2. NonBravais crystal lattice:

Some of lattice points is non-equivalent when you look at them from different orientation, and the atoms placed at the lattice points are not the same. This crystal is a non-Bravais lattice.

Example: (a 2-D honeycomb)

The vertices of this 2-D array do not form a Bravais lattice because the orientational relations are not the same when viewed from adjacent points (only if the page is rotated by 180°) each time one moves from one point to the next. However structural relations are clearly identical.

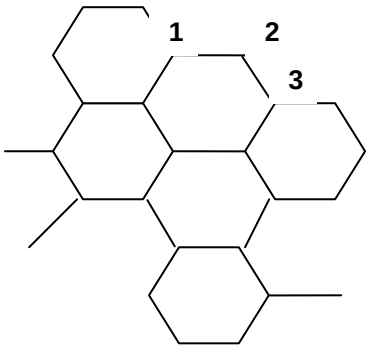


Figure 4: The vertices of the 2-D honeycomb do not form a Bravais lattice .

What is a unit cell?

A unit cell is the basic building block in a crystal structure which just fills space without any overlapping when translated by a translational vector.

Three types of unit cell are of major concern:

1. Primitive unit cell
2. Conventional (non-primitive) unit cell.[mostly termed as a unit cell].
3. Wigner-Sietz (WS) unit cell.

Primitive unit cell:

It is the smallest unit cell (i.e. the smallest volume) that can be repeated to form the lattice. The number of atoms in a primitive cell is always the same for a given crystal structure. It contains one lattice point only. The basis associated with a primitive cell is called a primitive basis.

[Note: No basis contains fewer atoms than a primitive basis contains].

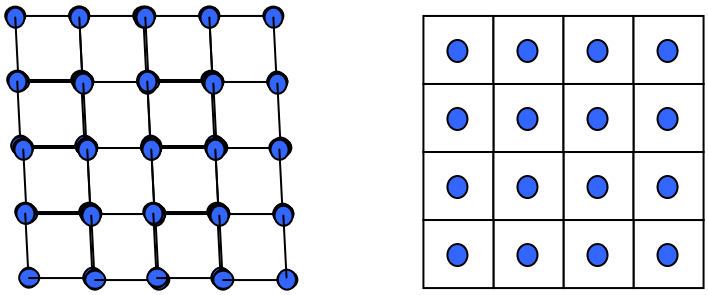


Figure 5: A unit cell that contains only one lattice point is a primitive cell

Conventional unit cell:

It is often used to describe the periodicity of crystals. Such a cell contains more than one primitive lattice point.

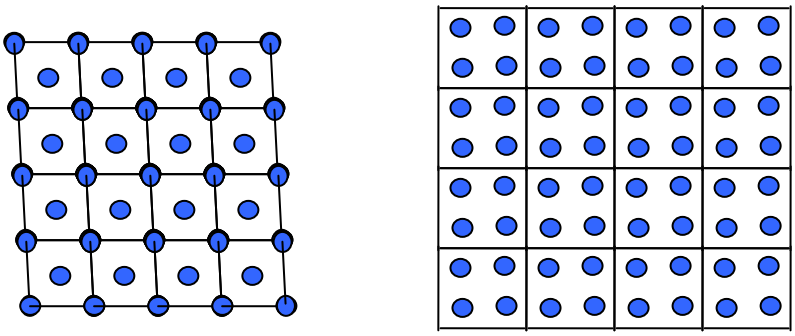


Figure 6: A unit cell that contains more than one lattice point is a conventional cell

Examples:

1. The body-centered cubic (bcc) lattices are described in terms of a cubic unit cell. Here the conventional unit cell of bcc= twice the primitive bcc unit cell. (Prove it!!, see figures 7 and 8).

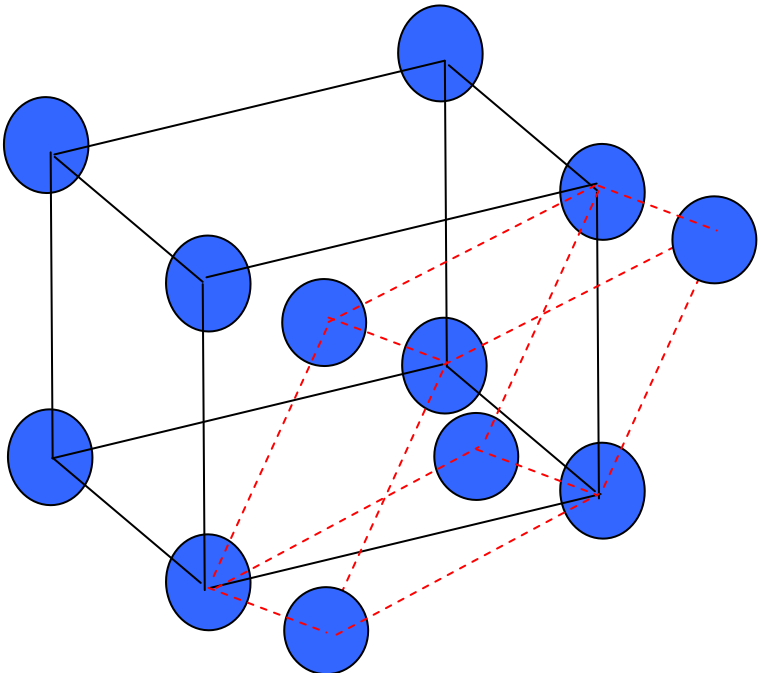
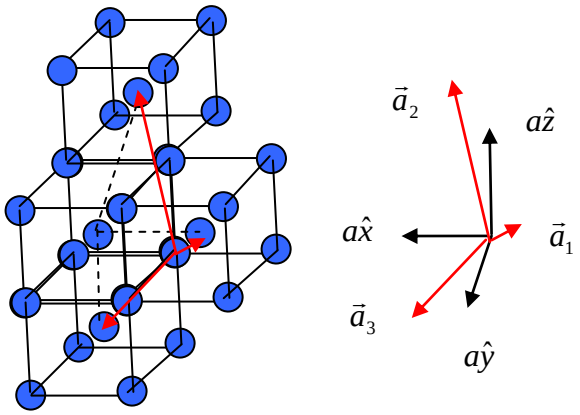


Figure 7: Conventional (solid line) and primitive (dash line) unit cells for the bcc Bravais lattice. The primitive cell has half the volume of the conventional cell.



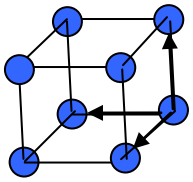


Figure 8:
a) A set of symmetric primitive vectors for bcc Bravais lattice

b)Primitive vectors for simple cubic (sc) Bravais lattice

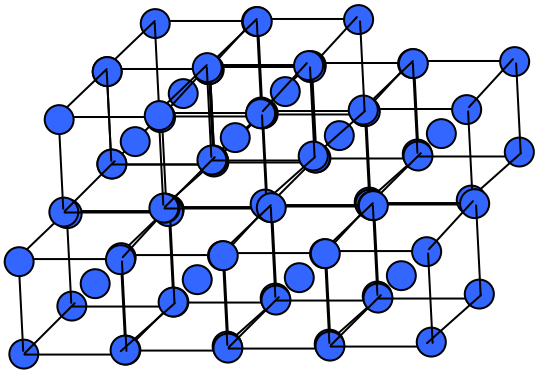


Figure 9: Body-centered cubic (bcc) Bravais lattice in 3-D