

Name: _____

Geos 306, Mineralogy

Midterm, Oct 11, 2002

100 pts

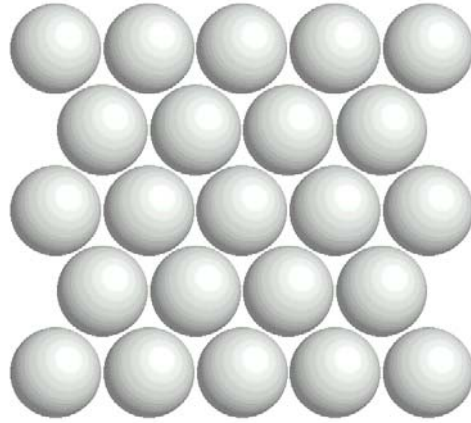
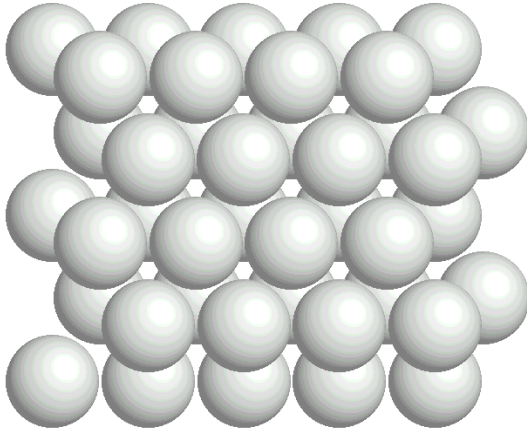
1. a) (10 pts) What are the 4 most abundant elements found in the Earth and what are their atomic abundances?

2. (15 pts) (a) Describe the electronic structures of atomic iron (Fe) and magnesium (Mg) in terms of spin diagrams.
- (b) Both Mg and Fe are found in the 2+ valence state. Make spin diagrams for both of these cations in the 2+ valence state.

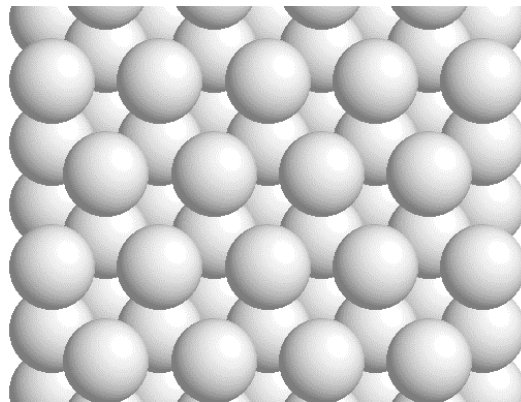
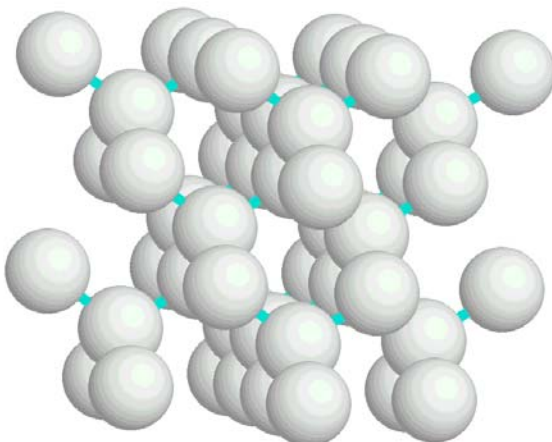
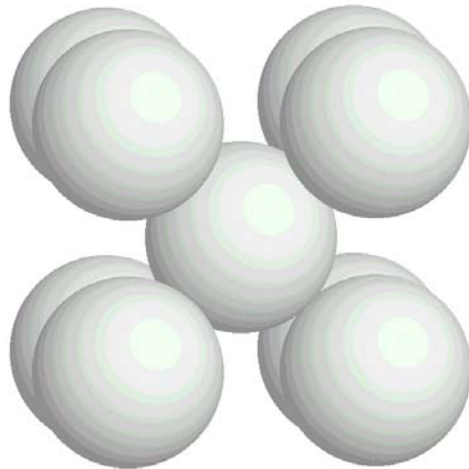
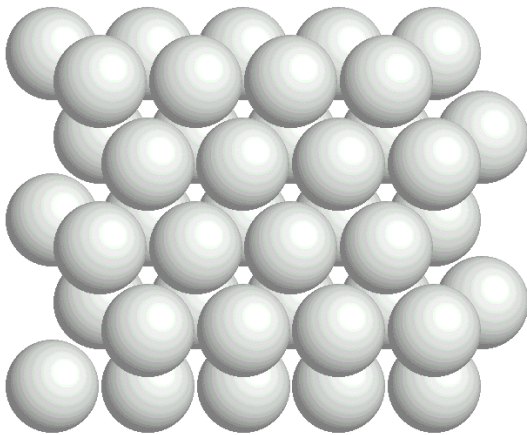
3. (10 pts) Derive the radius-ratio rule parameter ($r_C/r_A = .414$) for a 6-coordinated cation. Draw a picture and carefully label everything so that your answer can be evaluated properly.

4. (20 pts) Enumerate the 7 types of bonding, with a short description and an example of each.

5. a) (10 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) (10 pts) Label the packing type for each of the following diagrams.



6. (25 pts) Ringwoodite, Mg_2SiO_4 , is an important mineral found at depth in the upper mantle. It has the spinel structure. Assume the following radii, $r(\text{O}) = 1.35 \text{ \AA}$, $r(\text{Si}) = 0.4 \text{ \AA}$, $r(\text{Mg}) = 0.8 \text{ \AA}$.
- (15 pts) Determine the coordination numbers of Mg and Si, and then determine the bonding arrangement around O.
 - (5 pts) What are the average SiO and MgO bond lengths?
 - (5 pts) Which is the stronger bond, and why?