

Physics 880.06: Problem Set 4

Due Friday, October 25, 2002

1. Ashcroft and Mermin, Chapter 5, Problem 1.
2. Ashcroft and Mermin, Chapter 5, Problem 2, parts (a) and (b).
3. β -brass is an equiatomic compound of Cu and Zn, which has the CsCl structure. That is, the Cu and Zn atoms lie on two interpenetrating simple cubic lattices; if the cube has edge a , then the Zn lattice is displaced from the Cu lattice by the vector $(a/2)(\hat{x} + \hat{y} + \hat{z})$.
 - (a). What is the reciprocal lattice for this structure? Calculate the structure factor $S(\mathbf{K})$ [eq. (6.21)] for all reciprocal lattice vectors \mathbf{K} in terms of the atomic form factors $f_{Cu}(\mathbf{K})$ and $f_{Zn}(\mathbf{K})$.
 - (b). Above a temperature of about 460 C, the β -brass structure disorders, and the Cu and Zn atoms occupy the atomic sites on the crystal structure at random. Suppose that this situation can be treated by assuming that atomic site has the *same* atomic form factor. Show then that the structure factors $S(\mathbf{K})$ vanish for some \mathbf{K} 's, and find for which \mathbf{K} 's this vanishing occurs.