

**I. PROBLEM SESSION 1****A. Problem 1**

Barium Titanate,  $\text{BaTiO}_3$ , has a so-called cubic perovskite lattice structure in which the Ba atom sits in the corner of a cube, the O atoms are face centered on the sides of the cube, and the Ti atom is space centered in the cube.  $\text{BaTiO}_3$  is known for its ferro-electric properties.

- Find the primitive and basis vectors.
- Find the Bravais lattice describing  $\text{BaTiO}_3$ .

**B. Problem 2**

Consider the diamond structure (see Kittel page23):

- First, make a similar analysis as in Problem 1.
- How many atoms are there in the primitive cell of a diamond.
- The lattice constant of diamond is  $3.56\text{\AA}$ . What is the length of the primitive translation vector.
- How many atoms are there in the conventional cubic cell.
- What is the coverage of the diamond lattice.

**C. Problem 3**

Indices of planes:

Consider the planes with indices (100) and (001); the lattice is fcc, and the indices refer to the conventional cubic unit cell. What are the indices of these planes when referred to the primitive axes of Fig.11(see Kittel page 11)?

**D. Problem 4**

The coverage of a lattice structure is the maximum fraction of space filled by non-overlapping spheres centered on the sites of the lattice. Show that the coverage of a simple cubic lattice is 52%, a body-centered cubic lattice (bcc) has the coverage of 68%, and a facecentered cubic lattice (fcc) has the coverage of 74%.