

Physics 861 { Fall 2001

Problem set 5 - Due Thursday, Oct. 12

1. How many symmetry operations are contained
 - ² In the full octahedral group O_h ?
 - ² In the group O that does not include "improper operations"? What are improper operations?
 - ² In the group C_{4v} ? One of the operations in C_{4v} can be denoted as $(x; z; y)$ and is a mirror reflection in the yz plane. List all the operations of C_{4v} in this notation and describe them in words.

2. Consider an s-band in the tight binding approximation.
 - ² If J is the nearest neighbor interaction integral and all other interaction integrals, as well as the overlap integrals, are negligible, what is the bandwidth in a face centered cubic crystal? In a body-centered cubic? In an hexagonal close-packed?
 - ² What happens, qualitatively, to the bandwidth if the crystal is compressed?

3. Draw the free electron energy levels as in Fig. 9.5 (empty-lattice diagram) for the two-dimensional square lattice. Include at least 7 bands. Show how the bands are modified by a weak potential of the form $V(\cos(2\pi x/a) + \cos(2\pi y/a))$:

4. Problem 5, page 172 of AM. Do not forget the factor of 2 that comes from spin. For part (b), it will be enough to consider $m = 1:4$.

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Alternative, instead of problem 2: Problem 1, page 189 of AM. Also, part (d), find the expression for the band energy at small k . What is the effective mass at $k = 0$? What is the density of levels for small k ?