

FINAL EXAM
December 9, 1997

Please **read** each of the questions **carefully**. *Answer all portions of each question.* Here's your next chance to tell me all that you know! Remember that partial credit makes a difference, so don't leave any blanks! Points given in (). **GOOD LUCK!** ↑.

1. Physical and chemical attributes of a mineral are conferred, in part, by the type of bonding a mineral possesses. _____ bonds are the strongest, are the weakest _____ . _____ bonds are good conductors of electricity. (9 pts)
2. Give the definition of a mineral. List all attributes that are required for a substance to be considered a mineral. (10 pts)
3. Describe the six crystal systems. Give the relative lengths of each axis and the angles amongst the axes. Give the relationship of the axes to any symmetry elements. Use the back of this sheet if necessary. (18 pts).

4. The following two silicates are isostructural, $CaMgSi_2O_6$ and $NaFeSi_2O_6$ (12)

(a) To which silicate class do these belong? _____

(b) Would you expect to find solid solution between these minerals? _____
Why or why not?

If so, write a formula to express the solid solution. _____

If there is more than one type (site) of solid solution, which would you expect to be the **most limited**? Why?

5. Diamond and graphite are polymorphs, but have very different physical properties. Why? (5)

6. What type of polymorphic transition occurs between the following and what do they tell us about the P-T environment in which the rock formed? (6)

	Polymorphic trans.	Geological Significance
andalusite - kyanite	_____	_____
alpha - beta quartz	_____	_____
sanadine - microcline	_____	_____

7. Give two reasons why zeolites are effective industrial products. What is it about their structure that makes them useful? Describe. (6)

8. Feldspars are important rock-forming minerals. (a) Draw a ternary diagram which illustrates the compositional relationships in the two solid-solution series. Label each field clearly. (b) Briefly describe each solid-solution series, including temperature dependence, extent of solid solution, what occurs upon cooling. Illustrate your discussion with mineralogical examples where applicable. Indicate how this applies to Ca vs. K igneous rocks. (15 pts)

a.

b.

9. Describe the 4 types of phyllosilicates with respect to stacking of the T-O layers, interlayers and occupancy of the octahedral layer. Draw a generic crystal structure along c for each of the minerals, label. (12 pts)

10. a. Cleavage is one property used to distinguish amphiboles and pyroxenes. The cleavage angles for pyroxenes are _____

and for amphiboles are _____.

Why do they cleave where they do? _____

Why are they different? _____

Draw crystal structures of a pyroxene and an amphibole each for explanation.

Label the major cation sites (M1-M4, etc). (15)

11. You would expect to find _____ garnet in pelitic metamorphic rocks and _____ garnets in calcareous metamorphic rocks. (4)

Short Answer

12. Is chemistry alone sufficient to classify minerals? Why or why not? (3)

13. What differentiates the **classes** of silicates? e.g. nesosilicates from tectosilicates? (5)

14. Why do we classify minerals based on their anion or anionic complex? (3)

15. Why do most nesosilicates have no cleavage?

16. Why does B typically occur in triangular coordination and Na in twelve fold coordination?

17. The Bragg equation is $n\lambda = 2d \sin \theta$. How can we take advantage of this relation to determine what type of crystal structure various phyllosilicates possess? (5)

18. For each of the geologic environments listed below, name 2 MAJOR rock-forming minerals that characterize the environments. Extra, name one more mineral. (20 pts)

Geologic Environment

Minerals

- (a) High grade pelitic metamorphic _____
- (b) Li-rich pegmatite _____
- (c) Ultramafic igneous _____
- (d) Medium grade pelitic metamorphic _____
- (e) Low grade mafic metamorphic _____
- (f) High grade calcareous metamorphic _____
- (g) Evaporite deposit (salt dome) _____
- (h) Silica-undersaturated alkalic igneous _____
- (i) Mafic igneous _____
- (j) Hi P/Lo T mafic metamorphic _____
- (k) Silicic Igneous _____
- (l) Banded Iron Formation _____
- (m) Cu-Zn-Fe-S ore deposit _____

19. Why is the term "asbestos" misleading and ambiguous when applied to minerals? (10)

20. Coordination number of a cation *increases* or *decreases* (circle one) with increasing pressure.

21. Coordination number of a cation *increases* or *decreases* (circle one) with increasing temperature.

22. What is the bond strength of the following bonds? (9)

Al^{3+} in octahedral coordination in staurolite? _____

Fe^{2+} in tetrahedral coordination in staurolite? _____

Which bond is stronger? _____

23. Are fluorite and halite polymorphs? YES NO

24. Determine what bond type exists between each pair listed below. (10)

Cu-Cu in copper Zr - Si in zircon

Ba-O in barite Si-O in $MgSiO_3$

Na-Cl in halite C-O in calcite

S-S in sulfur, within layers between layers

25. Color can be used to identify a mineral when: _____

26. Why do Fe and Mn, Ca and Na often substitute for each other? _____

BONUS: (May get up to 15 bonus points)

BONUS I: Why are minerals important to society?

BONUS II: Minerals may contain $(OH)^-$, H^+ , or H_2O ? Why should these not be referred to as "water"? (i.e. what are the differences between these "waters" in the structure)? (5pts)

BONUS III: (6pts) What are three things that you liked about this class?

What are three things that you think would improve the course (please don't tell me about difficult tests, i agree, they are).

BONUS IV: What do you call a salamander that has turned into a dish?
(Hint: think mineral name).

Grades will be posted on bulletin board across from my office on Tuesday, 17 Dec. You may also pick up your exams then.

Have a very Happy Holiday!