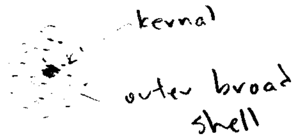
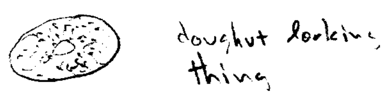
(1,0,0)

(2,0,0)

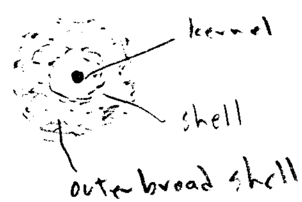


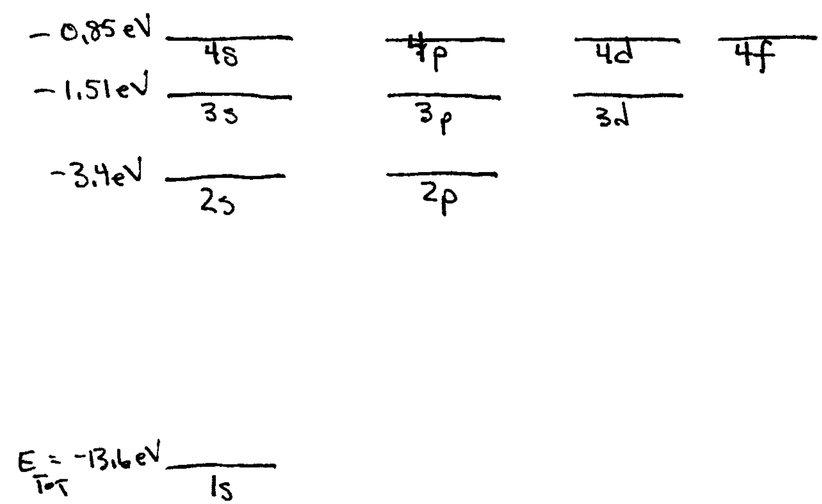
(2,1,0)

(2,1,1)



(3,0,0)





7-9 List all qu. no. combinations (n, ℓ, m_ℓ) for $n=6$ in Hydrogen

$n=6$

$\ell=0 \quad m_\ell=0$

$\ell=1 \quad m_\ell=-1,0,1$

$\ell=2 \quad m_\ell=-2,-1,0,1,2$

$\ell=3 \quad m_\ell=-3,-2,-1,0,1,2,3$

$\ell=4 \quad m_\ell=-4\ -3\ -2\ -1\ 0\ 1\ 2,3,4$

$\ell=5 \quad m_\ell=-5,-4,-3,-2,-1,0,1,2,3,4,5$

7-17. Select the Radial and Angular parts of the wavefunction from Table 7.1 & 7.2

$n=2 \quad \ell=1 \quad m_\ell=-1$

$$\left[\frac{r}{a_0}\frac{e^{-r/2a_0}}{\sqrt{3}\,(2a_0)^{3/2}}\right]\left[+\frac{1}{2}\sqrt{\frac{3}{2\pi}}\sin\theta\, e^{-i\phi}\right]$$

$n=2 \quad \ell=1 \quad m_\ell=0$

$$\left[\frac{r}{a_0}\frac{e^{-r/2a_0}}{\sqrt{3}\,(2a_0)^{3/2}}\right]\left[\frac{1}{2}\sqrt{\frac{3}{\pi}}\cos\theta\right]$$

$n=3 \quad \ell=2 \quad m_\ell=-1$

$$\left[\frac{1}{(a_0)^{3/2}}\frac{4}{81\sqrt{30}}\frac{r^2}{a_0^2}e^{-r/3a_0}\right]\left[+\frac{1}{2}\sqrt{\frac{15}{2\pi}}\sin\theta\cos\theta\, e^{-i\phi}\right]$$

7-19 Z-components of orbital ang. mom.

4p

$n=4 \quad \ell=1 \quad m_\ell = +1,\ 0,\ -1$

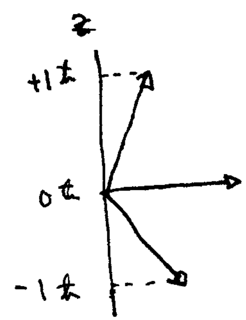
these are actually called "substate quantum no.s"

The actual z-comp L_z would be

$$\langle L_z\rangle = m_\ell \hbar$$

or

$$\langle L_z\rangle = +1\hbar,\ 0\hbar,\ -1\hbar$$



7-20

Maximum difference in Zeeman effect splitting for 4d state in a $B_z = 2.5$ Tesla field

4d $\quad n = 4 \quad \ell = 2 \quad m_\ell = \begin{cases} +2 \\ +1 \\ 0 \\ -1 \\ -2 \end{cases}$

The energy shift is $-\vec{\mu} \cdot \vec{B}$

$$-\mu_z B_z$$

$$-\,-\frac{e}{2m} L_z B_z$$

$$+\frac{e}{2m} m_\ell \hbar B_z$$

The $m_\ell = +2$ and -2 states shift the most

$$\left[\frac{e}{2m}(+2)\hbar B_z\right] - \left[\frac{e}{2m}(-2)\hbar B_z\right]$$

$$4 \frac{e}{2m} \hbar B_z$$

$$4 \frac{1.602{-}19}{2(9.1{-}31)} \frac{6.626{-}34}{2\pi} 2.5$$

$$9.29 \times 10^{-23} \text{ Joules}$$

$$5.8 \times 10^{-4} \text{ eV}$$