Review Package #3

Atomic Models and Subatomic Particles
The Periodic Table
Chemical Bonding
1. Atomic Models and Subatomic Particles:
   
   A. Subatomic Particles and Average Atomic Mass:
      - Subatomic particles: protons, neutrons and electrons – properties and how to calculate numbers of each
      - Atomic mass and atomic number
      - Ions
      - Isotopes and calculations of average atomic mass

   B. Quantum Molecular Model
      - Electron orbitals
      - Electron configurations of neutral atoms and ions
      - Significant figures (multiplication, division, adding and subtracting)

   C. History of the Atomic Models
      - Identifying which scientists made which discoveries

2. Elements and the Periodic Table:
   
   A. Organization of the Periodic Table
      - The history of the periodic table
      - metals, non-metals, and semi-metals
      - chemical families; Alkali metals, Alkaline Earth metals, Halogens, Noble Gases

   B. Periodic Trends
      - Atomic radius, and ionic radius (sizes of atoms versus their ions)
      - Ionization energy
      - Electronegativity

3. Chemical Bonding:
   
   A. Electrons, Electronegativity and Bonding (text pgs. 225-231)
      - valence, bonding, lone-pair electrons
      - types of chemical bonds; ionic, covalent, polar-covalent
      - predicting bond formation based on electronegativity differences
      - electron dot diagrams for elements

   B. Lewis Structures to Represent Bonding (text pgs. 236-243)
      - Rules for drawing Lewis structures (Octet rule)
      - Single, double and triple bonds (bonding capacity)
      - Lewis structures for simple ions, polyatomic ions and simple molecules
Atomic Models and Subatomic Particles:

1. Complete the following table.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Atomic Mass</th>
<th>Atomic Number</th>
<th>Number of Protons</th>
<th>Number of Neutrons</th>
<th>Number of Electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>40</td>
<td>20</td>
<td>19</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>Hg</td>
<td>201</td>
<td>80</td>
<td>80</td>
<td>81</td>
<td>80</td>
</tr>
<tr>
<td>Br</td>
<td>79</td>
<td>35</td>
<td>35</td>
<td>44</td>
<td>35</td>
</tr>
<tr>
<td>Ga</td>
<td>69</td>
<td>31</td>
<td>31</td>
<td>38</td>
<td>31</td>
</tr>
</tbody>
</table>

2. An element is analyzed by a mass spectrometer and the following spectrum resulted for the naturally occurring isotopes.

<table>
<thead>
<tr>
<th>Mass</th>
<th>% Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>20.5</td>
</tr>
<tr>
<td>71</td>
<td>27.4</td>
</tr>
<tr>
<td>72</td>
<td>7.8</td>
</tr>
<tr>
<td>73</td>
<td>36.5</td>
</tr>
<tr>
<td>74</td>
<td>7.8</td>
</tr>
<tr>
<td>75</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>

a) Calculate the average atomic mass for this element.

b) What element was analyzed?

c) Write the symbol for the most abundant isotope of this element, including the atomic mass, and the atomic number.
3. Write the core-notation electron configuration for the elements listed below.

Be ______________________ Ar ______________________
C ______________________ V ______________________
N ______________________ Cu ______________________
Na ______________________ Ge ______________________
S ______________________ Br ______________________

4. Complete the following table.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Number of Protons</th>
<th>Number of Neutrons</th>
<th>Number of Electrons</th>
<th>Electron Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{31}_{70}$Ga$^{3+}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{37}_{17}$Cl$^-$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{39}_{19}$K$^+$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{65}_{29}$Cu$^{2+}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{32}_{16}$S$^{2-}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{30}_{15}$P$^{3-}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{87}_{38}$Sr$^{2+}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$^{59}_{27}$Co$^{2+}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. In the table below briefly summarize the MAJOR contribution(s) the scientist made to our understanding of the atom.

<table>
<thead>
<tr>
<th>Scientist</th>
<th>Major Contribution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dalton</td>
<td></td>
</tr>
<tr>
<td>Bohr</td>
<td></td>
</tr>
<tr>
<td>Thompson</td>
<td></td>
</tr>
<tr>
<td>Chadwick</td>
<td></td>
</tr>
<tr>
<td>Rutherford</td>
<td></td>
</tr>
</tbody>
</table>
Elements and the Periodic Table:

1. What is a period of the periodic table? ____________________________

2. What is a group or family of the periodic table? ____________________________

3. Complete the following table, stating the name of the family (if we named it), the number of valence electrons and the charge on the ions that are usually produced from the elements in the group.

<table>
<thead>
<tr>
<th>Family Members</th>
<th>Family Name</th>
<th>Number of Valence Electrons</th>
<th>Charge on the Ions Usually Formed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li, Na, K, Rb, Cs, Fr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B, Al, Ga, In, Tl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F, Cl, Br, I, At</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Be, Mg, Ca, Sr, Ba, Ra</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N, P, As, Sb, Bi</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>He, Ne, Ar, Kr, Xe, Rn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O, S, Se Te, Po</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Define the following terms:

a) Atomic Radius:
__________________________

b) Ionization Energy:
__________________________

c) Electronegativity:
__________________________
5. Correctly fill in the blanks below with either “increases” or “decreases”
   a) As you move from left to right across the periodic table:
      Atomic radius ______________________
      Ionization Energy ______________________
      Electronegativity ______________________
   
   b) As you move down the periodic table:
      Atomic radius ______________________
      Ionization Energy ______________________
      Electronegativity ______________________

6. a) Which of the following has the LARGEST atomic radius?
   i) Li, Na, K, Rb ______
   ii) Na, Mg, Al, Si ______
   iii) Mg, Os, Cl ______
   iv) Na\(^{+}\), Mg\(^{2+}\), Al\(^{3+}\) ______
   v) P\(^{3-}\), S\(^{2-}\), Cl\(^{-}\) ______
   vi) N, O, F, Cl ______

   b) Which of the following has the LARGEST ionization energy?
   i) Li, Na, K, Rb ______
   ii) Na, Mg, Al, Si ______
   iii) Mg, Os, Cl ______
   iv) Na\(^{+}\), Mg\(^{2+}\), Al\(^{3+}\) ______
   v) P\(^{3-}\), S\(^{2-}\), Cl\(^{-}\) ______
   vi) N, O, F, Cl ______

   c) Which of the following has the SMALLEST electronegativity value?
   i) Li, Na, K, Rb ______
   ii) Na, Mg, Al, Si ______
   iii) Mg, Os, Cl ______
   iii) Mg, Os, Cl ______
   iv) N, O, F, Cl ______

   Chemical Bonding:
   1.a) Define valence electrons: ___________________________________________

   b) How many valence electrons does each of the following families contain?
   i. Alkali metals: ______
   ii. Alkaline earth metals: ______
   iii. The Boron family: ______
   iv. The Carbon family: ______
   v. The Nitrogen family: ______
   vi. The Oxygen family: ______
   vii. The Halogens: ______
   viii. The Noble gases: ______
2. Describe what is happening to the electrons involved in a:
   a) Covalent bond: ___________________________________________
   b) Polar-covalent bond: _______________________________________
   c) Ionic bond: _______________________________________________

3. Name the two types of intermolecular bonds:
   __________________________ and ___________________________

4. Draw the electron dot diagrams and Lewis structures for each of the following:
   a) Al                      g) SO₃
   b) Ca                      h) H₂O
   c) F⁻                      i) C₂H₂
   d) S²⁻                     j) CO₃²⁻
   e) CH₃OH                   k) N₂
   f) BF₃                     l) C₂HBr₃