# 22.101 Applied Nuclear Physics

## (Fall 2006)

**Problem Set No. 5** **Due: Oct. 25, 2006**

**Problem 1**

Consider Figs. 9.1 through 9.4. Explain in your own words the information given in each figure. Is the information consistent from one figure to another? What is the overall picture of nuclear stability when the figures are taken together?

**Problem 2**

Explain the addition of spin and orbital angular momentum operators to form the total angular momentum operator, $\underline{j} = \underline{S} + \underline{L}$, in terms of the eigenfunctions and eigenvalues of the these operators. In what way is addition of angular momentum operators different from the geometric addition of two classical vectors?

**Problem 3**

Write a brief essay (no more than two pages) summarizing the essential arguments that lead to the explanation of the magic numbers in terms of the nuclear shell model.

**Problem 4**

On the basis of the single-particle shell model with spin-orbit coupling (Fig. 9.6), predict the ground-state spin and parity of the following nuclides:

$$Be^{7},\ \ F^{19},\ \ Al^{27},\ \ Fe^{57},\ \ Mo^{95},\ \ Eu^{153},\ \ Au^{197},\ \ Pb^{207},\ U^{233}$$

Compare your results with experimental data (e.g., Nuclide Chart); in the case of any discrepancy between your predictions and data, give an explanation.