Homework #2

Due: April. 10 (M)

1. In the empty lattice model,

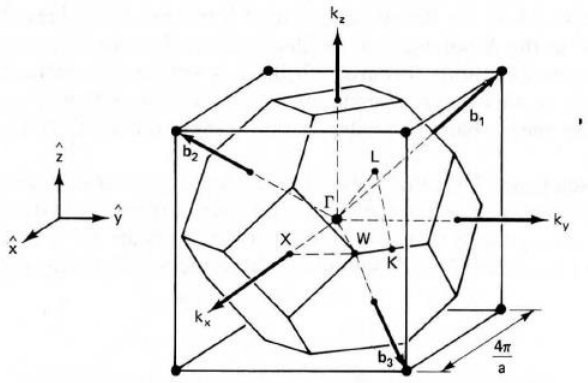
(1) Show that the next highest level above (2.42) occurs for h = k = 1, l = 0 and so on, or for

$$\mathbf{K} = \frac{2\pi}{a}(2\hat{z}) \qquad (2.43)$$

and so on. Show also that the energy of this point is sixfold degenerate and has the value

$$\mathscr{E}(0) = \frac{\hbar^2}{2m}\left(\frac{4\pi}{a}\right)^2 \qquad (2.44)$$

(2) Find all the values of wavevector ***k*** for the K-points. Get the energy of the K-point.



2. Equation (2 .103) shows that the energy of a Bloch electron, derived from one atomic state, consists of some constant value and an expression that varies with wavefunction between well-defined limits. From this equation draw the energy band as shown in Figure 2.12.

$$\mathscr{E} = \mathscr{E}_a - \alpha - 4\beta[\cos\tfrac{1}{2}k_x a \cos\tfrac{1}{2}k_y a + \cos\tfrac{1}{2}k_y a \cos\tfrac{1}{2}k_z a + \cos\tfrac{1}{2}k_z a \cos\tfrac{1}{2}k_x a] \qquad (2.103)$$

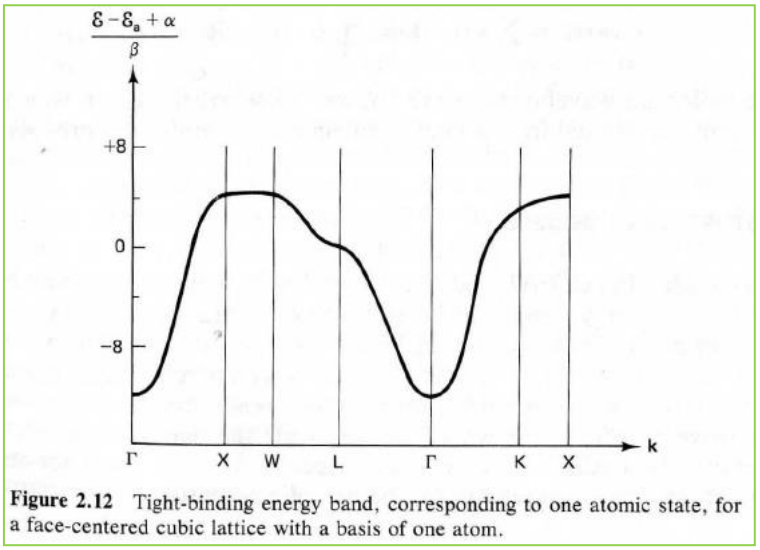


Figure 2.12 Tight-binding energy band, corresponding to one atomic state, for a face-centered cubic lattice with a basis of one atom.