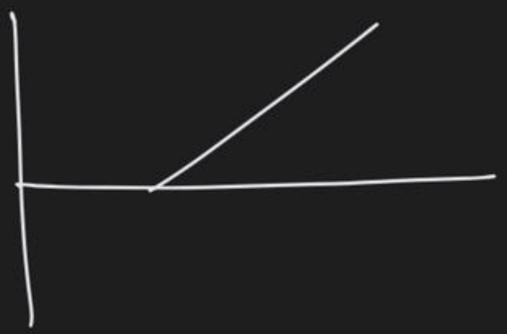
33 $\bar{\nu} = \frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$

$\bar{\nu} = R_H \left[\frac{1}{n^2} - \frac{1}{8^2} \right]$

(A) $-R_H$

(B) R_H

(A)



(4)

n_1 → lower

n_2 → higher

$KE = h\nu - h\nu_0$ $\quad$ I = G

38 $\quad \lambda = \dfrac{h}{\sqrt{2 \cdot m \cdot (h\nu - h\nu_0)}}$

$(n+\ell)$

IV < II < III < I

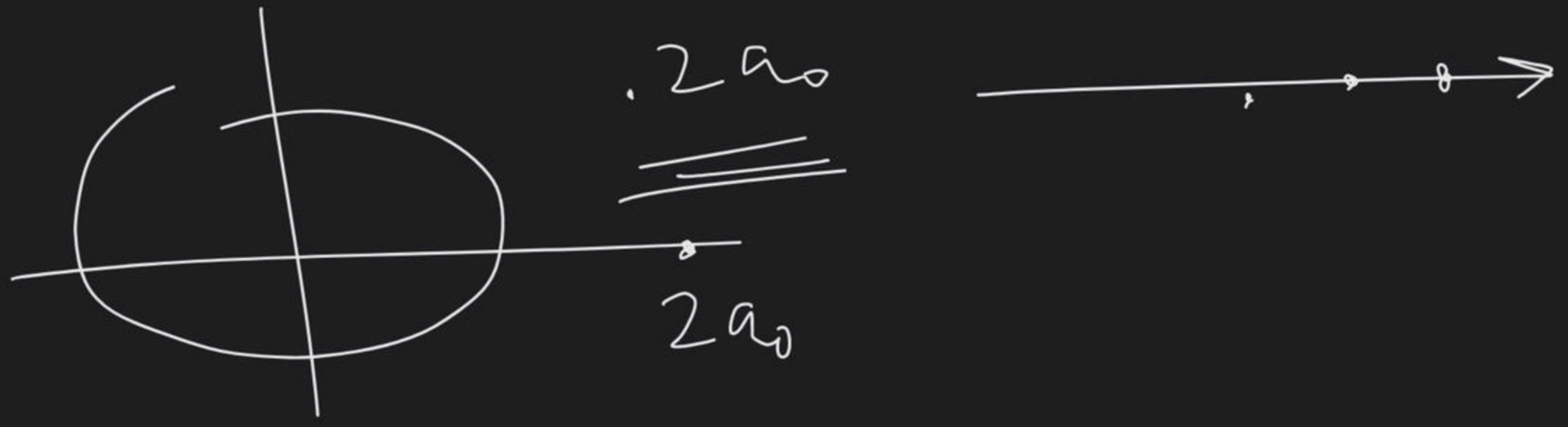
$$2\pi f\left(0.5\,\frac{n}{2}\right) = 1.5\,\pi f a_0$$

$$\frac{n}{2} = 0.75$$

(44)

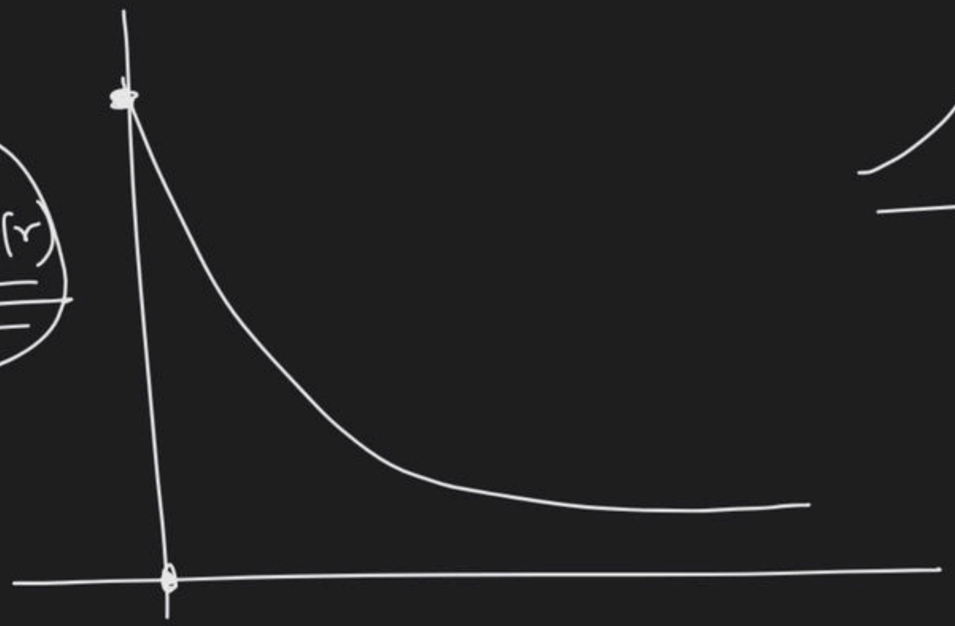
incorrect

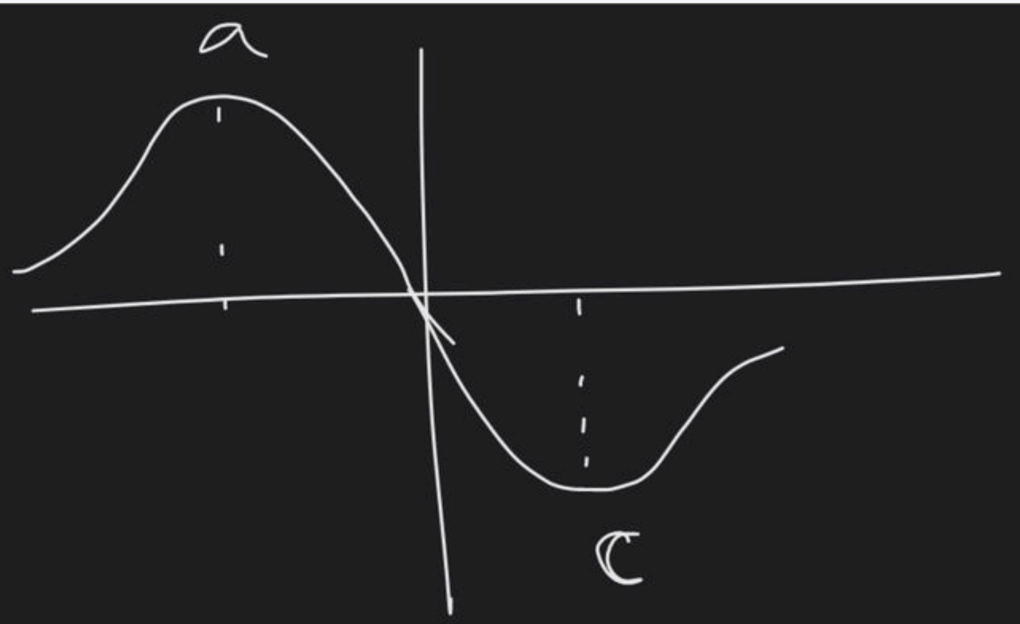
$\Delta E = -(2KE)$



(4)

$R_{2(r)}$





$\psi 2$

$R(r)$ vs r

$R^2(r)$ vs r

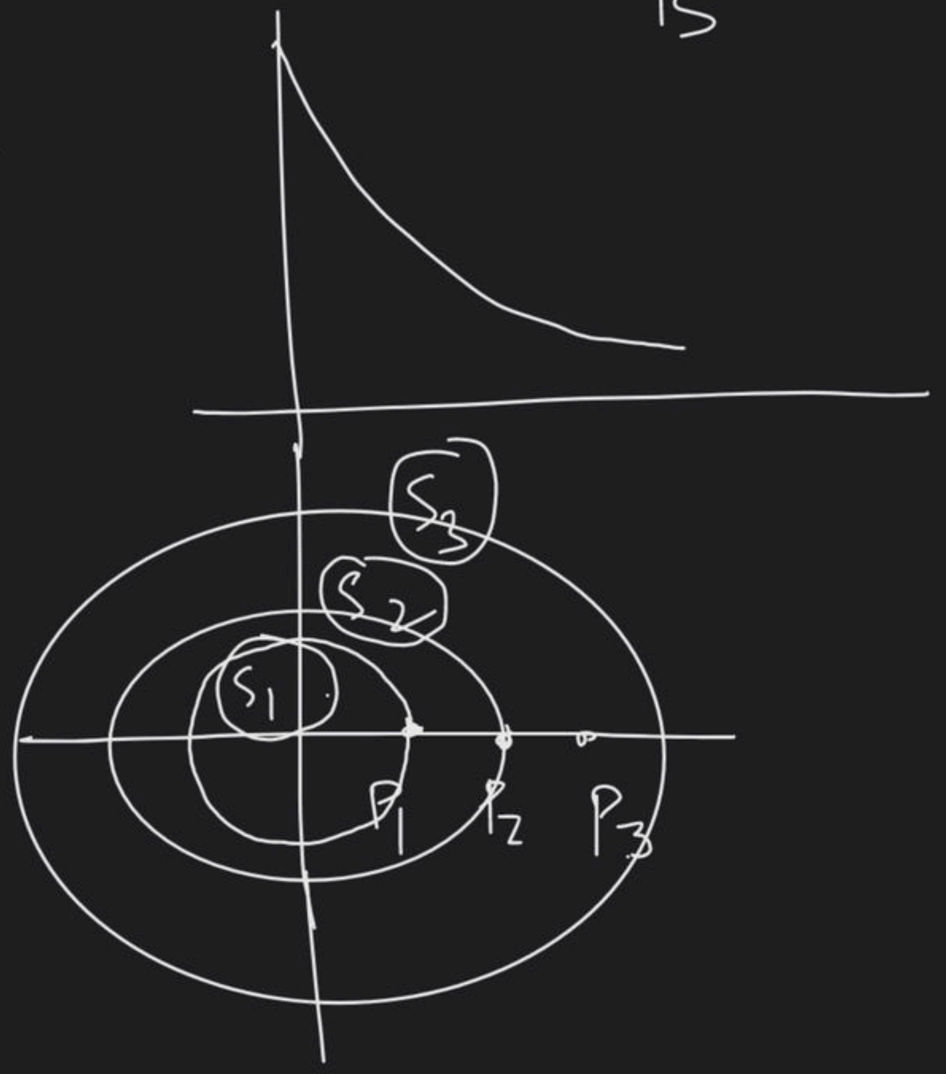
$n-l-1$

1S

In 1S orbital

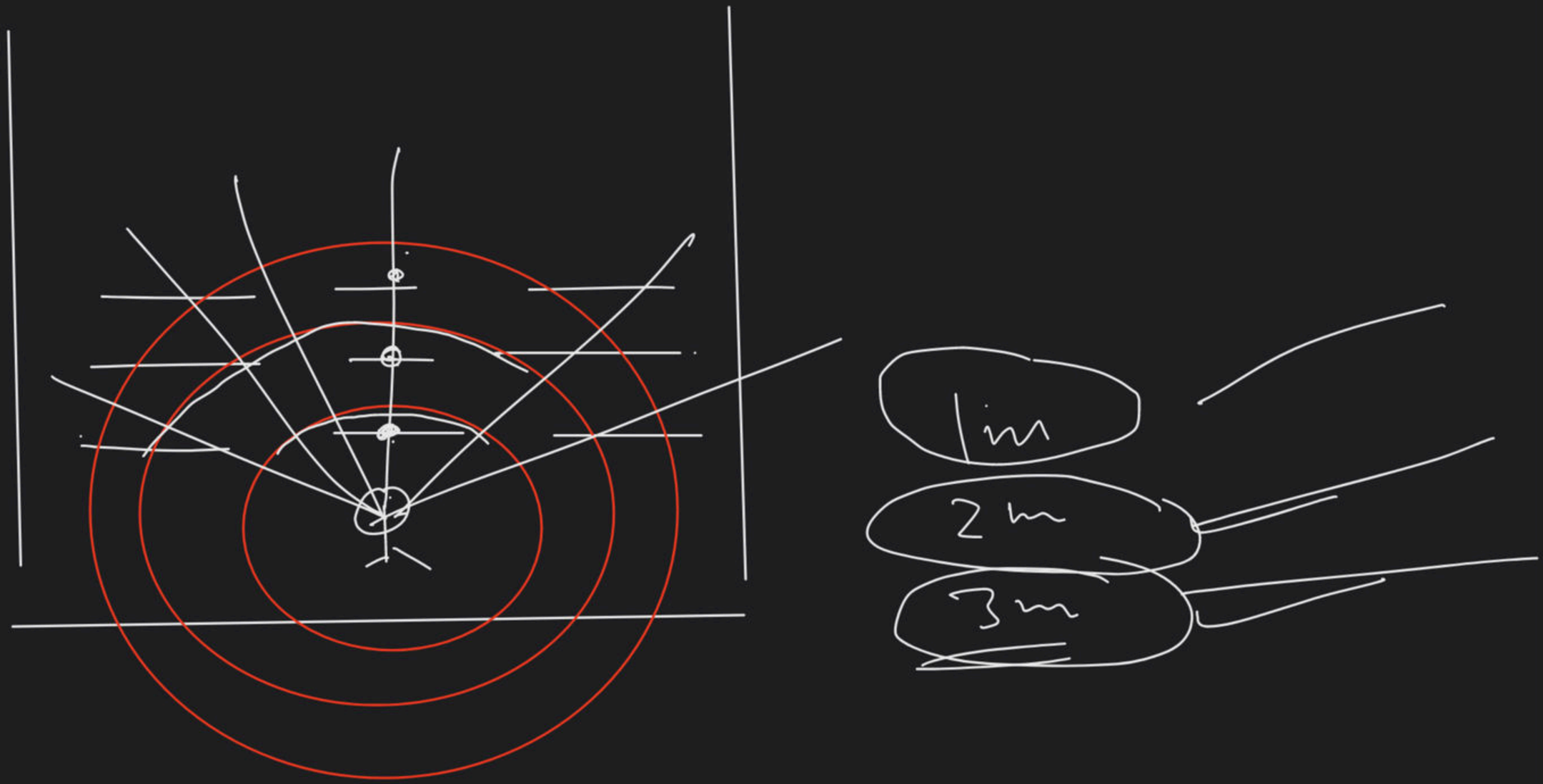
Probability of finding an e^- is more at

$1A^\circ$ or $2A^\circ$

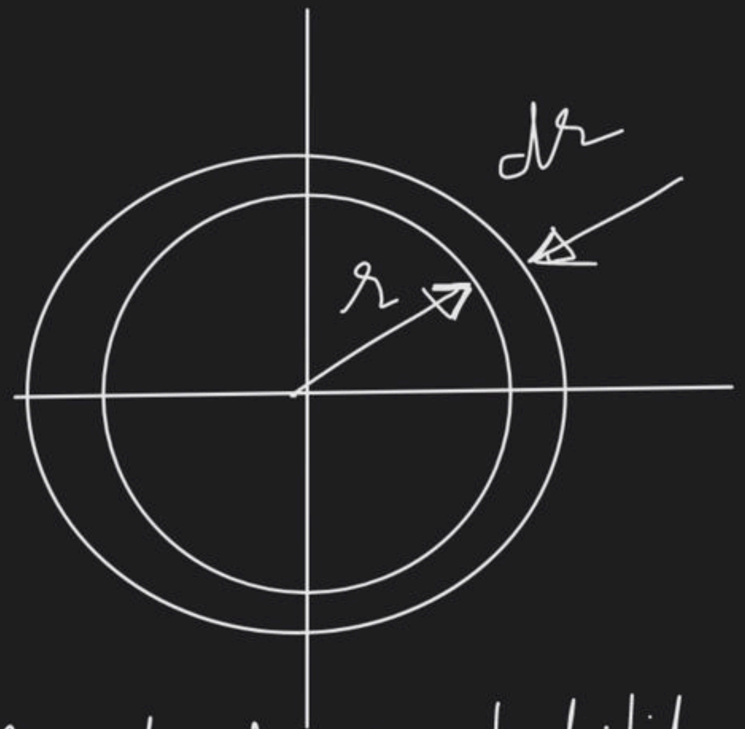


$1A^\circ$

$2A^\circ$


1m
2m
3m

$R^2(r)$ = Radial probability density



Volume of spherical shell

$= 4\pi r^2 dr$

Radial probability in spherical shell = $(4\pi r^2 dr)\, R^2(r)$

Radial probability per unit thickness of spherical shell $= 4\pi r^2 R^2(r)$

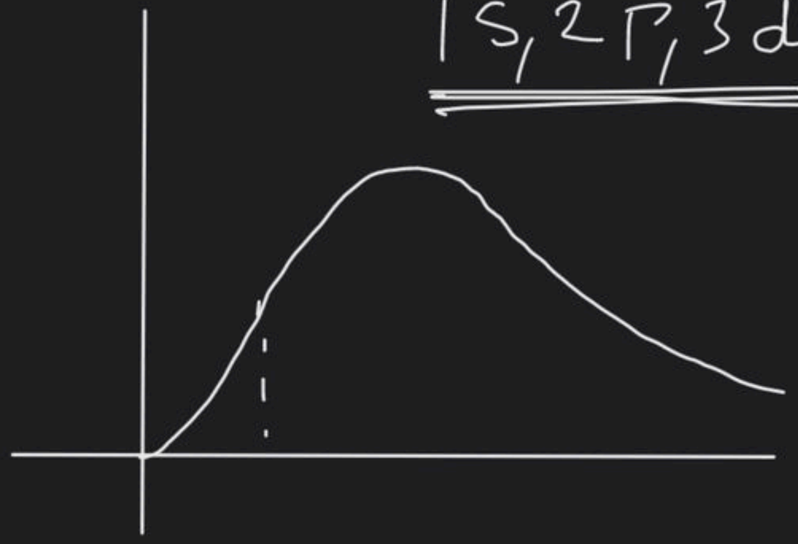
$=$ RPDF

Radial probability distribution function :→

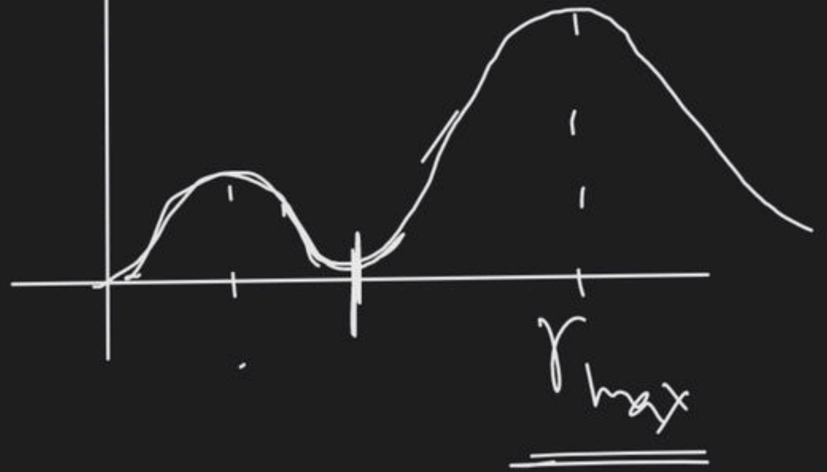
$4\pi r^2 R^2(r)$ vs r

$$RPDF_{1s} = 4\pi r^2 \left(\frac{2}{a_0^{3/2}} e^{-r/a_0} \right)^2$$

1s, 2p, 3d, 4f



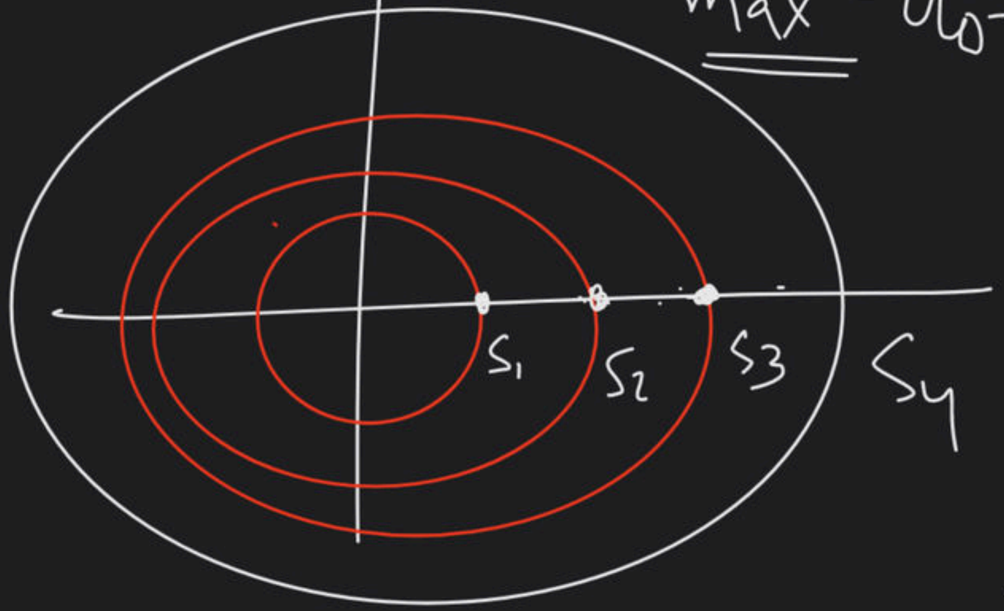
2s, 3p, 4d, 5f



$4\pi r^2 R^2(r)$

$RPDF_{1s} = 4\pi r^2 \left(\frac{4}{a_0^3} e^{-2r/a_0}\right)$

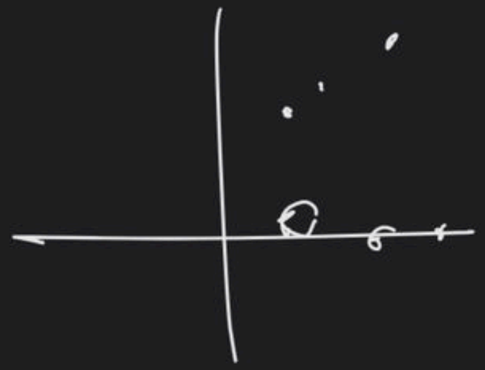
$r_{max} = a_0 = 0.529 A^0$ — 5 min



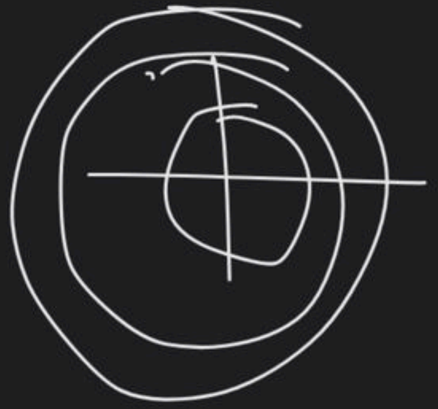
R^2 ψ^2

$R(r)$ vs r

$R^2(r)$ vs r



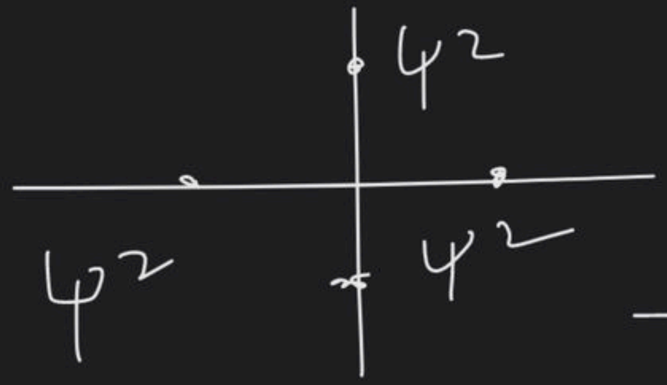
$4\pi r^2 R^2(r)$ vs r



Angular part of wave function

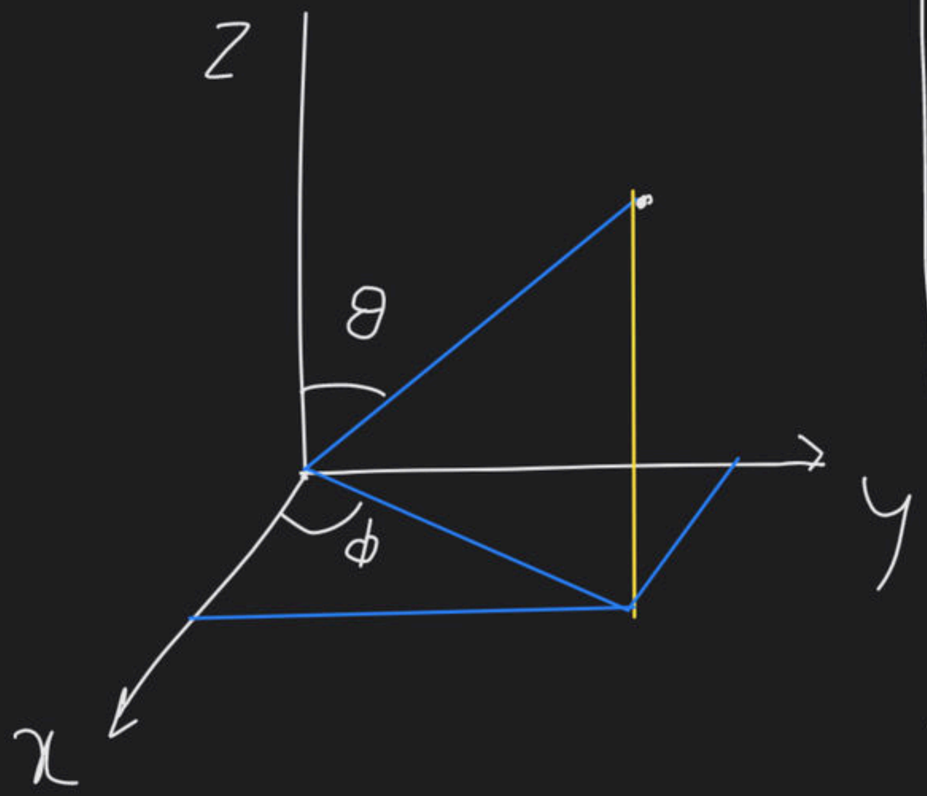
For 's' orbital :— Independent of θ & ϕ

⇒ It is spherically symmetrical.



$\longrightarrow \psi^2 = R^2(r)$

for 'p' orbital :-



- xy plane $\theta = 90^\circ$
- xz plane $\phi = 0$
- yz plane $\phi = 90^\circ$

z-axis $\theta = 0$

nodal

$P_x =$ yz

$P_y =$ xz

$P_z =$ xy

$$p_y = \left(\frac{3}{4\pi}\right)^{1/2} \sin\theta \sin\phi$$

$\phi = 0^\circ$

xz plane

nodal plane
or
angular node

$$p_x = \left(\frac{3}{4\pi}\right)^{1/2} \sin\theta \cos\phi$$

$\phi = 90^\circ$

yz

$$p_z = \left(\frac{3}{4\pi}\right)^{1/2} \cos\theta$$

$$\underline{d_{yz}} = \left(\frac{15}{4\pi}\right)^{1/2} \sin\theta \cos\theta \sin\phi$$

$\theta = 90^\circ \quad xy$

$\phi = 0^\circ \quad xz$

$\theta = 90^\circ \quad \underline{xy}$

$d_{xy} \rightarrow xz, yz$

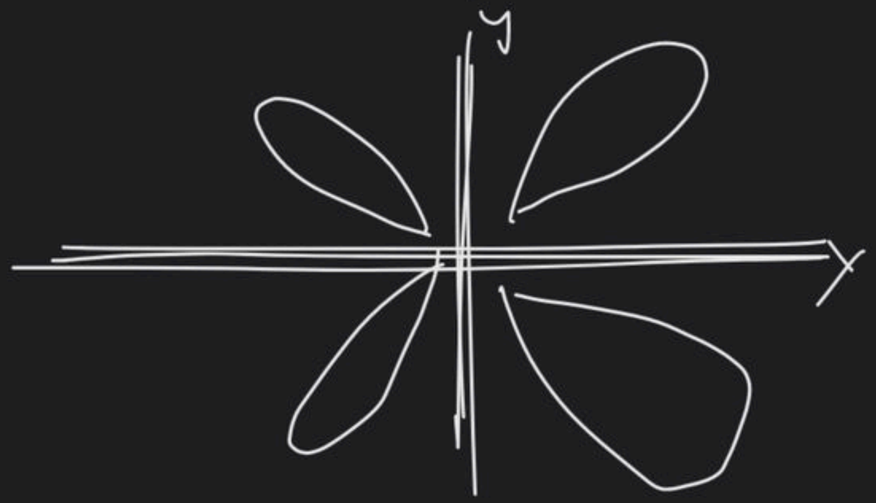
$d_{yz} \rightarrow xy, xz$

$\times\ d_{zx} \rightarrow yz, xy$

$$d_{xy} = \left(\frac{15}{4\pi}\right)^{1/2} \sin^2\theta \cos 2\phi$$

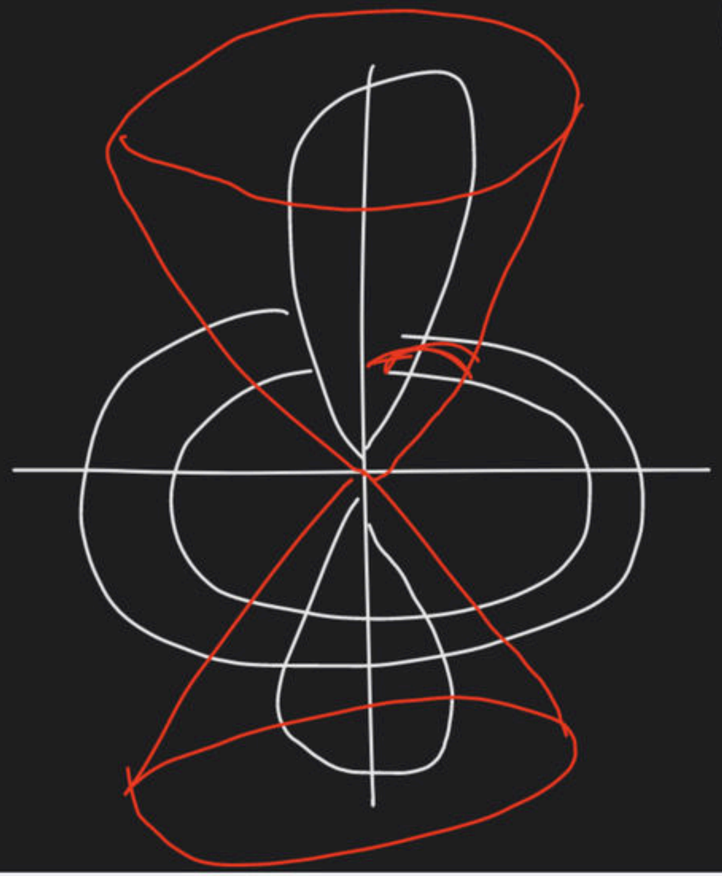
(xz) $\phi = 0$

(yz) $\phi = 90^\circ$



$$d_{z^2} = \left(\frac{5}{16\pi}\right)^{1/2} \left(3\cos^2\theta - 1\right)$$

$$\cos\theta = \pm 1/\sqrt{3}$$



No. of angular node = l

Total node = $n-l-1+l$

$= n-1$

no. of maxima $= n-l$

($4\pi r^2 R^2(r)$ vs r)

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▲ 2 • Asked by Prasidh

SIR IDEAL GAS KE COLLISION WALE PART MEIN THORI DIKKAT AA RAHI HAI...SIR HOW TO IMPROVE THAT?

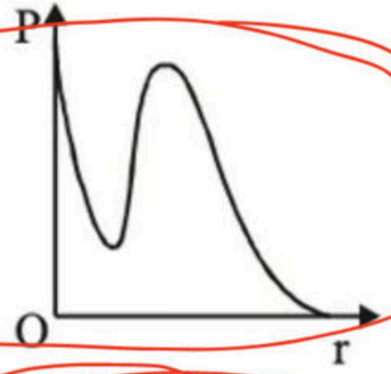
S-1

0-1

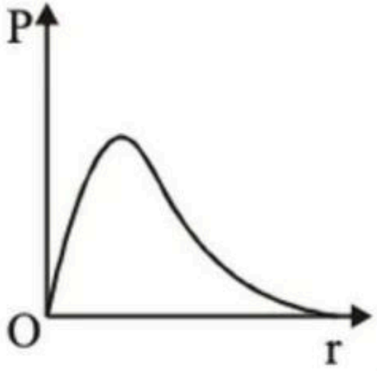
S-2

17. P is the probability of finding the 1s electron of hydrogen atom in a spherical shell of infinitesimal thickness, dr, at a distance r from the nucleus. The volume of this shell is $4\pi r^2 dr$. The qualitative sketch of the dependence of P on r is - **[JEE 2016]**

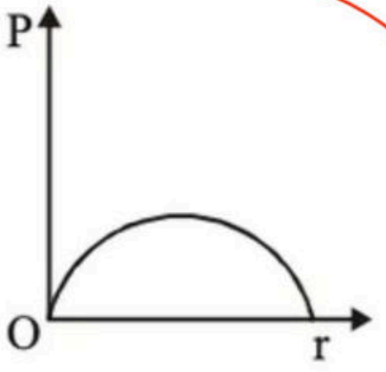
(A)



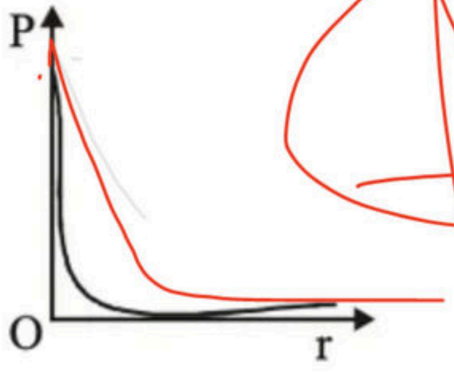
(B)



(C)



(D)



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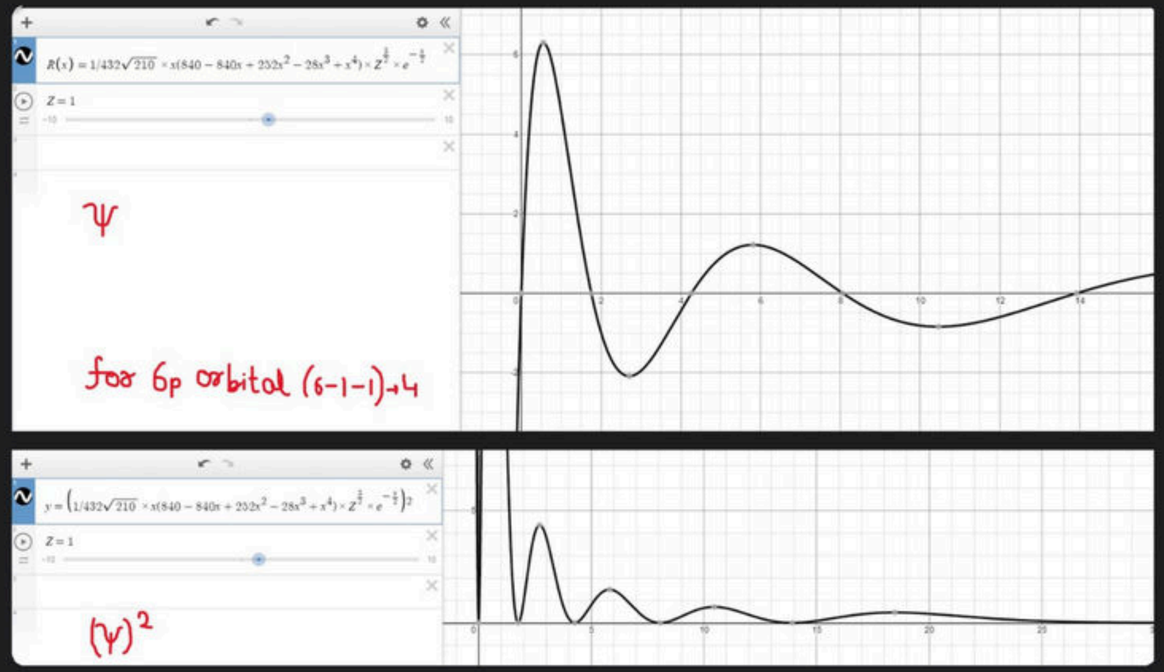
▲ 12 • Asked by Animesh Ku...

sir masti masti mein schrodinger uncle ka data 6p orbital ka dhhund ke approx equation plot kiya, maza aa gaya ^_^



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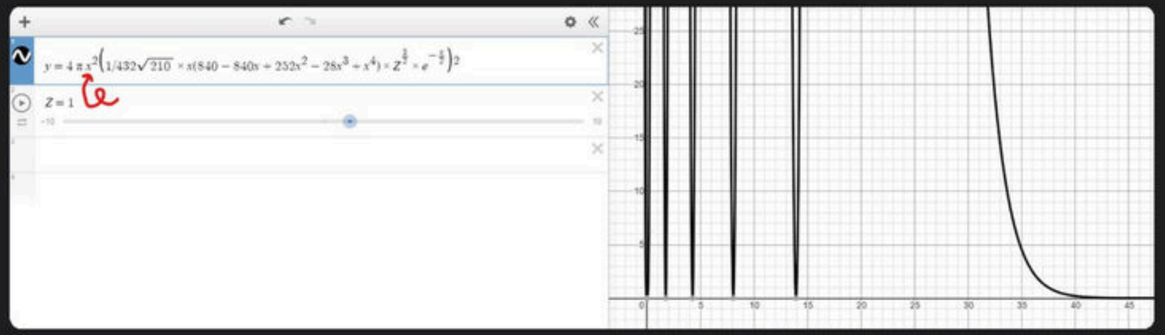
▲ 16 • Asked by Animesh Ku...

Please help me with this doubt



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▲ 8 · Asked by Nilarnab

sir combat me aya tha

The transition that belongs to the Lyman series in the hydrogen-atom spectrum is:

1s ← 4s

INCORRECT

1s ← 4p

CORRECT ANSWER

2s ← 4s

2s ← 4p

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▲ 8 • Asked by Sounak

Please help me with this doubt

The transition that belongs to the Lyman series in the hydrogen-atom spectrum is:

1s ← 4s

INCORRECT

1s ← 4p

CORRECT ANSWER

2s ← 4s

2s ← 4p