

Name: _____

Geosciences 306, Mineralogy
First Midterm, 2007
100 pts

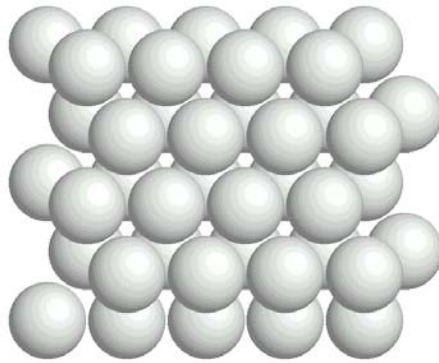
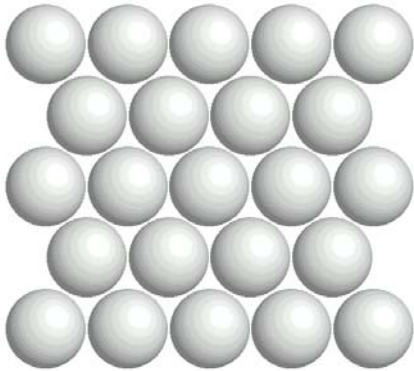
1. (10 pts) What are the 4 most abundant elements in the Earth and what are their atomic percentages?

2. (20 pts) Describe the electronic structures of atomic silicon (Si) and atomic sulfur (S) using spin diagrams. Make spin diagrams of Si^{4+} , S^{6+} , and S^{2-} .

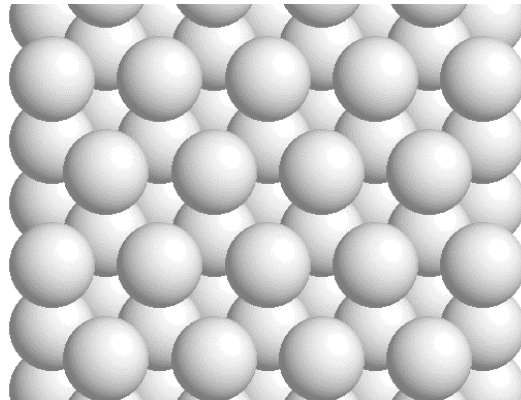
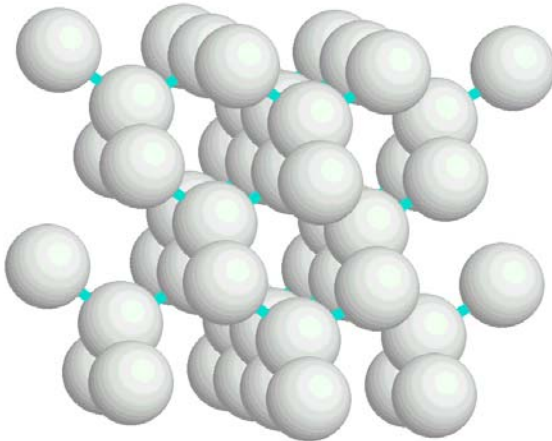
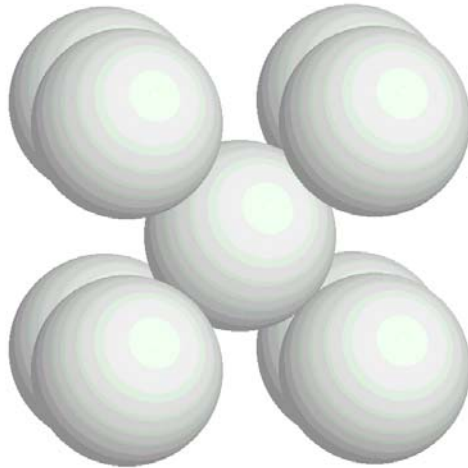
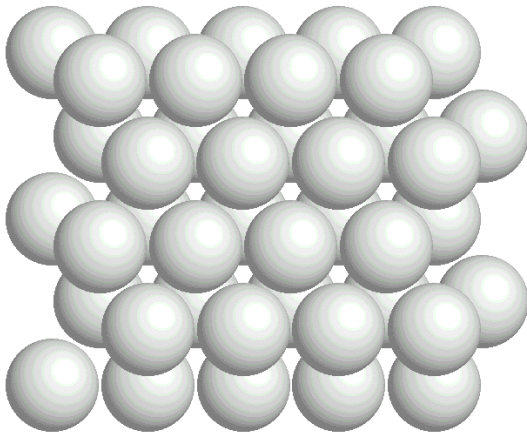
3. (20 pts) Derive the radius-ratio rule parameter ($r_C/r_A = .414$) for an octahedrally 6-coordinated cation. Draw a picture and carefully label everything so that your answer can be evaluated properly.

4. (20 pts) List 7 common types of bonding found in minerals along with a short description and 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) Calcite, CaCO_3 , is one of the most ubiquitous minerals on Earth. It is found in most rock-types and displays more crystal forms than any known mineral. It has diagnostic rhombohedral cleavage.

- a. Determine the coordination numbers of Ca and C using the radius ratio rules.
- b. Determine the bonding arrangement around the O atom by computing the Ca-O and C-O bond strengths and using Pauling's rules.
- c. Compute the Ca-O and C-O bond lengths.
- d. When calcite is cleaved, which bonds break, and why?

$$r(\text{Ca}) = 0.90 \text{ \AA}$$

$$r(\text{C}) = 0.26 \text{ \AA}$$

$$r(\text{O}) = 1.35 \text{ \AA}$$