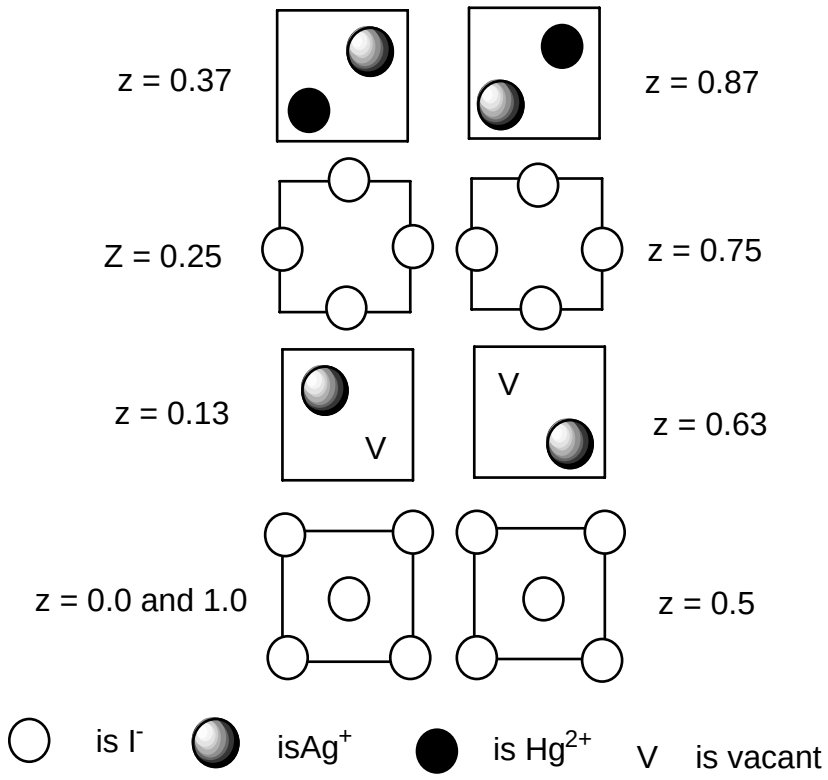
Solid-State Structure of an Interesting Material

The compound Ag_2HgI_4 is interesting because it shows a temperature-dependent change in its color and its conductivity. At temperatures below 50^oC it is yellow and non-conducting and at temperatures above 50^oC it is orange and conducting. Shown below are several cross-sections through the unit cell for Ag_2HgI_4 in its low temperature form:



Based on these cross-sections, answer the following questions:

- what is the coordination number for I^- (consider both cations)?
- what kind of packing do the iodide ions exhibit?
- what is the coordination number for Ag^+?
- what is the coordination number for Hg^{2+}?
- do the silver ions occupy tetrahedral holes or octahedral holes in the lattice of iodide ions? how about the mercury ions? do these agree with the radius-ratio rule? if no, then why do the cations fill tetrahedral holes? (see Appendix B.4 for ionic radii)
- how many iodide ions, silver ions, and mercury ions are in a unit cell? Is this consistent with the compound's empirical formula?

In the high-temperature form the silver ions, the mercury ions and the vacancies are randomly distributed throughout the lattice formed by the iodide ions (this is called a disordered form). Speculate on why the disordered, high-temperature form is conductive, whereas the ordered, low-temperature form is not.