HW Solution 13

November 30, 2010

41.36
(a)
For $l = 3$, $m_l = \pm 3, \pm 2, \pm 1, 0$ and $m_s = \pm\frac{1}{2}$
For $l = 2$, $m_l = \pm 2, \pm 1, 0$ and $m_s = \pm\frac{1}{2}$
For $l = 1$, $m_l = \pm 1, 0$ and $m_s = \pm\frac{1}{2}$
(b)
For N shell $n = 4$. For an f-electron, $l = 3$.
$\therefore\ L = \sqrt{12}\hbar$, $L_z = m_l\hbar = \pm 3, \pm 2, \pm 1, 0$ with maximum $3\hbar$, $S = \sqrt{3/4}\hbar$ for all electrons.
(c)
For d-state electron, $l = 2$, $L = \sqrt{6}\hbar$, $L_z = m_l\hbar$ with maximum $2\hbar$.
$cos\theta_{min} = \frac{L_z}{L} = \frac{2}{\sqrt{6}}$, $\theta = 35.3^o$.
$cos\theta_{min} = -\frac{2}{\sqrt{6}}$, $\theta = 144.7^o$.
(d)
This is not possible since l = 3 for an f-electron, but in the M shell the maximum value of l is 2.

41.50
(a)
The energy shift from zero field is $\Delta U_0 = m_l \mu_B B$.
For $m_l = 2$, $\Delta U_0 = 1.62 * 10^{-4} eV$.
For $m_l = 1$, $\Delta U_0 = 8.11 * 10^{-5} eV$.
(b)
$|\Delta\lambda| = \lambda\frac{|\Delta E|}{E_0}$, where $E_0 = 13.6eV(1/4 - 1/9)$, $\lambda_0 = 6.563 * 10^{-7}m$ and $\Delta E = 1.62 * 10^{-14} - 8.11 * 10^{-5} = 8.09 * 10^{-5} eV$.
$\therefore\ |\Delta\lambda| = 0.0281nm$.
The wavelength corresponds to a larger energy change, and so the wavelength is smaller.