# Problem Set 9

## Problem 1

1. Which of the following combinations of quantum numbers are allowed for a single-particle hydrogenic state?

   - $n = 3, \ell = 2, m_\ell = 1, \text{and } m_s = 0$
   - $n = 2, \ell = 0, m_\ell = 0, \text{and } m_s = -\frac{1}{2}$
   - $n = 7, \ell = 2, m_\ell = -2, \text{and } m_s = \frac{1}{2}$
   - $n = 3, \ell = -3, m_\ell = -2, \text{and } m_s = -\frac{1}{2}$

2. Determine the electronic configurations for the following elements:

$$B, F, Na, P, C, Cr, Mn, Fe, Cu, \text{ and } Kr$$

3. Using the rules for the addition of angular momenta (i.e., do not worry about exchange symmetry), determine all the possible electronic states for the elements B, C, and N in terms of their possible "term symbols", i.e., ${}^{2S+1}L_J$, where $S$ is the total electronic spin, $L$ is the total orbital angular momentum, and $J$ is the total angular momentum.

## Problem 2

1. What are $L, S$, and $J$ for a filled $d$ subshell (i.e., $nd^{10}$)? What is the corresponding term symbol?

2. Use Hund's rules to determine the ground state for carbon.