Geology 420 Name _____
Mineralogy Final Exam 2015 NDSU

1. Short answer: [33 pts]

a) The characteristic symmetry of the orthorhombic system is:

b) An X-ray diffraction pattern of opal would show what structural information?

c) 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 _____.

d) The crystal face that has intercepts of 1/3 along the a-axis, is parallel to the b-axis, and -1/2 along the c axis is the ( ).

e) Three examples of mineral compositions (and all names) that have polymorphs.

f) The crystal classes recognized by our textbook:

g) The point group of Cmmm (give long form) _____

h) Name an ore mineral (name and formula) commonly used to obtain the following:

Fe _____, _____ Be _____, _____

i) Give the mineral compositions, and another mineral that crystallizes in the same structure (isomorphic):

aragonite _____, _____

corundum _____, _____

galena _____, _____

2. The phase diagram below is for olivine. Reason by analogy with our previous discussion of the phase diagram for plagioclase feldspar to answer the following questions:

For the phase diagram below, in an equilibrium, continuous slow cooling scenario for a melt with composition Fo_{50}: [13 pts]

a. What is the T of first crystallization? _____

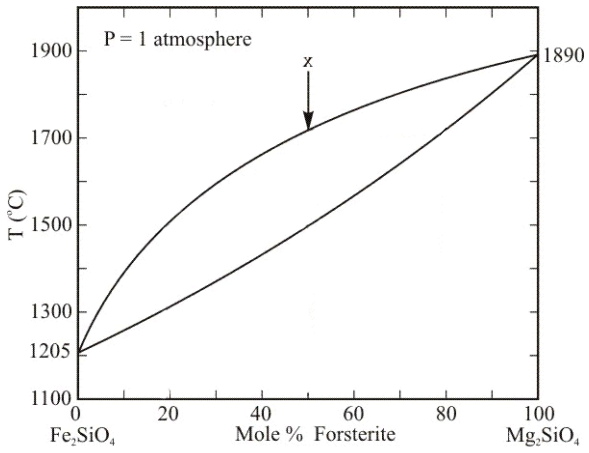
b. What is the T of final crystallization? _____

c. Label any one- and two-phase regions 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? _____

f. Why do we only rarely find chemically zoned olivine crystals?



3. A client asks you to evaluate a potential molybdenum ore, which seems to contain molybdenite, which has the formula: MoS_2. [24 pts]

a) You make an XRD analysis of the rock and determine that molybdenite does indeed occur in the sample. The diffractogram showed a peak for the 002 plane of molybdenite at a 2Θ angle of 14.38° measured with CuKα X-rays (λ = 1.5406 Å). What is the interplanar spacing d for that plane? _____ From this data, what would your estimate be for the length of molybdenite's c-axis? _____

b) The space group of molybdenite is $P6_3/mmc$. It has a _____ Bravais lattice and point group _____ in the _____ crystal system. [6 pts]

c) What is the weight % Mo metal in molybdenite? Mo = 95.94 g/mol; S = 32.06 g/mol.

e) You visually estimate that the ore contains 10 wt.% molybdenite. If the ore is to be economical to mine, it must contain a minimum of 5 wt.% Mo metal. Is the ore body economical to mine? (show your work: calculate its Mo content)

f) To validate this estimate, your next step will be to measure the whole rock content of Mo using AAS. Describe this instrument to your client. What is the source of excitation, and what is measured?

6. In 1900, A.N. Winchell noticed distinct optical properties of certain pyroxenes from northern Minnesota, which led him to the discovery of a new pyroxene type. Below is one of the original chemical analyses. [30 pts]

a. Calculate mol proportion and cation proportion for the oxides given. MW of oxides is provided.

Wt.%	Sample 1	MW oxide	Mol proportion	Cation proportion
SiO_2	45.05	60.08		
TiO_2	4.39	79.90		
Al_2O_3	0.16	101.96		
Fe_2O_3	5.50	159.69		
FeO	14.90	71.85		
MnO	1.58	70.94		
MgO	15.15	40.30		
CaO	10.72	56.08		
Na_2O	1.27	61.98		
K_2O	0.78	94.20		

b. Calculate mol % Wo-En-Fs. Show work here.

c. On the triangle below, indicate the locations and mineral formulas for Di, Hd, En, Fs on a mol % Wo-En-Fs diagram.

d. Plot the chemical analysis on the diagram.

e) What mineral do you suspect this to be? _____