Physics 449 **HOMEWORK SET 5** **Spring 2009**

Due Wednesday February 25

20) Determine the number of distinct quantum states for each of the following configurations. In each case list the spectroscopic symbols of the allowed states.

(a) two equivalent d electrons [e.g. $(3d)^2$].

(b) two non-equivalent d electrons [e.g. $(3d)^1(4d)^1$].

(c) the configuration $(4p)^1(4f)^1$.

(d) the configuration $(2p)^2(3p)^1$.

21) Use Hund's rules to predict the ordering in energy of the states in part (a) of problem 20 above.

22) A ^{4}D state is split by the spin-orbit interaction into a number of energy levels.

(a) Indicate the j-value of each level.

(b) Use the Lande interval rule to predict the ratios $\Delta E_1/\Delta E_0$ and $\Delta E_2/\Delta E_0$.

23) An atom with a $^4F_{3/2}$ ground state and a $^4D_{5/2}$ first excited state is placed in a magnetic field of 0.8T. Determine the g-factor and the energy splitting ($g\mu_B B$) of each level. Then determine the wavelengths of all the emission lines assuming $\lambda = 375\,\text{nm}$ for $B = 0$. Remember that $\Delta m_j = 0, \pm 1$.