Chapter 11 Worksheet

1. According to our discussion of light/radiation in class, light can be subdivided into categories based on its wavelength. Arrange the wavelength regions in order from highest energy to lowest energy. State which end corresponds to the shortest wavelength and which end corresponds to the longest wavelength.

2. There is an energy associated with green, blue, yellow, violet, red, and indigo light. Arrange these colors in order of highest energy to lowest energy per photon of light. Which end corresponds to the shortest wavelength and which end corresponds to the longest wavelength? What is the wavelength range (in nm) for the visible region of the electromagnetic spectrum?

3. Using the table below, match the energy diagram with the proper element. The energy diagram represents what happens to a valence electron in each of the metals once it gains energy and then loses that energy by emitting a photon of light. On the diagram label the ground state and the excited state.

<table>
<thead>
<tr>
<th>Element</th>
<th>Color of Emitted Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>green</td>
</tr>
<tr>
<td>Sodium</td>
<td>yellow</td>
</tr>
<tr>
<td>Lithium</td>
<td>red</td>
</tr>
</tbody>
</table>

4. Draw a diagram of the hydrogen atom based on the Bohr model. In your diagram, include at least four energy levels. Assume the electron is in the second energy level and use a solid line to show the transition the electron would make if hydrogen absorbed a photon of light. Use a dashed line to show the transition the electron would make if the atom emitted a photon of light. Assume the radiation absorbed and emitted is only equivalent to a jump of +/- 1 energy level.

5. For the following elements, provide the complete electron configuration, the condensed electron configuration and the number of valence electrons.

   O, Na, Fe, Kr, Zr, Ag, Pb

6. Write orbital box diagrams for the following elements.

   Mg, Mn, Ar

7. Define the term degenerate as it pertains to orbitals.

8. Would Strontium, Barium and Calcium show similar chemical behavior? Use orbital box diagrams to explain your answer.
9. For \( n = 2 \), what are the possible orbitals for an electron to go into?

10. What is the maximum number of electrons that can be in the \( 3p_x \) orbital? What is the maximum number of electrons that can fit in any orbital?

11. How many orbitals are there for \( n = 4 \)?

12. How many total electrons can each of the following sublevels contain?

   - \( s \) sublevel:
   - \( p \) sublevel:
   - \( d \) sublevel:
   - \( f \) sublevel:

13. Draw representative shapes of the \( s \), \( p \), and \( d \) orbitals (if there is more than one general shape, draw all of the possible shapes). You do not need to draw all of the possible orientations. In your picture, show the location of the nucleus. How would the size of the \( 2s \) orbital compare to the \( 3s \) orbital?

14. How many \( d \) electrons are there in the chromium atom?

15. What is the condensed electron configuration for \( \text{Al}^{3+} \), \( \text{Cl}^- \), and \( \text{Fe}^{2+} \)?

16. Order the elements \( S \), \( \text{Cl} \) and \( F \) in terms of increasing ionization energy.

17. Which of the following has the smallest radius? (i.e. which atom or ion below is the smallest)

   - \( B \), \( N \), \( N^{2+} \), \( N^{3-} \), \( P \), \( \text{As} \)

18. Using the Bohr model of the atom, calculate the effective nuclear charge of the valence electrons in nitrogen and fluorine.

19. All of the atoms listed below have electrons in the \( 2s \) and \( 2p \) orbitals. Are the electrons in the \( 2s \) and \( 2p \) orbitals the same distance away from the nucleus in each atom? If they are not, which atom are the electrons in the \( 2s \) and \( 2p \) orbitals closest to the nucleus?

   - \( \text{Sn} \), \( \text{Zn} \), \( W \), \( \text{Mg} \), \( \text{Cl} \)