Short Answer (5 points each)

1. List and describe the four quantum numbers.

2. Using effective nuclear charge justify the periodic trend for atomic radius.

3. Determine the point group for the following molecule or ion: $\text{AlCl}_4^-$, $\text{PCl}_5$.

4. Use drawings to identify the following symmetry elements: $C_3$ axis and the $\sigma_w$ plane in the $\text{NH}_3$ molecule.

5. Which of the following crystal lattices are appropriate for 1:1 salts?
   Sodium Chloride, Cesium Chloride, Fluorite Structure, Rutile Structure, Zinc Blende, Aragonite and Calcite

6. List the limiting factors of the Bohr model of the atom (i.e. what is wrong with it).

7. Describe the limiting factors of the Bohr Model of the Atom.

8. What is the coordination of the cation in the following crystal lattices: Sodium chloride, Cesium chloride

9. Find and list all the symmetry elements in the molecule: $\text{CH}_2\text{Cl}_2$

10. What is the periodic trend for electron affinity? What is electronic affinity?

Discussion Questions (10 points each)

1. Draw and completely label the Born-Haber cycle for KCl.

2. Using drawings and/or words describe the hexagonal closest packing lattice.

3. Using Fajan’s rules explain the following trend in solubility:

<table>
<thead>
<tr>
<th>Silver Halide</th>
<th>$K_{sp}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver fluoride</td>
<td>soluble</td>
</tr>
<tr>
<td>Silver chloride</td>
<td>$2 \times 10^{-10}$</td>
</tr>
<tr>
<td>Silver bromide</td>
<td>$5 \times 10^{-13}$</td>
</tr>
<tr>
<td>Silver iodide</td>
<td>$8 \times 10^{-17}$</td>
</tr>
</tbody>
</table>

4. Determine the effective nuclear charge for an electron in the 4s, 3s and 3d orbitals of a iron atom.

5. Explain the "breaks" in the graph of first ionization energy shown below.