Problems for chapter 3, due Feb. 3, 2012

Problems 1, and 3 in the text book.

Problem 3.

Show that the first three bands in the empty-lattice model span the following energy ranges.

$$E_1: \quad 0 \text{ to } \pi^2\hbar^2/2m_0a^2; \qquad E_2: \quad \pi^2\hbar^2/m_0a^2 \text{ to } 2\pi^2\hbar^2/m_0a^2;$$

$$E_3: \quad 2\pi^2\hbar^2/m_0a^2 \text{ to } 9\pi^2\hbar^2/2m_0a^2.$$

Problem 4.

Suppose that the crystal potential in a one-dimensional lattice is composed of a series of rectangular wells which surround the atom. Suppose that the depth of each well is V_0 and its width $a/5$.

a) Using the NFE model, calculate the values of the first three energy gaps. Compare the magnitudes of these gaps.

b) Evaluate these gaps for the case in which $V_0 = 5\,\text{eV}$ and $a = 4\,\text{Å}$.