MATRL 218/CHEM277: Assignment 1

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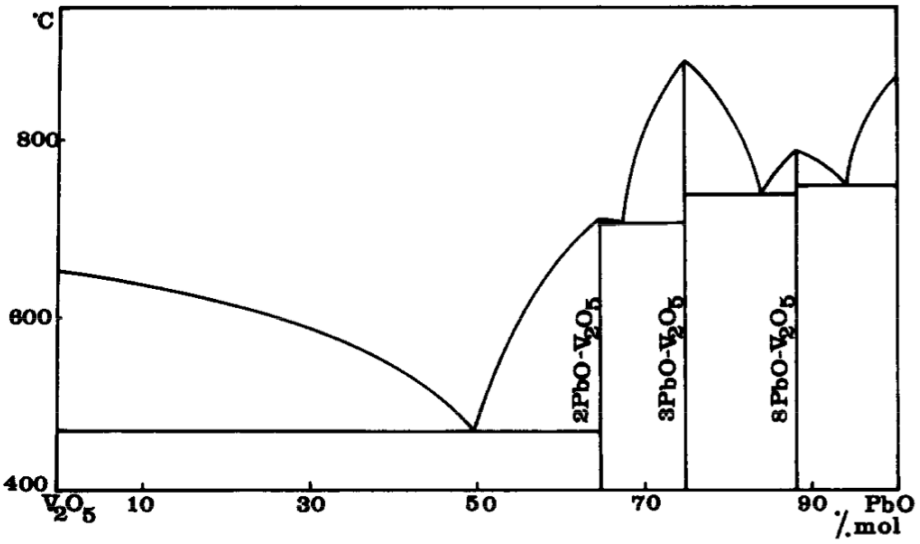
Due date: January 24th 2019 (in class, or under my door). Keep everything brief.

1. Are all amorphous solids considered glasses. How are glasses characterized?

2. Many liquids can be rapidly quenched to give a glass. Why can't this be indicated in a phase diagram? It has been observed that certain features in phase diagrams are found associated with some glass forming alloys. What are these features, and briefly why do they aid glass formation? Hint: The PbO-V_2O_5 phase diagram:



3. Why does the entropy of a liquid decrease when it becomes a glass, even though the effective structures of liquids and glasses ("snapshots") are similar, suggesting similar configurational entropies?

4. Read the linked work (on the website) by Lekkerkerker and explain the entropic stabilization of hard-sphere crystals.

5. Find out how to and sketch the a, b, c, n and d glides within a 3D cell.

6. Cubic cells always have a $\bar{3}$ or 3 in the space group label. What is the $\bar{3}$ symmetry element in a cube?

7. Sketch the 6_1 and 6_5 mirror pairs of symmetry operations and the 6_2 and 6_4 mirror pairs. Use a low-symmetry motif of the letter "R" for your illustration.

8. Sketch 2D objects with the following symmetries: (i) $2m'$ and (ii) $4mm$. Indicate the mirror lines. Also, mention any other symmetry operations that you find.

9. Use VESTA to open the `faujasite.vesta` on the website. Identify the space group and the cell parameter from the appropriate menus in VESTA.

10. Use VESTA to sketch the structures of (i) α-Po (ii) α-Fe, and (iii) Cu, whose structure is given in your notes and determine the coordination number (number of nearest neighbors) and distances of shortest contact. Do ensure that the structural images you submit *look* good, like structures that you will find in the PDF file on Oxide Structures on the website.