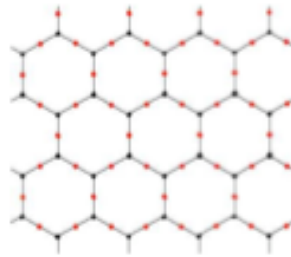


Reading: Chapters 1 and 2 of Kittel's book, *Introduction to Solid State Physics*

- (25) 1. Consider the two-dimensional crystal shown in the figure below. The red and black dots represent two kinds of atoms with nearest neighbor distance a . Determine: a) a set of lattice points
b) a choice of primitive translation vectors
c) the Wigner-Seitz cell and its area
d) the basis of atoms associated with a primitive unit cell.



- (25) 2. a) Problem 3, Chapter 1 of ISSP.
b) Sodium transforms from bcc to hcp at about 23K (the “martensitic” transformation). Assuming that the density remains fixed through this transition, find the lattice constant a of the hexagonal phase, given that $a = 4.23 \text{ \AA}$ in the cubic phase and that the $\frac{c}{a}$ ratio is that of the ideal value.
- (25) 3. (a) NaCl has a density of 2.167 g/cm^3 . What is the distance between adjacent atoms?
(b) Given the distance in a), calculate the energy due to the gravitational attraction between two neighboring atoms. If these two atoms have a typical magnetic moment of that of a free electron, calculate the energy due to the magnetic dipole attraction. Lastly, compare these energies with that from the Coulomb attraction of two oppositely charged ions.
- (25) 4 (a) Show that the volumes of the primitive cell for sc, bcc, and fcc lattices are a^3 , $\frac{1}{2} a^3$, $\frac{1}{4} a^3$, respectively, where a is the length of the edge of the conventional unit cell.
(b) What are the corresponding Brillouin zone volumes for the above three lattices?