Physics 224 **Fall 1999**

Phenomenology **due 11:00 am Tuesday Oct. 19**

PROBLEM SET 3

Oct. 14 Colloquium: "Starting from the Bottom: The Quest for Understanding Materials at the Spatial Limit"

Professor Wilson Ho, Cornell University

3:30 pm, 101 Rowland Hall

1. Eisberg and Resnick: 7.4

2. Identify the atoms that have the following ground state electronic configurations in their outer shell or shells: (a) $3s^2\ 3p^6\ 3d^8\ 4s^2$, (b) $4s^2\ 4p^4$ (c) $4s^2\ 4p^6\ 4d^2\ 5s^2$ (d) $4s^2\ 4p^6\ 4d^1\ 5s^2$, (e) $4s^2\ 4p^6\ 4d^{10}\ 4f^3\ 5s^2\ 5p^6\ 6s^2$.

3. Show that the multiplicity of a level, defined as the number of different J–values that can be formed from given L and S values, is $2L+1$ or $2S+1$, whichever is smaller.

4. What are the values of L, S, and J and the multiplicities of the levels having the following term designations: ${}^1S_0$, ${}^3D_2$, ${}^4P_{5/2}$, ${}^2F_{7/2}$, ${}^6I_{13/2}$?

5. What types of terms can result from the following values of L and S? (Answer in spectroscopic notation.) (a) $L=1$, $S=1/2$ (b) $L=3$, $S=1$, (c) $L=2$, $S=7/2$, (d) $L=5$, $S=3/2$. (Partial answer: (a) ${}^2P_{1/2}$, ${}^2P_{3/2}$).

6. What spectral terms result from an electron configuration $3d\ 4f$, assuming LS coupling?

7. In the transition ${}^4F_{3/2} - {}^{10}D_{5/2}$, how many lines will appear in the Zeeman pattern? Explain your reasoning by listing the allowed transitions.