Mineralogy Exam 1 - 2007
NDSU Dept. of Geosciences

Short answer [4 points each]

1. A $\bar{1}$ (one-fold rotoinversion axis) is equivalent to what single symmetry operation? ________.

   A $\bar{2}$ (two-fold rotoinversion axis) is equivalent to what single symmetry operation? ________.

   A $\bar{3}$ is equivalent to what two symmetry operations? ________________________________.

2. The space group of magnetite ($\text{Fe}_3\text{O}_4$) is $Fd\bar{3}m$. It has a ____________________ Bravais lattice and the point group ____________________ in the _______________________ crystal system.

3. The plane that has intercepts of $-\frac{1}{2}$ along the a-axis, is parallel to the b-axis, and $-\frac{1}{3}$ along the c-axis is the (________).

4. Fill in the blanks:

<table>
<thead>
<tr>
<th>Crystal System</th>
<th>Characteristic Symmetry</th>
<th>Metrical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monoclinic</td>
<td></td>
<td>$a_1=a_2\neq c$; $\alpha=\beta=90^\circ$; $\gamma=120^\circ$</td>
</tr>
</tbody>
</table>

5. For the following figures, what are the: [12 pts]

   Crystal system: ___________________  Crystal system: ___________________

   Principal directions: <          ><          ><          >  Principal directions: <          ><          ><          >

   Point group: ___________________  Point group: ___________________

6. Draw a complete stereogram with symmetry elements and generalized equivalent faces for the point group $4\bar{2}m$. Indicate the principal directions. [20 pts]
7. For each figure, name the crystal form or combination of forms. [12 pts]

8. Define piezoelectricity. Why do some crystals exhibit this property, while others do not? [6 pts]

9. Rutile, TiO$_2$, is used as a pigment in paint. It has space group $P\overline{4}_2\text{m}$. [15 pts]
   a. What does this tell you about the crystal structure of rutile?
   b. Your text states that rutile has $a = 4.59$ Å and $c = 2.96$ Å. What does this mean?
   c. Rutile’s cleavage is parallel to $\{110\}$. Describe this – how many directions is this?

10. Why do some minerals have cleavage, and others do not? [5 pts]

11. Are the following minerals? Why or why not? [9 pts]
    a) a pure platinum ring
    b) coal
    c) window glass

12. What is the main difference between point groups and space groups? [5 pts]