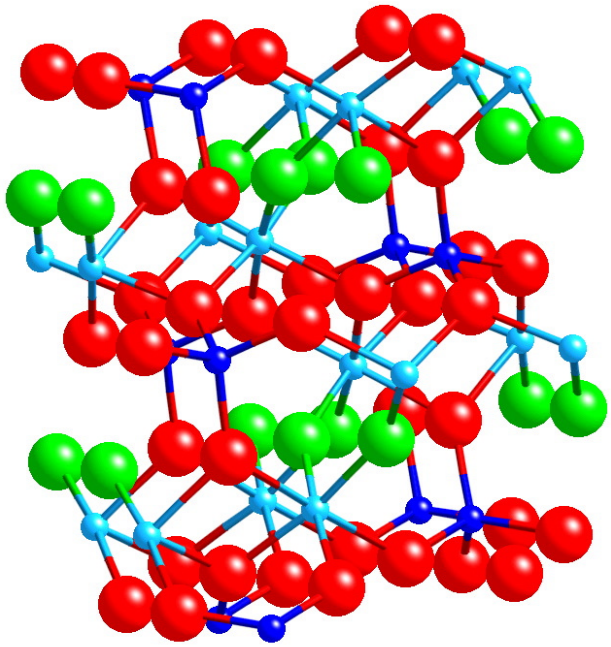
Homework #2 (print this out and answer on the sheet, or you can answer on another sheet)



Local Charge Balance

Examine the Topaz structure at right. Complete this chart for topaz:

Color in diagram	Element	Ionic Charge	Number of bonds
Red	Oxygen		
Dk. Blue	Silicon		
Lt. Blue	Aluminum		6
Green	Fluorine		

What silicate structural group is topaz in (you could look this up, but try to see the tetrahedral linkages at right to figure it out)?

What should the Si:O ratio be for this group?

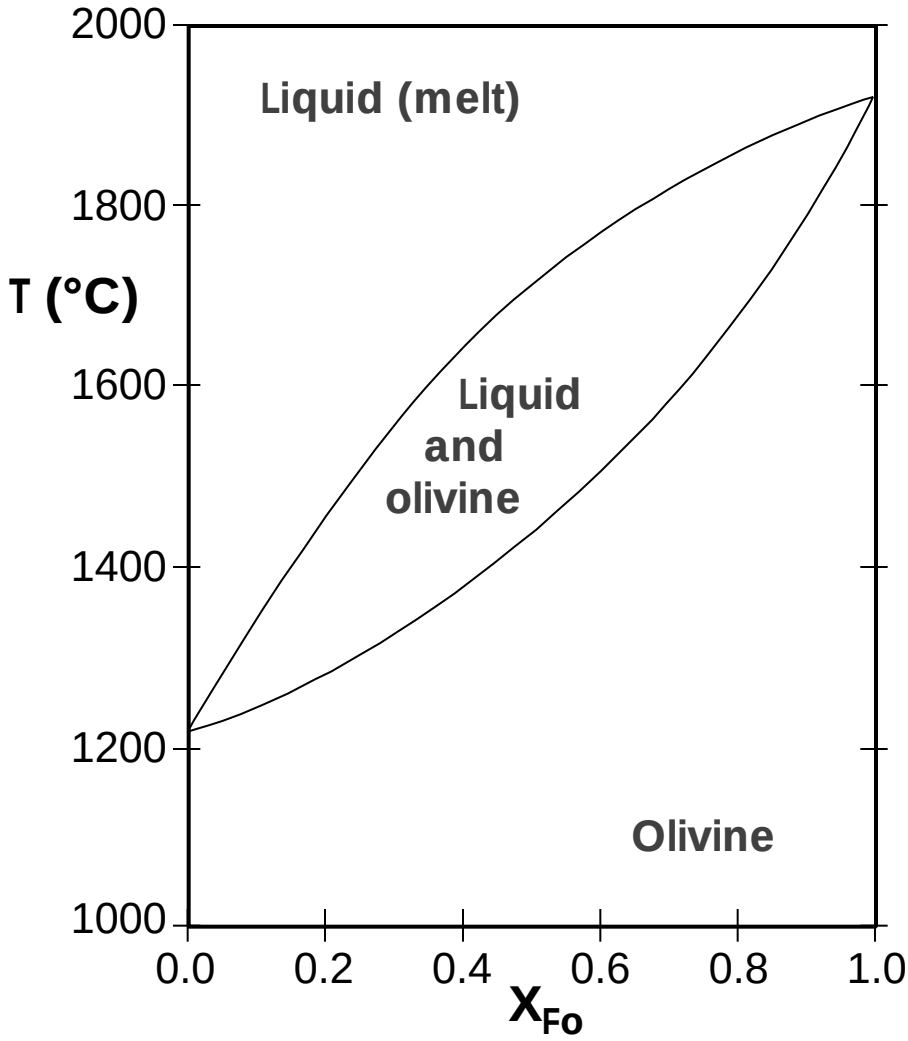
Draw a local charge balance diagram for the silicon

Draw a local charge balance diagram for the fluorine.

Draw a local charge balance diagram for the oxygen.

Draw a local charge balance diagram for the aluminum

Phase Diagrams



A Liquid of composition Fo_{60} is cooling down from 2000°C.

1. What is the composition of the first olivine crystal to form? _____
2. What is the temperature at which this occurs? _____

As the system (now crystals and liquid) continues to cool, it does so slowly enough that all the volume of already-formed olivine crystals remain in equilibrium with all the remaining liquid.

3. At what temperature is there half liquid and half crystals, if we're going by the number of atoms in each? (Note: Going by atoms is the obvious, easy way. Reckoning by mass or volume would be much more difficult) _____
4. What is the composition of the last bit of liquid left, just before the last bit of crystal forms? _____
5. At what temperature does this occur? _____
6. After this has occurred, crystallization is complete. What is the composition of the olivine crystals? _____

If we imagine a different system, in which the liquid (again at composition Fo_{60}) cools down from 2000°C, but this time the crystals do not remain in equilibrium with the liquid. Instead, as soon as a crystal forms, it is removed from the system.

7. What is the composition of the final bit of liquid to crystallize? _____
8. What is the composition of the final bit of crystal to form? _____
9. If the olivine crystals were removed from the system because they were settling to the bottom of a magma chamber, then sketch what the bottom of the chamber might look like, labeling olivine compositions for both early and late crystals.

10. If the olivine crystals were removed from the system because they were being "armored" (i.e., new crystal material was forming before the earlier crystal material could get to equilibrium with the liquid), then sketch what the first crystal formed would look like by the end of the crystallization episode, labeling chemical composition at the center and rim of the crystal.