

Name: _____

Geosciences 306, Mineralogy
First Midterm, 2008
100 pts

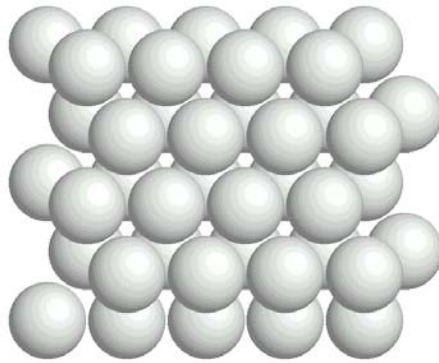
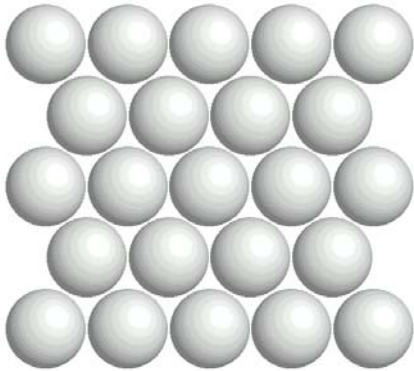
1. (10 pts) What are the 4 most abundant elements in the Earth and what are their atomic percentages? For each of the four elements, name one mineral that contains the element.

2. (20 pts) Describe the electronic structures of atomic iron (Fe) and atomic oxygen (O) using spin diagrams. Make spin diagrams of Fe^{2+} , Fe^{3+} , and O^{2-} .

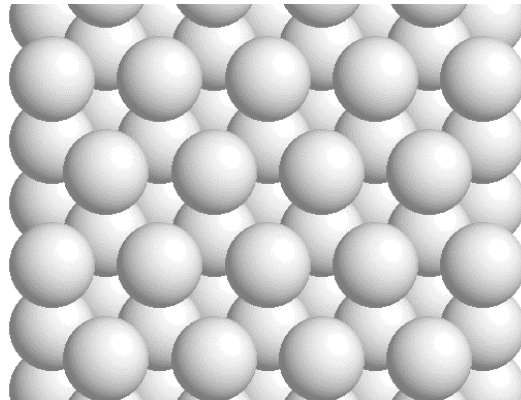
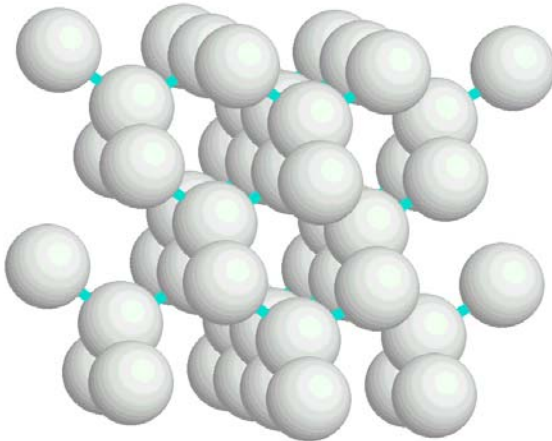
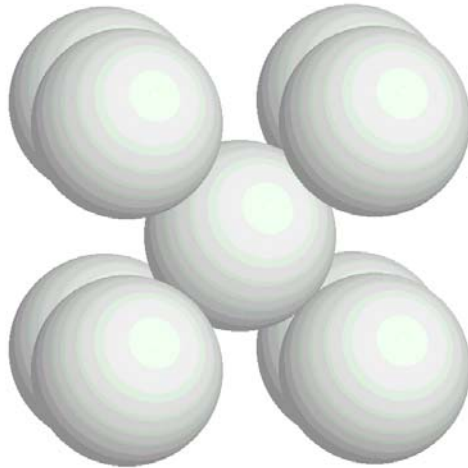
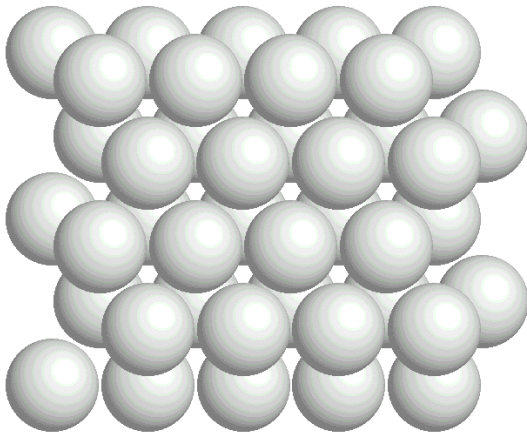
3. (20 pts) Derive the radius-ratio rule parameter ($r_C/r_A = .414$) for a trigonal planar 3-coordinated cation. Draw a picture and carefully label everything so that your answer can be evaluated properly.

4. (20 pts) List 7 common types of bonding found in minerals along with a short description and an example of each.

5. a) (5 pts) Suppose the illustrated figures represent closest-packed arrangements of anions. Identify the different locations where cations could be coordinated with 2, 3, 4, 6, or 12 anions. In the position of the cation, write its coordination number.



- b) (5 pts) Label the packing type for each of the following diagrams.



(20 pts) Akimotoite, MgSiO_3 , is a rare high-pressure mineral first described in 1999 from the shock-metamorphosed Tenham chondrite meteorite that fell in Australia in 1879. It appears to have been transformed from pyroxene when the meteor impacted onto the Earth's surface at high pressures and temperatures.

- Determine the coordination numbers of Mg and Si using the radius ratio rules.
- Determine the bonding arrangement around the O atom by computing the Si-O and Mg-O bond strengths and using Pauling's rules.
- Compute the Si-O and Mg-O bond lengths.
- When akimotoite is heated, it transforms back to pyroxene. Which bonds break first, and why?

$$\begin{aligned}r(\text{Si}) &= 0.55 \text{ \AA} \\r(\text{Mg}) &= 0.85 \text{ \AA} \\r(\text{O}) &= 1.25 \text{ \AA}\end{aligned}$$