2. An electron in a hydrogen atom drops from the n = 6 to the n = 3 level.
   a. What is the **wavelength** of light emitted? (4 pt)
   
   b. What is the **energy** of this light in kJ/mol? (6 pt)

   \[
   \lambda = \frac{1}{4} \times 1.4 \times 10^{-4} \text{nm} = 1094 \text{ nm} = 1.094 \times 10^{-9} \text{ m}
   \]

   \[
   \nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8} \text{ m/s}}{1.094 \times 10^{-9} \text{ m}} = 2.7 \times 10^{14} \text{ s}^{-1}
   \]

   \[
   E = h\nu = \left(6.626 \times 10^{-34} \text{ J s}\right) \times 2.7 \times 10^{14} \text{ s}^{-1} \times \frac{1.4 \times 10^{3} \text{ J}}{1000 \text{ J/mole}}
   \]

   \[
   = 10.9 \text{ kJ/mole}
   \]
3. What is the deBroglie wavelength of a 300-g object moving at a velocity of 50 m/s (about 100 mph)? (4 pt)

\[ \lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34} \text{ Js} \cdot \text{ kg}^2}{(0.300 \text{ kg})(50 \text{ m/s})} = 4.4 \times 10^{-35} \text{ m} \]

4. What are the four quantum numbers, and give their names or what they indicate. (8 pt)
   a. \( n \) - principal - energy
   b. \( l \) - angular momentum - shape
   c. \( m_l \) = magnetic - orientation
   d. \( m_s \) = spin

5. How many orbitals are in the following subshells: (6 pt)
   a. 5p \( \Rightarrow 3 \)
   b. 4f \( \Rightarrow 7 \)
   c. 3d \( \Rightarrow 5 \)

6. Give the electron configurations for the following (9 pt)
   a. As \( [\text{Ar}] 4s^2 3d^{10} 4p^3 \)
   b. Pb \( [\text{Xe}] 6s^2 4f^{14} 5d^{10} 6p^2 \)
   c. Ag \( [\text{Kr}] 5s^1 4d^{10} \quad \boxed{\text{Cr}} \rightarrow [\text{Ar}] 4s^1 3d^5 \)

7. What is an atomic orbital? (3 pt)

A mathematical function that describes the wave-like behavior of an electron in an atom.
8. Give the value of $\ell$ and the letter used to designate the orbital. (6 pt.)

$\ell$ value:  

designated letter: [Diagram showing $\ell = 1$ and the letter $P$]

9. Complete the following orbital diagram for carbon. (4 pt)

[Diagram showing 1s, 2s, and 2p orbitals]

10. Indicate which is smaller in the following sets: (6 pt)
   a. $\text{Cr}^{3+}$ or $\text{Cr}$
   b. $\text{Se}^{2-}$ or $\text{Se}$
   c. $\text{N}^{3-}$ or $\text{O}^{2-}$

11. Indicate which element has the higher first ionization energy (4 pt)
   a. $\text{Si}$ or $\text{S}$
   b. $\text{O}$ or $\text{S}$

12. Which element would have the higher (more negative) electron affinity (4 pt)
   a. $\text{Mg}$, $\text{Na}$, $\text{Ne}$, $\text{O}$
   b. $\text{B}$, $\text{C}$, $\text{Li}$, $\text{Be}$

13. Which compound will have the higher lattice energy (6 pt)
   a. $\text{LiCl}$ or $\text{NaCl}$
   b. $\text{NaCl}$ or $\text{MgCl}_2$
   c. $\text{AlCl}_3$ or $\text{MgCl}_2$

14. Give products for the following reactions (8 pt)

   $2\text{Na(s)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{Na}^+\text{(aq)} + 2\text{OH}^-\text{(aq)} + \text{H}_2\text{(g)}$

   $2\text{Na(s)} + \text{O}_2\text{(g)} \rightarrow \text{Na}_2\text{O}_2\text{(s)}$
\[ 4\text{ Li}(s) + \text{O}_2(g) \rightarrow 2\text{Li}_2\text{O} \]

\[ \text{Be}(s) + \text{Br}_2(l) \rightarrow \text{BeBr}_2(s) \]

15. What is the **generic** valence electron configuration of: (4 pt)
   a. halogen \( ns^2np^5 \)
   b. group 3A metal \( ns^2np^1 \)

16. Draw the Lewis structures for the following. Also, draw resonance structures where you can. (8 pt)
   a. \( \text{SF}_4 \) \[ S \quad \begin{array}{c} 7 \\ 1 \end{array} \]
   \[ \begin{array}{c} F \quad 7 \\ 1 \end{array} \]
   \[ \begin{array}{c} F \quad 7 \\ 1 \end{array} \]
   \[ \begin{array}{c} F \quad 7 \\ 1 \end{array} \]
   \[ \begin{array}{c} F \quad 7 \\ 1 \end{array} \]

   b. \( \text{PH}_3 \) \[ \begin{array}{c} 2 \\ 3 \end{array} \]
   \[ \begin{array}{c} H \quad 1 \\ 1 \end{array} \]
   \[ \begin{array}{c} H \quad 1 \\ 1 \end{array} \]
   \[ \begin{array}{c} H \quad 1 \\ 1 \end{array} \]

   c. \( \text{NO}_2^- \) \[ \begin{array}{c} 7 \\ 5 \\ 12 \\ 10 \\ 6 \end{array} \]

17. For the following Lewis structure, **calculate** the formal charges on all atoms. (6 pt)

\[ \begin{array}{c} \text{O} \end{array} = \begin{array}{c} \text{C} \end{array} = \begin{array}{c} \text{N} \end{array} \]

\[ \text{FC}_\text{O} = 6 - 4 - \frac{1}{2}(4) = 0 \]

\[ \text{FC}_\text{C} = 4 - 0 - \frac{1}{2}(8) = 0 \]

\[ \text{FC}_\text{N} = 5 - 4 - \frac{1}{2}(4) = -1 \]

For extra credit, can you draw a better resonance structure for the above compound? If so, why is yours better? (2 pt)

Negative charge on more electronegative element.