Physics 412 Solid State Physics
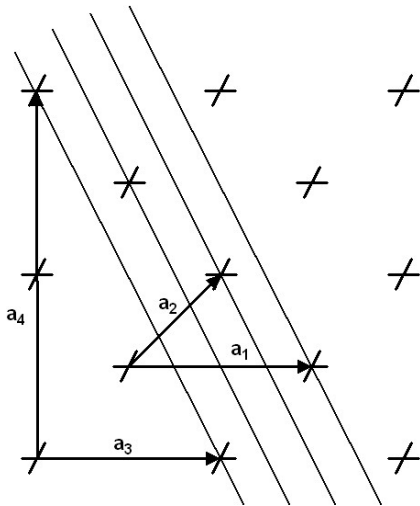
Homework 2, due Sept. 27

Name:

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

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

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 **a1** and **a2**?

(b) Sketch the reciprocal lattice. Indicate **b1**, **b2** and the reciprocal vector $\mathbf{G_{hk}}$ which corresponds to the set of planes shown.

(c) What are the Miller indices for the planes when indexed with reference to **a3** and **a4**?

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

$$\boldsymbol{a_1} = \frac{\sqrt{3}}{2} a\hat{\boldsymbol{x}} + \frac{1}{2} a\hat{\boldsymbol{y}}$$

$$\boldsymbol{a_2} = -\frac{\sqrt{3}}{2} a\hat{\boldsymbol{x}} + \frac{1}{2} a\hat{\boldsymbol{y}}$$

$$\boldsymbol{a_3} = c\hat{\boldsymbol{z}}$$

(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?