Physics 422 **Name (Print):** _____
Fall 2018
Homework assignemnt 2
Due: 9/13/2017

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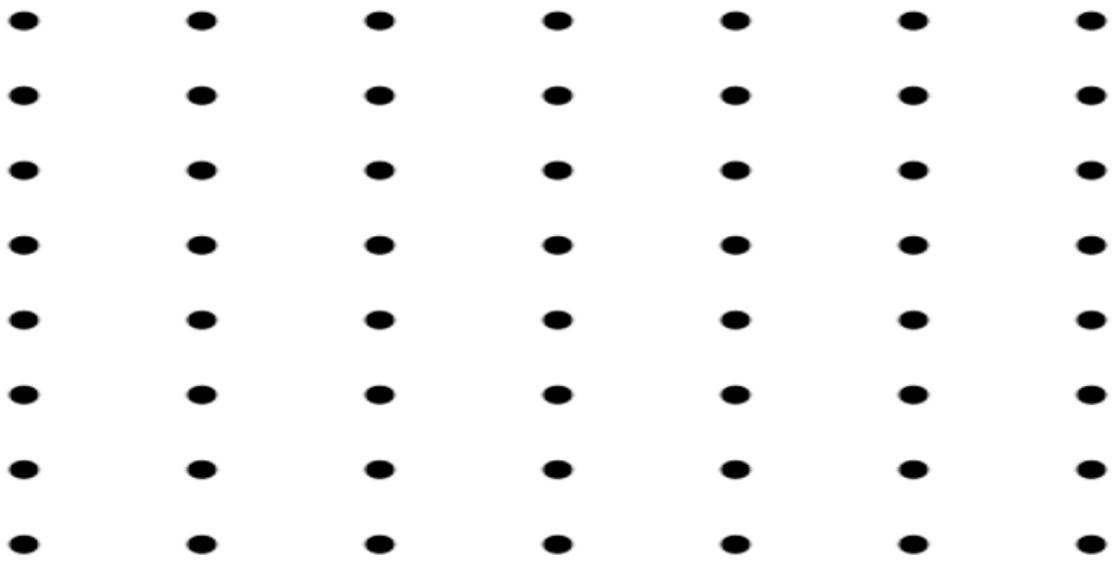
1. Draw a series of cubic unit cells with the following lattice planes on them
   - (001)
   - (110)
   - (201)
   - $(2\bar{1}0)$
   - $(1\bar{1}1)$

2. Consider a Silicon crystal. It forms a diamond structure (FCC lattice with 2 Si basis). Given a lattice constant of 0.543 nm (the edge of a conventional unit cell)
   (a) Calculate the volume density of Si atoms (atoms/cm^3)
   (b) Calculate the areal density of atoms on the (110) plane.

3. Consider the 2D real space lattice shown in the figure and answer the following questions.



   a) Draw a primitive unit cell in the figure.
   b) Draw a set of primitive lattice vectors in the figure.
   c) As its own figure, draw the reciprocal lattice.
   d) Draw a primitive unit cell for the reciprocal lattice.
   e) Draw a set of primitive lattice vectors for the reciprocal lattice.
   f) The spacing between real space lattice points in the $\hat{x}$ and $\hat{y}$ directions is a, and b respectively. What is the spacing between reciprocal lattice points in the directions of your primitive lattice vectors?

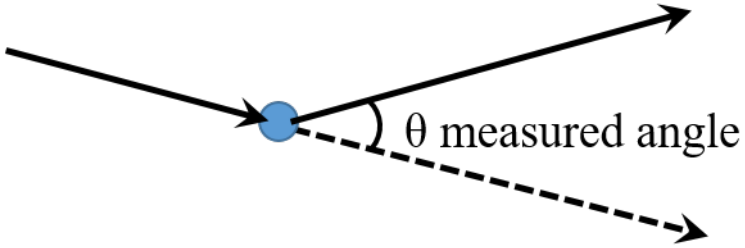
4. A beam of 0.162 nm X-rays is incident upon a powdered sample of cubic metal palladium. The peaks in the scattered X-ray pattern are observed at angles of 42.3, 49.2, 72.2, 87.4, and 92.3 degrees from the direction of the incident beam (see figure).

   a) What is the lattice type?

   b) Calculate the lattice constant.

   c) What is the nearest neighbor distance?

   d) Is this consistent with the density of palladium of 12023 kg/m^3 (atomic mass = 106.4)



5. We often use the conventional cubic unit cell as opposed to their primitive unit cells when describing the FCC and BCC lattices. Treating it as a cubic lattice with a "4-lattice point basis" determine the "systematic absences" in the scattering peaks of the FCC lattice. That is to say, of the peaks we would expect to observe from the cubic lattice, which are missing. (Hint: This is determined by calculating the structure factor).