JEE-Adv

7, 13, 14, 15, 23, 24, 26

S-II 11–18

7

(A) -2

(B) $E^{x} \propto \frac{1}{r_n}$ $x = 1$

$T.E = -\frac{1}{2}\frac{KZe^2}{r}$

(C) $r_n \propto n^2 Z^{-1}$

$y = -1$

(D) $= 0$

14

$KE = \frac{1}{2}mv^2$

$mvr = \frac{nh}{2\pi}$

$mv(4a_0) = \frac{\cancel{2}h}{\cancel{2}\pi}$

$KE = 13.6\frac{Z^2}{n^2}$

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

$$= \frac{h}{m\sqrt{\frac{8RT}{\pi m}}}$$

$$\propto \frac{1}{\sqrt{mT}}$$

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

$$= \frac{h}{\sqrt{2m \, \frac{3}{2}KT}}$$

$$\lambda \propto \frac{1}{\sqrt{mT}}$$

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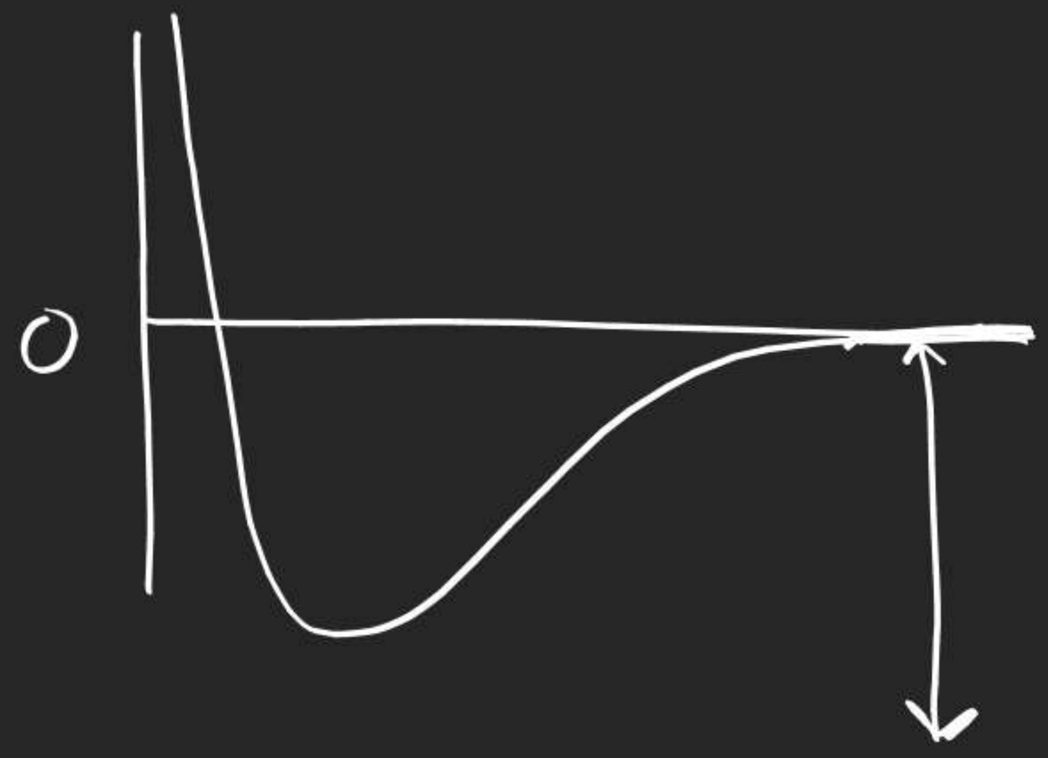
23 $r \propto n^2$ $\quad$ I – T

$mvr = \frac{nh}{2\pi}$ $\quad$ II – S

$KE = 13.6 \frac{Z^2}{r_1^2}$ $\quad$ III – P

III – P

PE (kJ/mol)



$$PE = 2\,T.E$$
$$= -13.6 \times 2 \times 2 \text{ eV}$$

$$-13.6 \times 2 \times 2 \times 1.6 \times 10^{-19} \times N_A$$

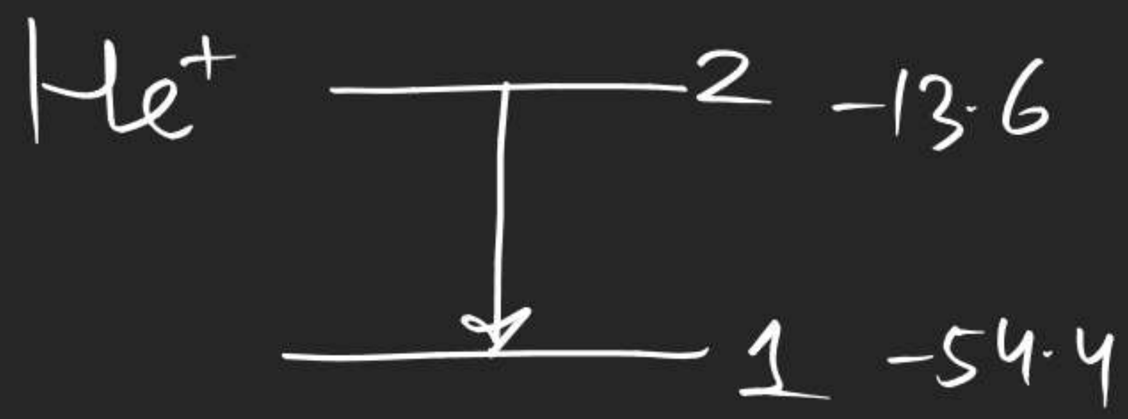
H H

26

$$r_n = 0.529 \frac{n^2}{Z} \text{Å}$$

$$= \underline{52.9} \frac{n^2}{Z} \text{ pm}$$

$$r_n = 52.9 \times \frac{4}{2} = 105.8 \text{ pm}$$



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b λ

13 c

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

$$\lambda = (12.016\ A^\circ)^2 = \frac{\cancel{150}}{V} = \frac{\cancel{150} \times 144}{13.6 \times 11}$$

$V = 1$

$n=3$ (-1.5)

$$2.51\,eV = 13.6 \times 9 \times \left(\frac{1}{36} - \frac{1}{n_2^2}\right)$$

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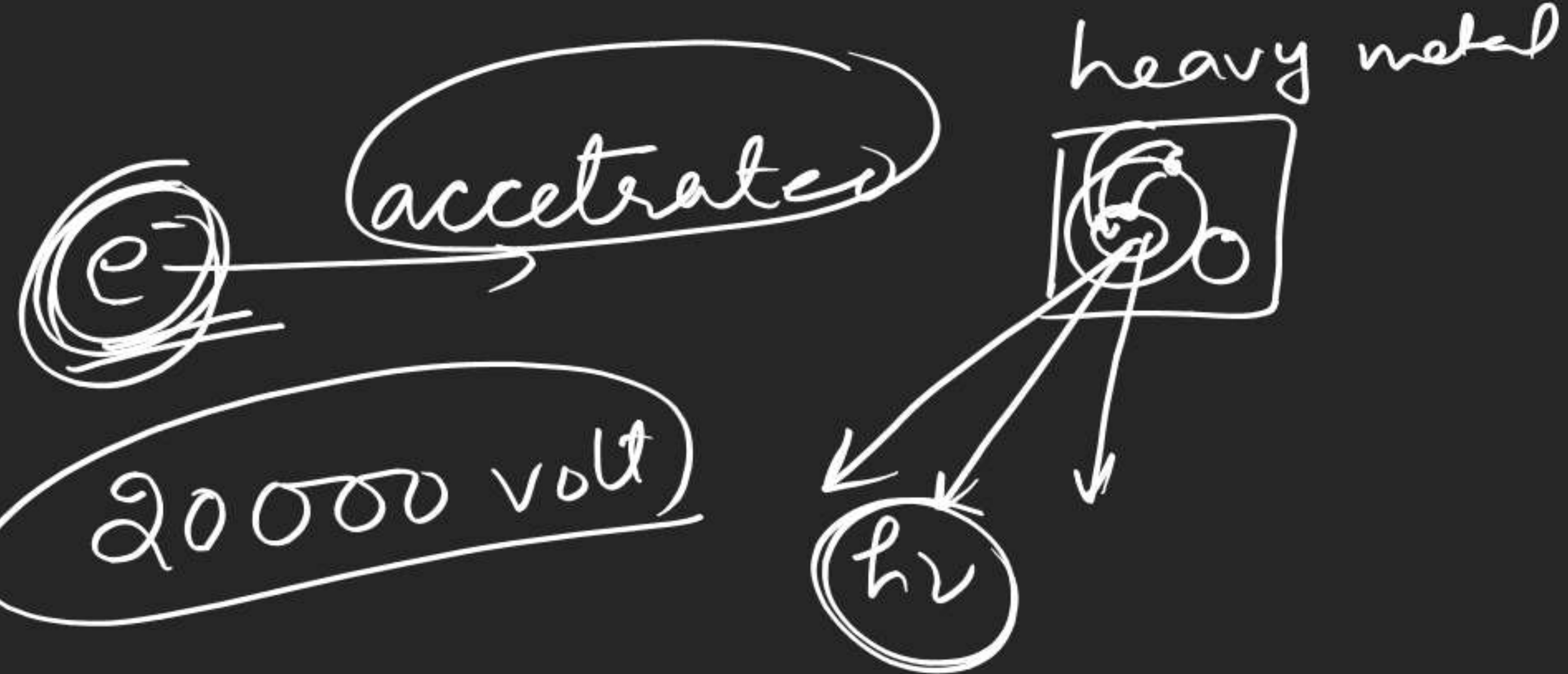
15

$4.5\,eV = KE$

$$\text{Energy} = h\nu = 4.5\,eV = \frac{1240\,nm.eV}{\lambda}$$

16



$$20000\ eV = \frac{1240\ nm.eV}{\lambda}$$

$$U = k \ln r$$

17

$$U = -\frac{ke^2}{3r^3}$$

$$\frac{dU}{dr} = +\frac{\cancel{3}ke^2}{\cancel{3}r^4}$$

$$F = -\frac{dU}{dr} = -\frac{ke^2}{r^4}$$

$$mvr = \frac{nh}{2\pi}$$

$$\frac{mv^2}{r} = \frac{ke^2}{r^4}$$

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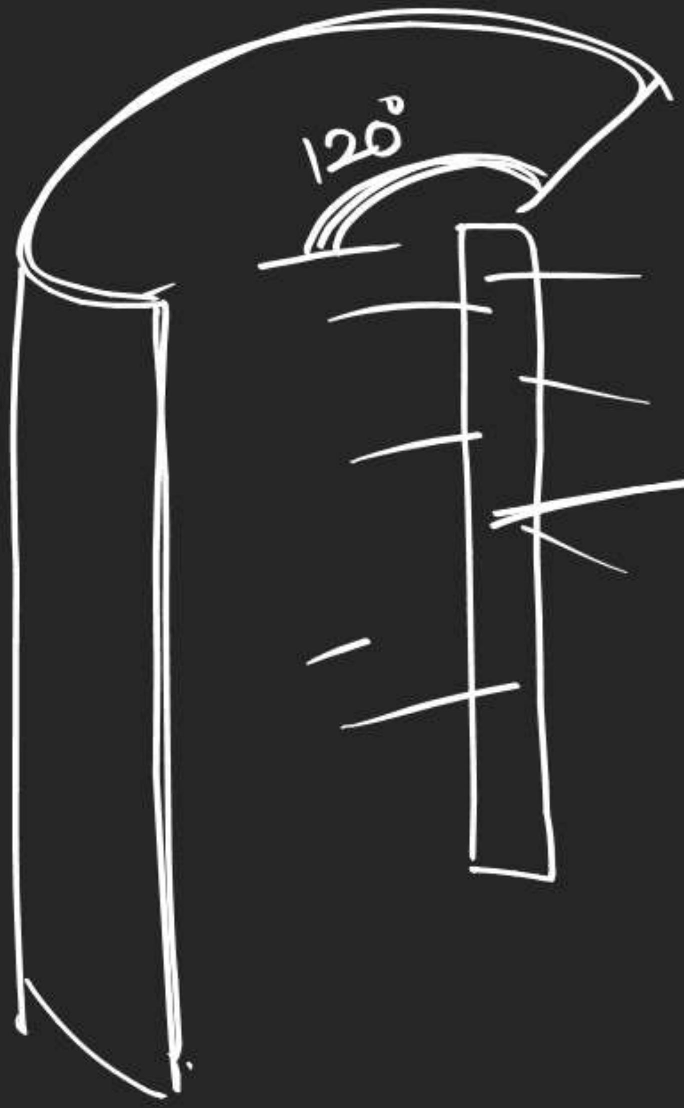


$$\frac{\left(n \times \frac{1}{3}\right) \times 1.6 \times 10^{-19}}{\quad}$$

Coulombs/sec

$R(r)$ vs r

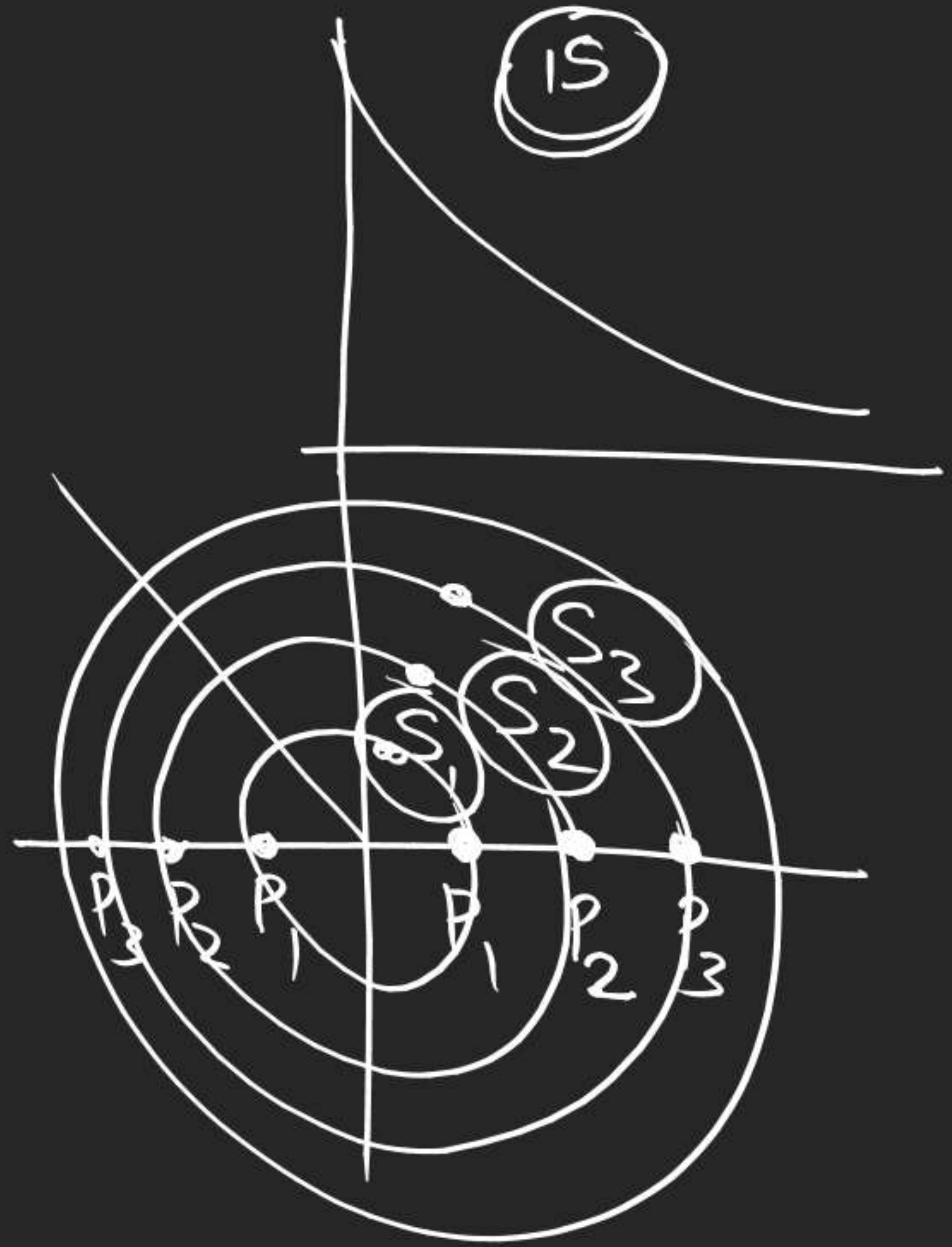
$R^2(r)$ vs r

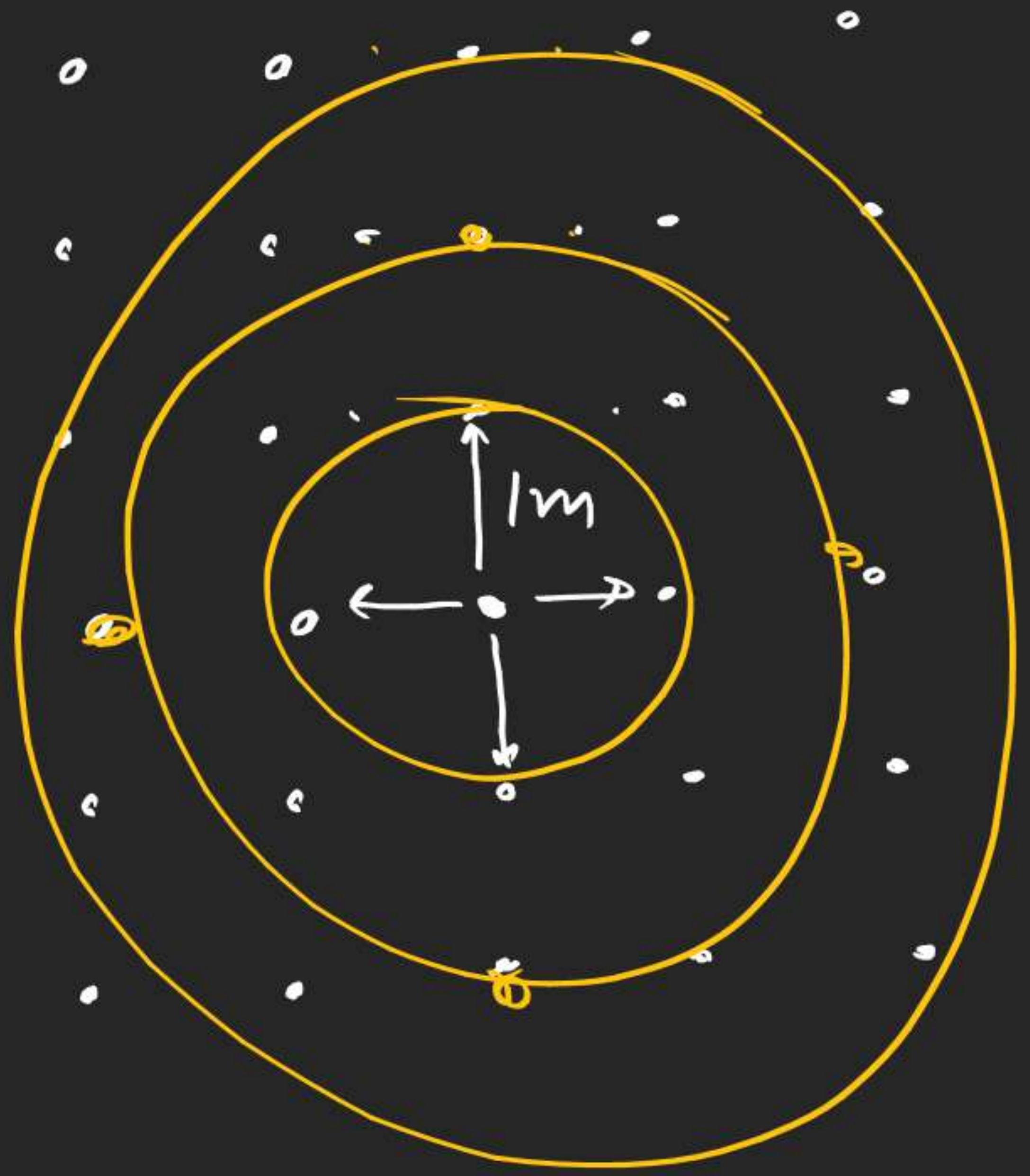
$n-l-1$ = radial node

$1 A^\circ$

$2 A^\circ$

$3 A^\circ$





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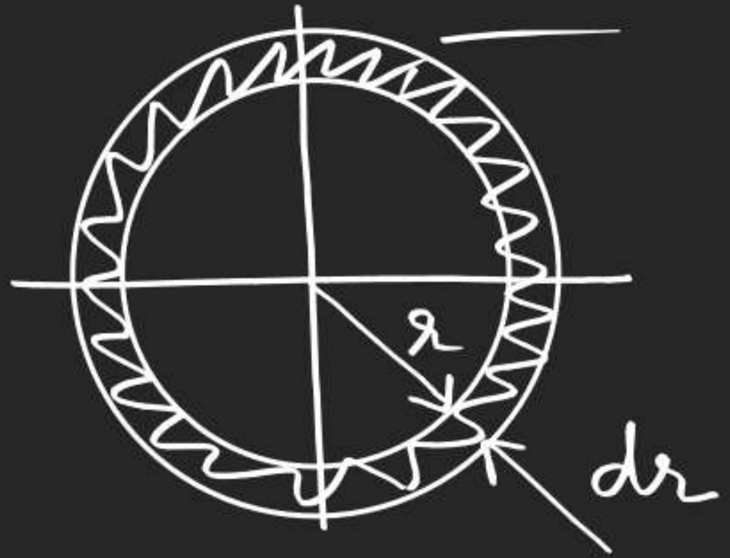
Radial probability distribution function (RPDF)



Vol of spherical shell

$$= 4\pi r^2 dr$$

$$\psi = R(r)\, f(\theta, \phi)$$

ψ^2

Probability density

$R^2(r)$

Radial probability density

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

Radial probability per unit thickness of spherical shell $= \dfrac{4\pi r^2 R^2(r)\, \cancel{dr}}{\cancel{dr}} = 4\pi r^2 R^2(r) = \text{RPDF}$

RPDF vs r

$$R(r)_{1s} = c\left(\frac{1}{a_0}\right)^{3/2} e^{-r/a_0}$$

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

$$RPDF = c' r^2 e^{-2r/a_0}$$

$$r_n = 0.529\,\frac{n^2}{z}\,A^\circ$$
$$= 0.529\ A^\circ$$

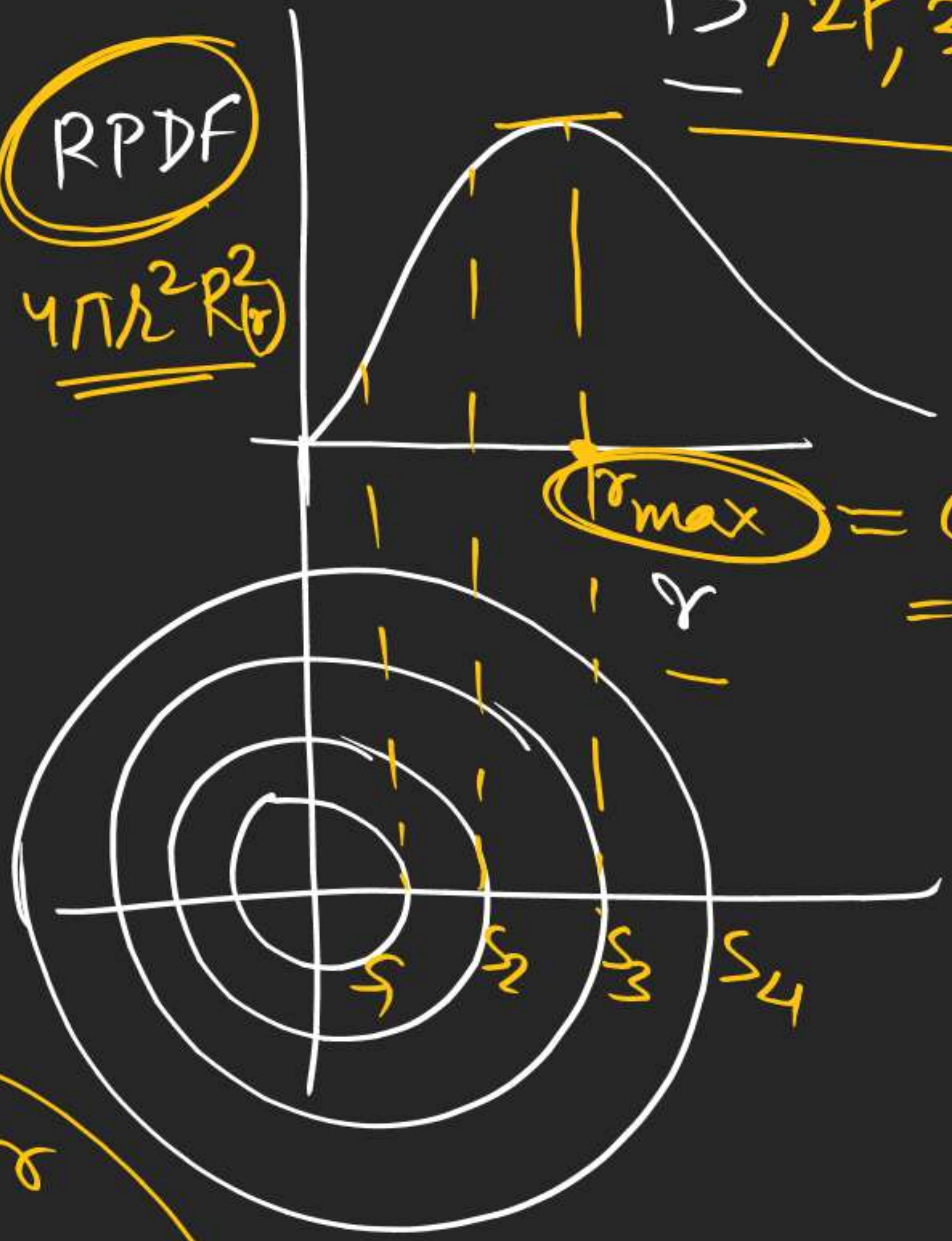
$R^2(r)$ vs r

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

RPDF

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

1S, 2P, 3d, 4f



$r_{max} = 0.529\ A^\circ$
$= a_0$

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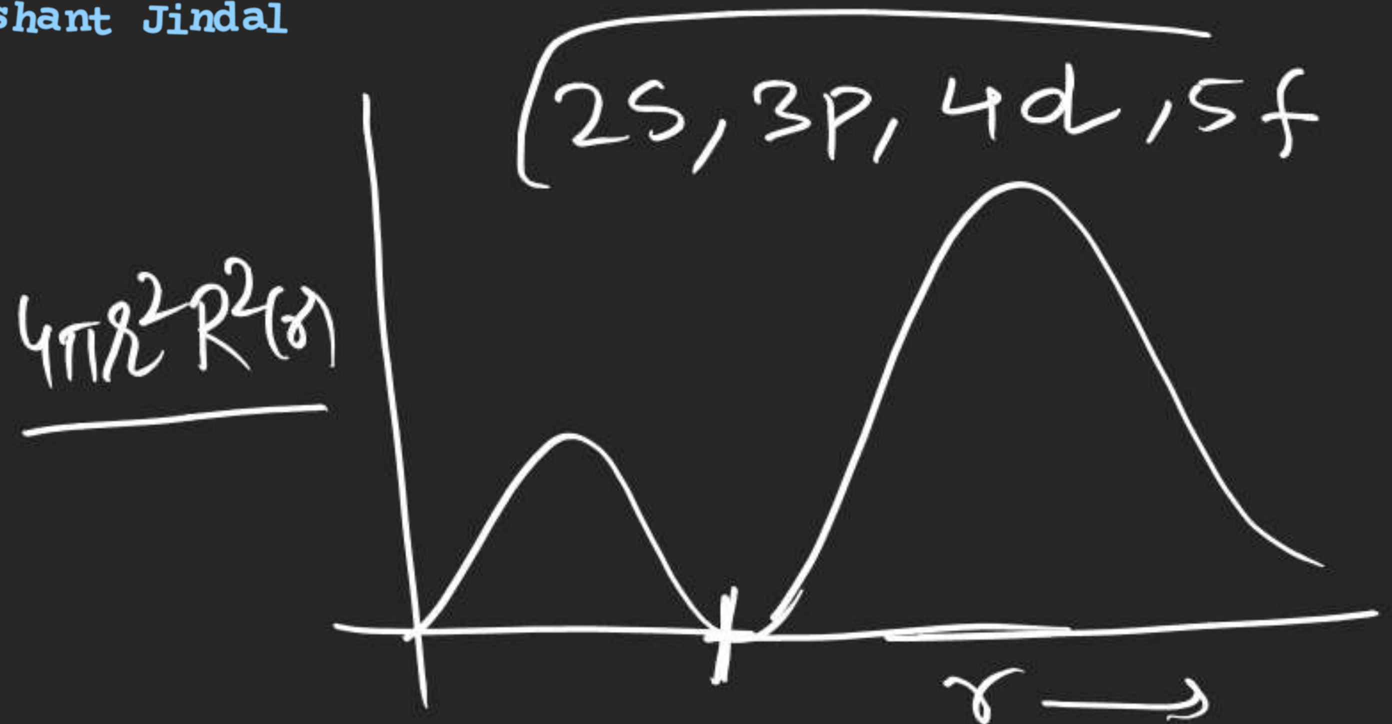

no. of maxima $= n - l - 1 + 1$

$= n - l$