Physics 412 Solid State Physics

Homework 2, due Sept. 27

Name:

1. Show that the distance between two consecutive (h k l) planes in a cubic lattice with cube edge $a$ satisfies

\[ d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}} \]

2. This figure shows a set of planes, and two sets of unit cell vectors.

(a) What are the Miller indices for the planes, indexed with reference to $a_1$ and $a_2$?

(b) Sketch the reciprocal lattice. Indicate $b_1$, $b_2$ and the reciprocal vector $G_{hk}$ which corresponds to the set of planes shown.

(c) What are the Miller indices for the planes when indexed with reference to $a_3$ and $a_4$?

3. The primitive translation vectors of the hexagonal lattice may be taken as

\[
\begin{align*}
  a_1 &= \frac{\sqrt{3}}{2} a\hat{x} + \frac{1}{2} a\hat{y} \\
  a_2 &= -\frac{\sqrt{3}}{2} a\hat{x} + \frac{1}{2} a\hat{y} \\
  a_3 &= c\hat{z}
\end{align*}
\]
(a) Show that the volume of the primitive cell is $\sqrt{3}a^2c/2$ 
(b) Find the primitive translation vectors of the reciprocal lattice.

4. KCl and KBr are alkali halides with the NaCl structure. Reflections from the following planes are observed with X-ray diffraction:

KBr: (1 1 1), (2 0 0), (2 2 0), (3 1 1), (2 2 2), (4 0 0), (3 3 1), (4 2 0)

KCl: (2 0 0), (2 2 0), (4 0 0), (4 2 0)

Why do you think there is such a difference in two similar geometrical structures?