

Introduction to Crystal Structures

1. quartz - ball and stick model

There are only two kinds of atoms in this model. Silicon is black and oxygen is red. For each, fill in the following table:

color	element	ion and charge	coordination #	bond strength

The formula is SiO_2 . So, there are twice as many oxygen as silicon in this structure. Is the coordination number for oxygen equal to half the coordination number for silicon? Why or why not?

2. calcite - ball and stick model

Here we have black carbon, red oxygen and white calcium atoms. The CO_3 groups are tightly bonded complexes and act as an ionic group. So, treat them as one unit and fill in the following table:

color	element or radical	charge	coordination #	bond strength

3. sphalerite - clear plastic model

In this kind of model, the different ions have different sizes. This is more realistic than the standard ball and stick model. The little red balls represent zinc. The large white ones are sulfur. Assuming that sphalerite is ionic, you can determine coordination numbers and bond strengths just as you did for quartz. You, of course, realize that if there are equal numbers of Zn and S, then their ionic charge must be the same. So, fill in the following table. This is a bit more complicated than for quartz.

color	element	ion and charge	coordination #	bond strength

4. **wurtzite** - clear plastic model

In this model, the little red balls represent zinc. The large white ones are sulfur.

Wurtzite and sphalerite are *polymorphs*. What does this mean?

Assuming that wurtzite is ionic, you can determine coordination numbers and bond strengths just as you did for sphalerite.

color	element	ion and charge	coordination #	bond strength

How do the coordination numbers, bond strengths, etc. compare between wurtzite and sphalerite?

Sphalerite and wurtzite form different shaped crystals because they have different atomic arrangements, even if the same composition. Look carefully at the models and explain why the two have different structures. They just do not look the same. Why?

Make a sketch of a unit cell of wurtzite, and also a sketch of a unit cell of sphalerite. Show where the two kinds of atoms are located in each of the unit cells. (You may want to look in your book and determine what crystal system each belongs to.)

5. **olivine** - plastic model

In this olivine model, the large pinkish spheres are oxygen. The small brown marbles are magnesium. The white marbles are silicon. Fill in the following table:

color	element	ion and charge	coordination #	bond strength

Are the coordination numbers for the magnesium and the silicon the same? Why or why not?

Make a sketch of each of the cations, showing the correct number of bonds around each and the strength of the bonds.

Now, make a sketch of each of an oxygen anion, showing the correct number of bonds around each and the strength of the bonds. This is tough!

6. **albite** - ball and stick model

The red balls are oxygen, black are silicon, silver are aluminum, and gold are sodium.
For the cations only, fill in the following table:

color	element	ion and charge	coordination #	bond strength

Make a sketch of each of the cations, showing the correct number of bonds around each and the strength of the bonds.

Now, if you are masochist and want lots of extra credit, do the same sort of analysis for the oxygen anions! Good luck.