Petrology Final Exam
Fall 2003

1. What are the most important mineral properties that can be used to distinguish minerals when viewing them with a petrographic microscope? How do you "see" these properties? How can you quantify them?

2. Specifically: How do you distinguish quartz from feldspars, and how do you distinguish the various types of feldspars from each other?

3. What is the phase rule and what is its significance when applied to igneous or metamorphic rocks?

4. Look at a phase diagram for SiO_2 minerals. (There is one in Mineralogy, page 95.) Why are different minerals stable in different parts of PT space? Specifically, what properties of the various minerals determines their stability? At 800°, if you go from low pressure to high pressure, you pass through fields for tridymite, high quartz, low quartz, coesite and stishovite. Why does this make sense? At 1 atm, if you go from low T to high T, you pass through fields for low quartz, high quartz, tridymite, cristobalite and then a melt. Why does this make sense? Explain the stability relationships.

5. Magmas of many different compositions reach the surface of the earth. Similarly, we find plutons of lots of different compositions so we know that intrusive magmas are also highly variable in composition. What is the source of the variability? Why are there so many different compositions? Although compositionally variable, most are dominated by oxygen and silicon. Why?

6. Define, contrast, etc. the following terms. Use diagrams to illustrate.
   - melting temperature
   - liquidus
   - solidus
   - eutectic
   - peritectic
   - congruent melting
   - incongruent melting
   - reaction series
   - solid solution

7. How do the above terms relate to magmatic differentiation?

8. Choose one ternary diagram showing melting/crystallization relationships and for several different melt compositions: describe how crystallization will proceed from temperatures well above the liquidus to temperatures well below the solidus. What minerals will be present in what ratios, and what will the final rock texture be?

9. Why are some volcanic events more violent and dangerous than others?

10. When a rock is metamorphosed we can use phase diagrams to predict what will happen. Alternatively, we can interpret the history of a metamorphic rock by studying mineral assemblages. All this depends on the fact that only one mineral assemblage is stable for a given composition under a given set of conditions. Why is this true? Explain what is going on.

11. Given a standard PT diagram or a TX diagram, you should be sure to be able to say which minerals are stable in which part of the diagram. And, given a mineral assemblage, you should be able to tell me where it is stable relative to all the reactions.

12. How do geothermometers and geobarometers work? Why do they work? Give a couple of examples and explain how PT calculations are done.

13. Describe the general changes that take place in pelitic rocks as they are metamorphosed from very

low grade to high? What mineral and textural changes occur?

14. Answer the same question as above (#13) for
    basaltic rocks
    granitic rocks
    limestones

15. When considering the metamorphism of calcareous or ultramafic rocks, we often use TX diagrams instead of PT diagrams. This is because the fluid composition is very important. What is a metamorphic fluid? Why is it more important for calcareous or ultramafic rocks than, for example, granites or pelites? How does fluid composition affect mineral stability and why? Use diagrams and good logic to explain.

16. What are the most important things learned in this class? Choose at least four or five and explain why they are important. If you were to follow up on those topics, what questions would you ask? What topics would you pursue? Etc.