

Name: _____

Geos 306, Mineralogy
Midterm, Sept 20, 2004
100 pts

1. (8 pts) What are the 4 most abundant elements found in the Earth and what are their atomic abundances?

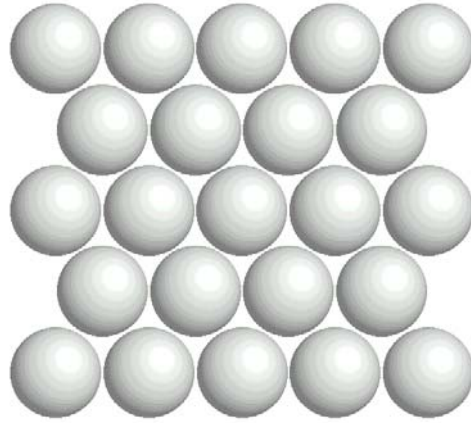
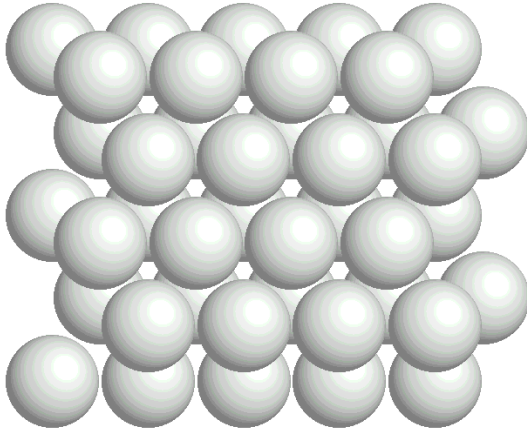
2. (7 pts) List the 3 most common isotopes of carbon, indicating the number of protons and neutrons for each. Which isotope is the least common?

3. (10 pts) (a) Describe the electronic structures of atomic titanium (Ti) and chlorine (Cl) in terms of spin diagrams. (b) What are two common valence states of Ti? Make spin diagrams for both of these valence states.

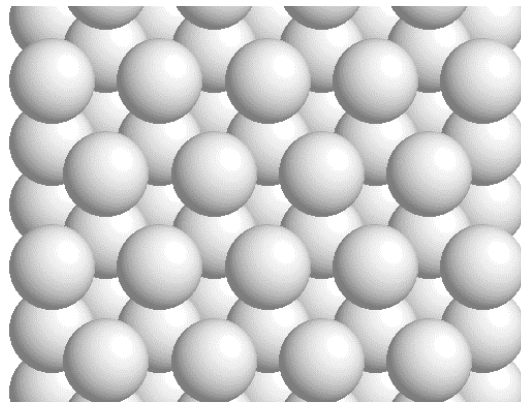
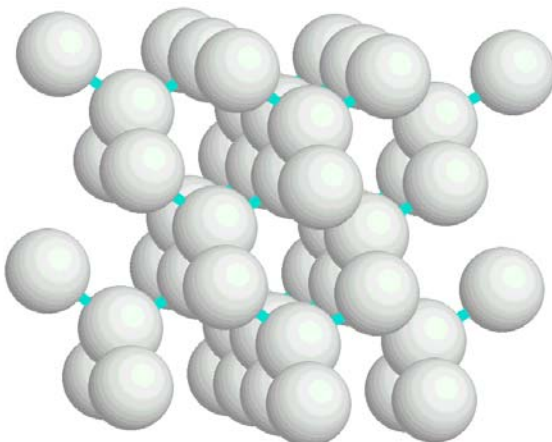
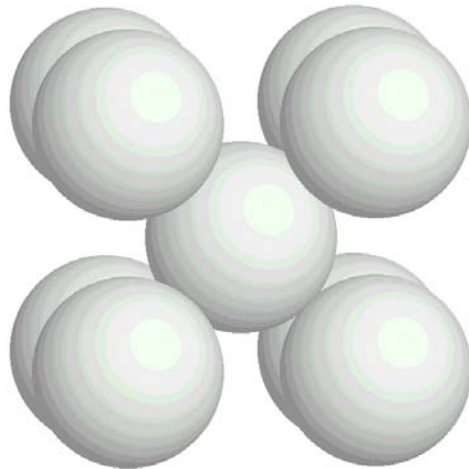
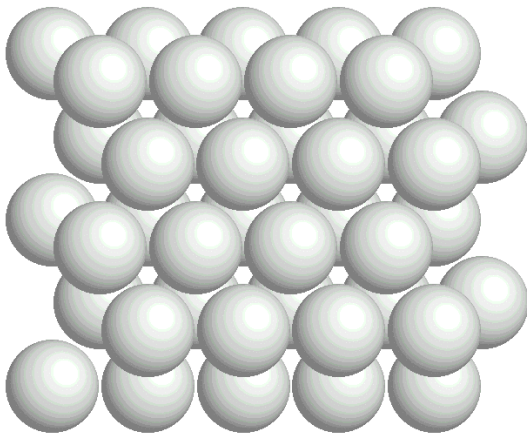
4. (15 pts) Derive the radius-ratio rule parameter ($r_C/r_A = .225$) for a 4-coordinated cation. Draw a picture and carefully label everything so that your answer can be evaluated properly.

5. (20 pts) Enumerate the 7 types of bonding, with a short description and an example of each.

6. 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.



7. (20 pts) Corundum, Al_2O_3 , is an important rock-forming mineral whose gem varieties include ruby and sapphire. Assume the following radii, $r(\text{O}) = 1.35 \text{ \AA}$, $r(\text{Al}) = 0.65 \text{ \AA}$.
- (15 pts) Determine the coordination numbers of Al and of O.
 - (5 pts) What is the average AlO bond length?