1. Write the electron configuration of the following atoms (a-f). You may use the noble gas shortcut.

(a) Mg \[\text{[Ne]} 3s^2\]
(b) Co \[\text{[Ar]} 4s^2 3d^7\]
(c) S \[\text{[Ne]} 3s^2 3p^4\]
(d) Sn\#50 \[\text{[Kr]} 5s^2 4d^{10} 5p^2\]
(e) Sm\#62 \[\text{[Xe]} 6s^2 5d^1 4f^8\text{ or [Xe]} 6s^2 4f^6\]
(f) P \[\text{[Ne]} 3s^2 3p^3\]

2. Arrange the following species in increasing order of the property in the left-hand column.

(a) 1st ionization energy \[\text{Al} \quad \text{Ga} \quad \text{In}\] \[\text{In} < \text{Ga} < \text{Al}\]
(b) 1st ionization energy \[\text{Al} \quad \text{S} \quad \text{Cl}\] \[\text{Al} < \text{S} < \text{Cl}\]
(c) atomic radii \[\text{Al} \quad \text{S} \quad \text{Cl}\] \[\text{Cl} < \text{S} < \text{Al}\]
(d) atomic radii \[\text{Cu} \quad \text{Ag} \quad \text{Au}\] \[\text{Cu} < \text{Ag} < \text{Au}\]
(e) 1st ionization energy \[\text{Al} \quad \text{B} \quad \text{F}\] \[\text{F} < \text{B} < \text{Al}\]
(f) ionization energy \[\text{Al} \quad \text{Al}^+ \quad \text{Al}^{2+}\] \[\text{Al} < \text{Al}^+ < \text{Al}^{2+}\]
(g) radium \[\text{Al}^+ \quad \text{Al} \quad \text{Al}^{2+}\] \[\text{Al}^+ < \text{Al} < \text{Al}^{2+}\]

In October 2008, the discovery of element 118 was made. On which property would you rank this new element? cation: smaller than parent; anion: larger than parent.
3. Answer the following. Each of (a)-(h) is worth 3 pts.
(a) Why is a potassium atom bigger than a sodium atom? (The answer is not “the element is above or below (or to the left or right) in the periodic table.”)

\[
\text{Orbital in } K \text{ is bigger than } Na
\]

(b) Write the equations for the first and second ionization energies of Mg.

\[
Mg(g) \rightarrow Mg^+(g) + e^- \quad I_E_1
\]

\[
Mg^+(g) \rightarrow Mg^{2+}(g) + e^- \quad I_E_2
\]

(c) How many unpaired electrons does an atom of phosphorus have in the ground state? Use orbital boxes and arrows to explain your answer.

\[
[\text{Ne}]3s^23p^3 \quad [\text{Ne}] \quad \begin{array}{c}1s \\ 111 \quad 3 \text{ unpaired electrons}
\end{array}
\]

(d) Why does an electron absorb a photon when an electron in an atom rises from a lower energy orbital to a higher energy orbital?

The photon provides energy to raise the electron to the higher energy orbital.

(e) One of the following quantum numbers is incorrect which one is it? \( m_l \)

\[
\begin{array}{c}
n = 3 \quad l = 2 \quad m_l = 3 \quad m_s = \frac{1}{2} \\
1, 2, 3, \ldots \quad 0, \pm 1, \pm 2, \pm 3 \quad \text{are allowed}
\end{array}
\]

(f) For the incorrect quantum number in (e), list all the allowed values that would give a correct set of quantum numbers

(g) In October 2006, the discovery of element # 118 was published. To which group of the periodic table does this element belong? \( \text{Noble gases/18/18A} \)

(h) In the ground state of element # 118, in which orbital is the highest energy electron?

\( 7p \)
4. One of the emission lines in the spectrum of sodium is at 589 nm. (10⁹ nm = 1 m). This emission is responsible for the yellow color of sodium vapor lamps. 
(a) Calculate the frequency in Hz (1/s) for the photon with this energy.

\[ \text{wavelength} \rightarrow 589 \text{ nm} \times \frac{1 \text{ m}}{10^9 \text{ nm}} = 5.89 \times 10^{-7} \text{ m} \]

\[ \nu \lambda = c \quad \nu = \frac{c}{\lambda} = \frac{2.998 \times 10^8 \text{ m/s}}{5.89 \times 10^{-7} \text{ m}} = 5.09 \times 10^{14} \text{ Hz} \]

(b) This photon represents the energy release when an excited electron falls from a higher orbital to a lower orbital in a sodium atom. Calculate the energy of this photon (J).

\[ E = h \nu \]

\[ = (6.626 \times 10^{-34} \text{ J} \cdot \text{s}) \left(5.09 \times 10^{14} \text{ Hz}\right) \]

\[ = 3.37 \times 10^{-19} \text{ J} \]