Homework Assignment #10  
Due date: Monday, November 26, 2018

1. Reed, Chapter 8, 8-1
2. Reed, Chapter 8, 8-4
3. A beam of electrons enters a magnetic field $B = 0.8T$. What is the difference in energy between electrons that are “spin up” and “spin down” relative to the field?
4. Calculate the magnetic moment of the hydrogen atom (in units of the Bohr magneton $\mu_B$) for the $4^2P_{3/2}$ state.
5. If the hydrogen atom in the $4^2P_{3/2}$ state is placed in an external magnetic field $B$, into how many levels will the state split? Calculate the difference in energy between adjacent substates if $B = 0.5T$.
6. (a) Write down the quantum numbers for the states described in spectroscopic notation as $^2S_{3/2}$, $^3D_2$ and $^5P_3$.
   (b) Determine if any of these states are impossible, and if so, explain why. (Please note that these could describe states with more than one electron.)
7. Consider the hydrogen atom in the $4^2F_{5/2}$ state. Take into account the effects of fine-structure (spin-orbit coupling).
   (a) Write down the spectroscopic notation of the state that the $4^2F_{5/2}$ is degenerate with, in the absence of an external magnetic field.
   (b) Calculate the magnitude of the magnetic moment of the hydrogen atom in the $4^2F_{5/2}$ state, in units of the Bohr magneton $\mu_B$.
   (c) Suppose the hydrogen atom in the $4^2F_{5/2}$ state is placed in an external magnetic field $B$. What will be the spacing in energy between adjacent magnetic substates, in terms of $\mu_B B$, where again $\mu_B$ is the Bohr magneton?