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PROBLEM SET 3

*Oct. 16 Colloquium:* “Nonlinear Dynamics, Parity, and Geometry: The Emergence of Structure in Inhomogeneous Turbulence”

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3 pm, 101 Rowland Hall (formerly PS I)

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)  $4s^2 4p^6 4d^{10} 4f^3$ .
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  $^4F_{3/2} - ^{10}D_{1/2}$ , how many lines will appear in the Zeeman pattern? Explain your reasoning by listing the allowed transitions.