1. Describe the energy for

  (a)   a free electron

  (b)   a strongly bound electron

  (c)   an electron in a periodic potential (i.e., in a crystal)

   Why do we get these different band schemes?

2. Answer the following questions.

(a) Calculate how much the kinetic energy of a free electron at the corner of the first Brillouin zone of a simple cubic lattice (three dimensions!) is larger than that of an electron at the midpoint of the face.

(b) Construct the first four Brillouin zones for a simple cubic lattice in two dimensions.

3. Answer the following questions.

(a) Calculate the shape of the free electron bands for the cubic primitive crystal structure for $n = 1$ and $n = -2$ (See Fig. 5.6).

(b) Calculate the main lattice vectors in reciprocal space of an fcc crystal.

(c). If $\mathbf{b}_1 \cdot \mathbf{t}_1 = 1$ is given (see equation (5.14)), does this mean that $\mathbf{b}_1$ is parallel to $\mathbf{t}_1$?