

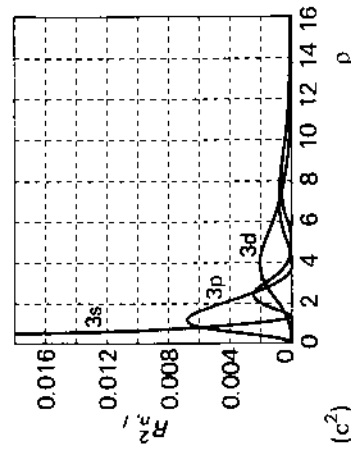
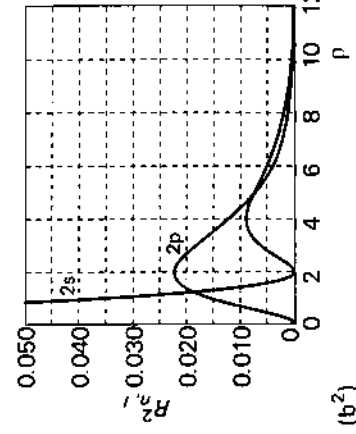
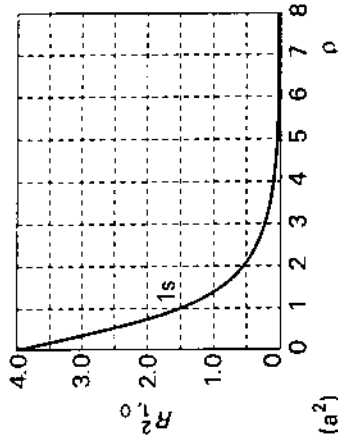
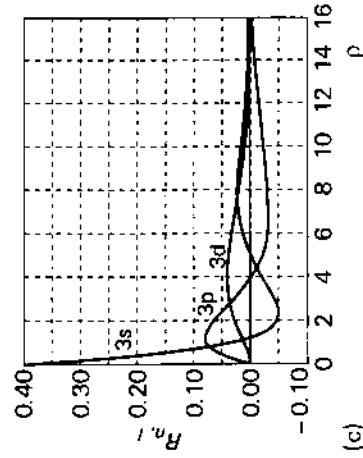
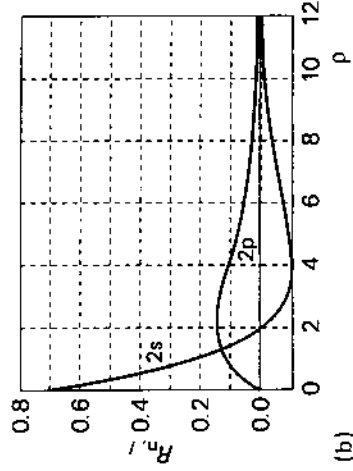
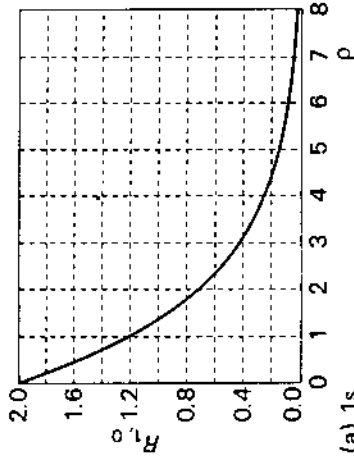
Normalized Hydrogen-Like Wave Functions for the First Two Energy Levels

$$\psi_{nlm}(r, \theta, \phi) = R_{nl}(r) \cdot \Phi_{lm}(\theta) \cdot \Phi_m(\phi)$$

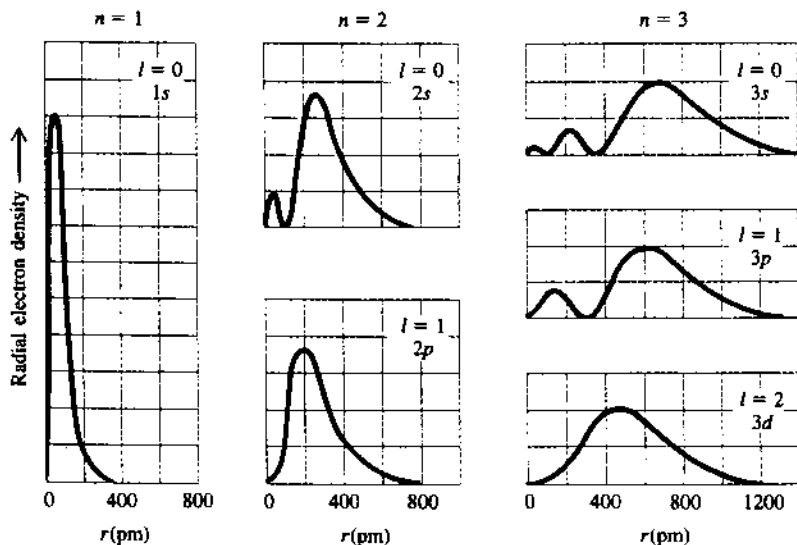
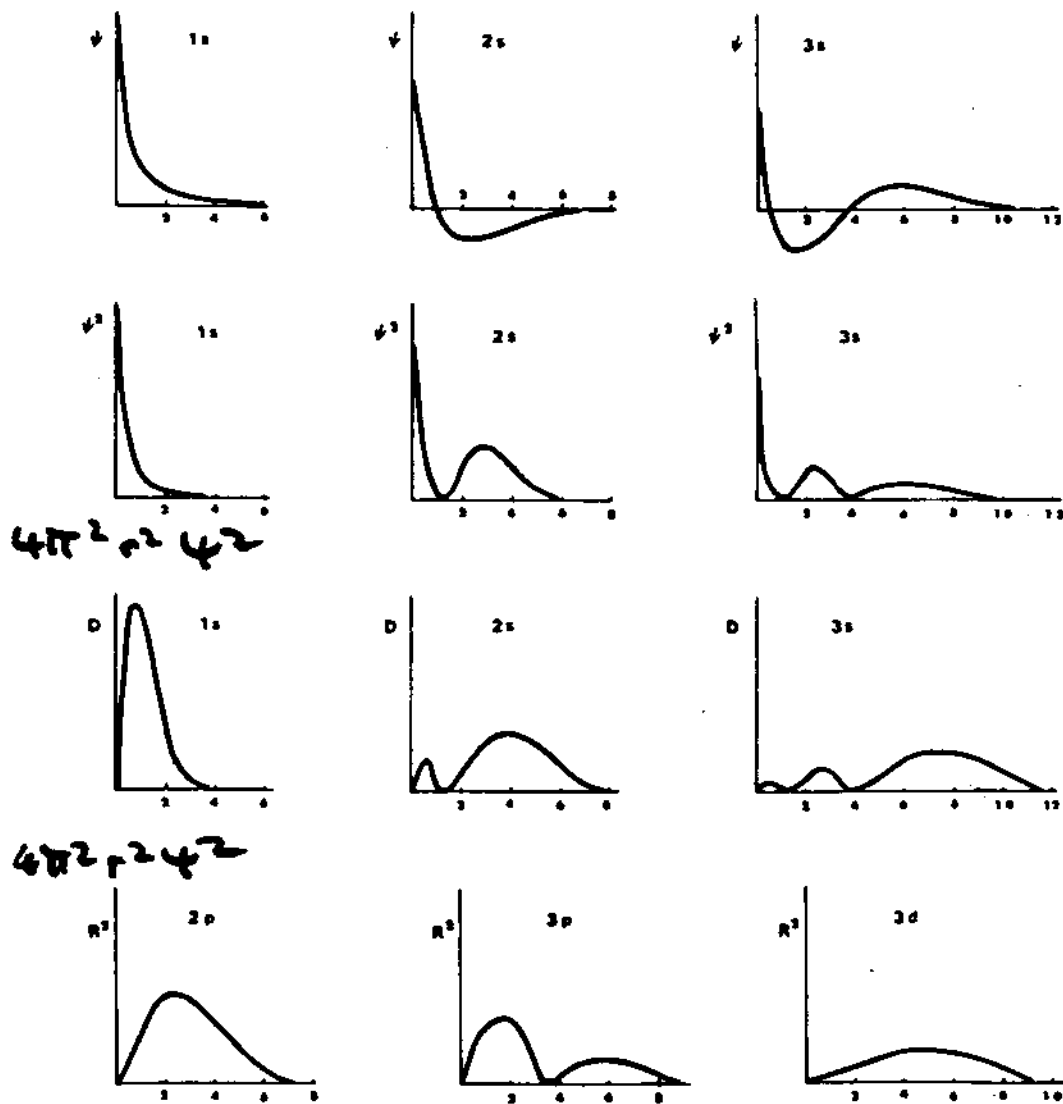
$n$	$l$	$m$	$R_{nl}(r)$ (radial function)	$\Phi_{lm}(\theta) \cdot \Phi_m(\phi)$ (angular function)	Symbol for wave function or orbital
1	0	0	$2 \left( \frac{Z}{a_0} \right)^{3/2} e^{-Zr/a_0}$	$\left( \frac{1}{4\pi} \right)^{1/2}$	1s
2	0	0	$\left( \frac{Z}{2a_0} \right)^{3/2} \left( 2 - \frac{Zr}{a_0} \right) e^{-Zr/2a_0}$	$\left( \frac{1}{4\pi} \right)^{1/2}$	2s
2	1	0	$\frac{1}{\sqrt{3}} \left( \frac{Z}{2a_0} \right)^{3/2} \left( \frac{Zr}{a_0} \right) e^{-Zr/2a_0}$	$\left( \frac{3}{4\pi} \right)^{1/2} \cos \theta$	2p <sub>0</sub> or 2p <sub>z</sub>
2	1	+1	$\frac{1}{\sqrt{3}} \left( \frac{Z}{2a_0} \right)^{3/2} \left( \frac{Zr}{a_0} \right) e^{-Zr/2a_0}$	$\left( \frac{3}{8\pi} \right)^{1/2} \sin \theta e^{i\phi}$	2p <sub>+1</sub>
2	1	-1	$\frac{1}{\sqrt{3}} \left( \frac{Z}{2a_0} \right)^{3/2} \left( \frac{Zr}{a_0} \right) e^{-Zr/2a_0}$	$\left( \frac{3}{8\pi} \right)^{1/2} \sin \theta e^{-i\phi}$	2p <sub>-1</sub>

Equivalent Hybrid Functions for 2p<sub>+1</sub> and 2p<sub>-1</sub>

2	1	$\pm 1$ hybrid	$\frac{1}{\sqrt{3}} \left( \frac{Z}{2a_0} \right)^{3/2} \left( \frac{Zr}{a_0} \right) e^{-Zr/2a_0}$	$\left( \frac{3}{4\pi} \right)^{1/2} \sin \theta \cos \phi$	2p <sub>x</sub>
2	1	$\pm 1$ hybrid	$\frac{1}{\sqrt{3}} \left( \frac{Z}{2a_0} \right)^{3/2} \left( \frac{Zr}{a_0} \right) e^{-Zr/2a_0}$	$\left( \frac{3}{4\pi} \right)^{1/2} \sin \theta \sin \phi$	2p <sub>y</sub>



# Radial Wavefunctions and other Related Functions



**Figure 7.31**

Plots of radial electron density versus  $r$ . The value of  $r$  corresponding to the largest peak is the most probable distance of the electron from the nucleus, that is, the distance at which the electron spends the greatest fraction of time.

