1. Consider the diagram shown ==> Describe in detail what happens to a melt of compositon “O” (20 wt% albite) as it cools from 900 to 500 degrees.

At what temperature will it be 50% solidified?

Describe what you think the mineral grain will look like after it is entirely crystallized and cooled to below 500 degrees. Be as specific as possible.

2. Consider the diagram below. Consider a rock with composition indicated by the dot labeled "X."

What minerals are present in that rock and what are their relative proportions. Be clear which proportion goes with which.

Describe what happens if the rock is heated until it is entirely melted.. Be specific and clear about proportions and compositions.

3. Consider the attached copy of Figure 6-12.. Six different composition melts are indicated with capital letters:

melt	$\%SiO_2$
A	13
B	31
C	35
D	43
E	59
F	84

Below are six rock descriptions. For each, simply put the letter of the correct melt composition in the left hand column. Each letter is used once.

You might care to know that forsterite (olivine) and enstatite (orthopyroxene) are both orthorhombic minerals. Cristobalite is tetragonal, tridymite is monoclinic.

Yes, we are ignoring the possibility that quartz might form at low temperature.

Which melt?	rock description
	Contains tridymite and enstatite. The enstatite forms well developed orthorhombic crystals. Enstatite is surrounded by tridymite (generally subhedral to anhedral), but the tridymite crystals, and some of have four fold axes of symmetry even though tridymite is monoclinic. A bit of forsterite is present in the centers of some of the enstatite grains.
	Contains tridymite and enstatite. The tridymite crystals, which account for 80% of the rock, vary from quite small to medium sized. Some appear to have a four fold axis of symmetry even though tridymite is monoclinic. Subhedral to anhedral enstatite crystals fill in the interstices between tridymite.
	Contains tridymite and enstatite. The tridymite crystals, which account for slightly less than half of the rock, vary from quite small to medium sized. Some appear to have a four fold axis of symmetry even though tridymite is monoclinic. Subhedral to anhedral enstatite crystals fill in the interstices between tridymite.
	Contains tridymite and enstatite. The tridymite crystals are few in number, but are large and well developed, but some appear to have a four fold axis of symmetry even though tridymite is monoclinic. Subhedral to anhedral enstatite crystals fill in the interstices between tridymite.
	Contains tridymite and enstatite. Contains tridymite and enstatite. The enstatite forms well developed orthorhombic crystals. Enstatite is surrounded by tridymite (generally subhedral to anhedral), but the tridymite crystals, and some of have four fold axes of symmetry even though tridymite is monoclinic.
	Contains forsterite and enstatite. Forsterite crystals have a nice shoe-box shape. Spaces between them are filled with enstatite.

4. A special kind of high pressure rock is called a blueschist. Generally blueschists form at pressures greater than about 16 Kbar (=1.6GPa) and temperatures less than about 600°C.

What color do you think blueschists are?

Which side of the reaction has the greatest volume?

Which side of the reaction has the greatest entropy?

Look at the phase diagram below, and consider only the information it contains. For each mineral or mineral assemblages in the table: Would you expect it in a normal blueschist?

mineral or assemblage	circle one of the answers below	
quartz but no albite or jadeite	yes	no
jadeite but no albite or quartz	yes	no
albite but no jadeite or quartz	yes	no
jadeite and quartz but no albite	yes	no
jadeite and albite but no quartz	yes	no
albite and quartz but no jadeite	yes	no
albite, jadeite and quartz	yes	no

Consider the minerals above (albite, jadeite and quartz) and also leucite. List and balance all possible reactions involving these minerals.*

*If you forgot the formulas for albite, jadeite, quartz and leucite, shame on you. But here they are:
albite=$NaAlSi_3O_6$, jadeite=$NaAlSi_2O_6$, quartz=SiO_2, leucite=$NaAlSiO_4$

5. On the triangular diagram below, plot the locations of the following

mineral	formula
pyrope	$Mg_3Al_2Si_3O_{12}$
quartz	SiO_2
corundum	Al_2O_3
enstatite	$Mg_2Si_2O_6$
spinel	$MgAl_2O_4$

How many chemical components are needed to describe these minerals?

Write the phase rule:

For a normal reaction, F=1. How many minerals in a normal reaction?

List all possible reactions. You don't have to balance them if you do not wish to.