1. Match each equation given below to the appropriate energy term (I – VI). Then indicate whether the sign of the energy term will be + or −. 

<table>
<thead>
<tr>
<th>energy term</th>
<th>+ or −</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sn⁺(g) → Sn²⁺(g) + e⁻</td>
<td>I. electron affinity</td>
</tr>
<tr>
<td>MgF₂(s) → Mg²⁺(g) + 2 F⁻(g)</td>
<td>II. 1st ionization energy</td>
</tr>
<tr>
<td>F(g) + e⁻ → F⁻(g)</td>
<td>III. 2nd ionization energy</td>
</tr>
</tbody>
</table>

2. a. How many valence electrons does a sulfur atom have? 
   b. Draw the Lewis symbol for an element, X, if it has 3 valence electrons.

3. Consider the Pauling electronegativity values (χ) given for the following elements: 
   Zn (χ=1.6) Br (χ=2.8) C (χ=2.5) S (χ=2.5) 

   a. Which one of the following bonds is the most polar?
      Zn–Br Zn–S C–S C–Br

   b. Which one of the following bonds is nonpolar?
      Zn–Br Zn–S C–S C–Br

4. a. Which one of the following is diamagnetic?
   S²⁻ Cl Ti²⁺ Fe³⁺

   b. Which one of the following has the least favorable electron affinity value?
   S Br Ar B

   c. Which one of the following elements has the smallest 1st ionization energy?
   O Ca Kr Rb

   d. Which one of the following species is isoelectric with P³⁻?
   N³⁻ Ne Al³⁺ K⁺

   e. Which one of the following has the largest atomic radius?
   I Rb Cr Ar

   f. Which one of the following is the most electronegative?
   K Ga Ca S

   g. Which one of the following compounds should have the greatest lattice energy?
   SrCl₂ Li₃N KBr
5. a. Using the noble gas core symbolism, write the electron configuration of In⁺.

b. Circle the species in the following list that have noble gas configurations: Zn²⁺ Al³⁺ P⁻ Zr Y⁵⁺ Ne

c. Put the following species in order of decreasing radius: Te²⁻, Ca²⁺, Br⁻, Se²⁻

6. a. How many electrons can have the following set of quantum numbers? n = 3, ℓ = 2, mₑ = 0, mₛ = –1/2

b. How many electrons can have the following combination of quantum numbers? n = 10, ℓ = 8, mₑ = 3

7. Consider the ground-state orbital diagram shown below:

Circle 1 core electron in the diagram above. Put an X over 1 valence electron in the diagram above.

8. Circle the one best answer below. Why is the 2nd ionization energy of Ca less than the 2nd ionization energy of K?

a. Ca has a noble gas configuration and therefore does not want to ionized.

b. The 2nd ionization energy corresponds to removal of a 4s electron from K, but a 4p electron from Ca.

c. The 2nd ionization energy corresponds to forming an anion of K, and that is an energetically unfavorable process.

d. The 2nd ionization energy corresponds to the removal of a core electron from K vs. a valence from Ca.

e. It’s not; the 2nd ionization energy of Ca is greater than the 2nd ionization energy of K.

9. Circle the one best answer below. Why is the 1st ionization energy of O less than the 1st ionization energy of N?

a. It’s not; the 1st ionization energy of O is greater than the 1st ionization energy of N.

b. The 1st ionization energy of O corresponds to the removal of a spin-paired 2p electron, which is a lower energy cost than the removal of an unpaired 2p electron in N.

c. The 1st ionization energy of N requires that a core electron be removed.

d. The removal of an electron from O results in a noble gas configuration, and is therefore energetically favorable.

e. All of these are true.
1. a. How many electrons can have the following set of quantum numbers?  $n = 3, \ell = 2, m_\ell = 0, m_s = -1/2$  
   ________ 

   b. How many electrons can have the following combination of quantum numbers?   $n = 10, \ell = 8, m_\ell = 3$  
   ________ 

2. Consider the ground-state orbital diagram shown below:

   \[
   \begin{array}{cccccccccccccccccc}
   & & & & 1s & & 2s & & 2p & & 3s & & 3p & & 4s & & 3d & & 4p & & 5s & & 4d & & 5p & & 6s
   \\
   & & & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow & & \uparrow
   \end{array}
   \]

   Circle 1 core electron in the diagram above.  Put an X over 1 valence electron in the diagram above.

3. a. Using the noble gas core symbolism, write the electron configuration of In$^+$.  
   __________________________

   b. Circle the species in the following list that have noble gas configurations:  
   Zn$^{2+}$  Al$^{3+}$  P$^-$  Zr  Y$^{3+}$  Ne

   c. Put the following species in order of decreasing radius:  
   Te$^{2-}$, Ca$^{2+}$, Br$^-$, Se$^{2-}$  
   ________  >  ________  >  ________  >  ________

4. Match each equation given below to the appropriate energy term (I – VI).  Then indicate whether the sign of the energy term will be + or –.

   energy term  
   + or –

   a.  Sn$^+$ (g) $\rightarrow$ Sn$^{2+}$ (g) + e$^-$  
   I. electron affinity  
   IV. $\Delta H^\circ_f$

   b. MgF$_2$ (s) $\rightarrow$ Mg$^{2+}$ (g) + 2 F$^-$ (g)  
   II. 1$^{st}$ ionization energy  
   V. lattice energy

   c.  F (g) + e$^-$ $\rightarrow$ F$^-$ (g)  
   III. 2$^{nd}$ ionization energy  
   VI. bond energy

5. Circle the one best answer below.  Why is the 1$^{st}$ ionization energy of O less than the 1$^{st}$ ionization energy of N?

   a. It’s not; the 1$^{st}$ ionization energy of O is greater than the 1$^{st}$ ionization energy of N.

   b. The 1$^{st}$ ionization energy of O corresponds to the removal of a spin-paired 2p electron, which is a lower energy cost than the removal of an unpaired 2p electron in N.

   c. The 1$^{st}$ ionization energy of N requires that a core electron be removed.

   d. The removal of an electron from O results in a noble gas configuration, and is therefore energetically favorable.

   e. All of these are true.

6. Consider the Pauling electronegativity values ($\chi$) given for the following elements:

   Zn ($\chi$=1.6)  Br ($\chi$=2.8)  C ($\chi$=2.5)  S ($\chi$=2.5)

   a. Which one of the following bonds is the most polar?

      Zn–Br  Zn–S  C–S  C–Br

   b. Which one of the following bonds is nonpolar?

      Zn–Br  Zn–S  C–S  C–Br
7. a. How many valence electrons does a phosphorus atom have? _______________________
   b. Draw the Lewis symbol for an element, X, if it has 4 valence electrons. _______________________

8. a. Which one of the following species is isoelectric with P\(^3^-\)?
   \[ N^4^- \quad Ne \quad Al^{3+} \quad K^+ \]
   b. Which one of the following has the largest atomic radius?
   \[ I \quad Rb \quad Cr \quad Ar \]
   c. Which one of the following is the most electronegative?
   \[ K \quad Ga \quad Ca \quad S \]
   d. Which one of the following compounds should have the greatest lattice energy?
   \[ SrCl_2 \quad Li_3N \quad KBr \]
   e. Which one of the following is diamagnetic?
   \[ S^{2-} \quad Cl \quad Ti^{2+} \quad Fe^{3+} \]
   f. Which one of the following has the least favorable electron affinity value?
   \[ S \quad Br \quad Ar \quad B \]
   g. Which one of the following elements has the smallest 1\(^{st}\) ionization energy?
   \[ O \quad Ca \quad Kr \quad Rb \]

9. Circle the one best answer below. Why is the 2\(^{nd}\) ionization energy of Ca less than the 2\(^{nd}\) ionization energy of K?
   a. Ca has a noble gas configuration and therefore does not want to ionized.
   b. The 2\(^{nd}\) ionization energy corresponds to removal of a 4s electron from K, but a 4p electron from Ca.
   c. The 2\(^{nd}\) ionization energy corresponds to forming an anion of K, and that is an energetically unfavorable process.
   d. The 2\(^{nd}\) ionization energy corresponds to the removal of a core electron from K vs. a valence from Ca.
   e. It’s not; the 2\(^{nd}\) ionization energy of Ca is greater than the 2\(^{nd}\) ionization energy of K.