Geology 420 Name _____
Mineralogy Final Exam 2007 NDSU

1. Short answer:

a) The names and formulae of two halides and a sulfide with the [NaCl] structure. [6 pts]

b) Three examples of mineral compositions (and all names) that have polymorphs. [9 pts]

c) For an element with multiple valence states, how does ionic radius change with increasing positive charge. Why? [3 pts]

d) The symmetry operation that produces an identical motif after a translation of one-half of a unit cell followed by a mirror operation is called a _____. [2 pts]

e) The crystal face that has intercepts of 1/2 along the a-axis, is parallel to the b-axis, and -1/2 along the c axis is the ( ). [2 pts]

f) The following minerals can be used as ores for what metals?
ilmenite _____; bauxite_____; chalcopyrite _____; beryl _____. [4 pts]

g) What point group results from adding a center of symmetry (an inversion) to 622? Demonstrate this with "before" and "after" stereograms. [8 pts]

2. Supply the missing trioctahedral phyllosilicate name or formula, **and** a schematic drawing, using our convention: ▭ = octahedral layer, and ⏢ = tetrahedral layer. [8 pts]

brucite		**$Mg(OH)_2$**
_____	⏢	$Mg_6Si_4O_{10}(OH)_8$
talc		_____
phlogopite		_____
_____		$Mg_3Si_4O_{10}(OH)_2$-$Mg_3(OH)_6$

3. One of the minerals in question 2 occurs in asbestiform habit. Explain from your knowledge of its structure, why it has such a habit. Make a drawing to illustrate your answer. [5 pts]

4. A client asks you to evaluate a potential tungsten ore, which seems to contain scheelite, $CaWO_4$. Show work for full credit.

   a) You carry out an XRD analysis of the rock and determine that scheelite does indeed occur in the sample. The diffractogram showed a peak for the 200 plane of scheelite at a 2Θ angle of 34.20° measured with CuKα X-rays (λ = 1.5418 Å). What is the interplanar spacing d for that plane? _____ From this information, what is your estimate for the length of scheelite's a-axis? _____ [10 pts]

(continued)

b) The space group of scheelite is $I4_1/a$. It has a _____ Bravais lattice and point group _____ in the _____ crystal system. [3 pts]

c) What is the weight % W metal in scheelite? W = 183.85 g/mol; Ca = 40.08 g/mol, O = 16.0 g/mol. [4 pts]

d) You visually estimate the ore contains 5 wt.% scheelite. If the ore is to be economical to mine, it must contain a minimum of 1.0 wt.% W metal. Assuming the entire ore body is identical to your sample (a very bad assumption), estimate whether the ore body is economical to mine by calculating its W content. [4 pts]

e) To validate this estimate, your next step will be to measure the whole rock content of W using XRF. Describe this instrument to your client. What is the source of excitation, and what is measured? [5 pts]

5. Feldspars often weather to phyllosilicates. Write a balanced reaction for the weathering of potassium feldspar (K-spar) to kaolinite in the form: [4 pts]

$$\text{K-feldspar} + H_2O + H^+ \text{ —> kaolinite} + K^+ + H_4SiO_4$$

6. For the phase diagram below, in an equilibrium, continuous slow cooling scenario for a melt with composition An_{70}: [15 pts]

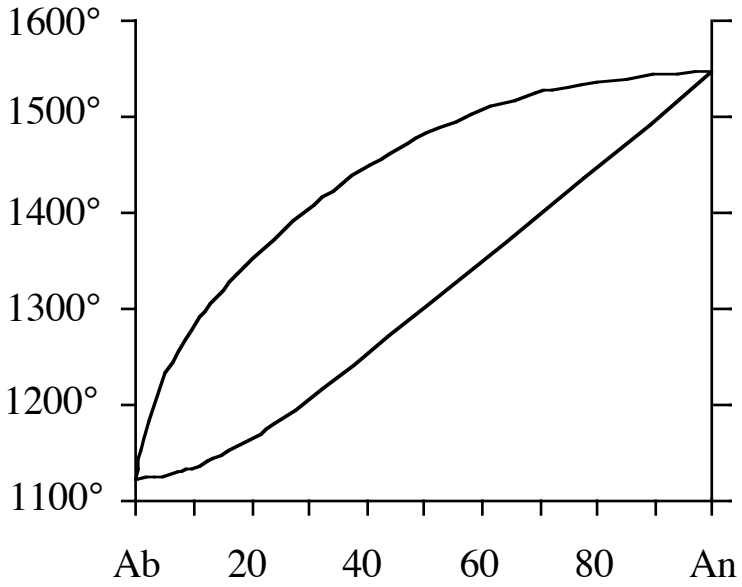
a. What is the T of first crystallization? _____

b. What is the T of final crystallization? _____

c. Write the names and formulas for An and Ab below them on the diagram.

d. What are the two curved lines called (label them on the diagram)?

e. What is the composition of the final crystallized rock? _____



7. a) What are the name and the formula of the mineral at each number on the diagram?
b) What is the name of each solid solution at A and B?
c) What minerals coexist at X and Y?. [8 pts]