Electron Configuration Worksheet

1. In what way are the electron configurations of H, Li, Na, K, Rb and Cs similar? In what way are the electron configurations of O, S, Se, Te and Po similar?

2. Identify the following atoms or ions:
   a. It has the ground-state configuration \([\text{Ar}]\, 4s^2\, 3d^{10}\, 4p^1\)
   b. It has the ground-state configuration \([\text{Kr}]\, 4d^{10}\)
   c. It forms a –3 ion that is isoelectronic with Kr

3. Write out BOTH the full electron configuration and the abbreviated electron configuration for each of the following. Predict if the atom would be paramagnetic or diamagnetic.
   a. Fe
   b. Mo
   c. Au

4. For each of the atoms listed in the problem above, give the number of inner (core) and outer (valence) electrons and then list a set of quantum numbers representing an electron of highest energy (one of the last electrons to fill).
5. Draw the electron orbital box diagram (horizontal is fine) for each of the following neutral atoms, and indicate whether they are paramagnetic or diamagnetic:
   
   a. Ge

   b. Ca

6. Arrange the following elements in order of increasing effective nuclear charge, decreasing atomic radii (size), increasing 1st Ionization Energy, increasing electron affinity, and decreasing metallic behavior:

   C, F, Li, K, O

7. Which in each of the following sets is larger? Why?
   
   a. S or S^{2-}

   b. Sr or Sr^{2+}
Answers

1. H, Li, Na, K, Rb and Cs all have an outer shell with the configuration $\text{ns}^1$. O, S, Se, Te and Po all have and outer shell with the configuration $\text{ns}^2\text{np}^4$.

2. a. Ga
   b. $\text{Cd}^{2+}$
   c. As

3. a. Full: $1\text{s}^22\text{s}^22\text{p}^63\text{s}^23\text{p}^64\text{s}^23\text{d}^6$
   Abbreviated: $[\text{Ar}]4\text{s}^23\text{d}^6$
   paramagnetic
   b. Full: $1\text{s}^22\text{s}^22\text{p}^63\text{s}^23\text{p}^64\text{s}^23\text{d}^{10}4\text{p}^65\text{s}^14\text{d}^5$
   Abbreviated: $[\text{Kr}]5\text{s}^14\text{d}^5$
   Paramagnetic
   c. Full: $1\text{s}^22\text{s}^22\text{p}^63\text{s}^23\text{p}^64\text{s}^23\text{d}^{10}4\text{p}^65\text{s}^24\text{d}^{10}5\text{p}^66\text{s}^14\text{f}^45\text{d}^{10}$
   Abbreviated: $[\text{Xe}]6\text{s}^14\text{f}^45\text{d}^{10}$
   Paramagnetic

4. a. 24 inner, 2 outer, 8 valence ($4\text{s}^23\text{d}^6$)
   b. 41 inner, 1 outer, 6 valence ($5\text{s}^14\text{d}^5$)
   c. 78 inner, 1 outer, 11 valence ($6\text{s}^15\text{d}^{10}$)

5. a. 

\[
\begin{array}{ccc|c}
4\text{s} & 3\text{d} & 4\text{p} & \text{Ge is paramagnetic} \\
\end{array}
\]

b. 

\[
\begin{array}{c}
4\text{s} \\
\end{array}
\]

Ca is diamagnetic

6. increasing effective nuclear charge: K<Li<C<O<F
decreasing atomic radii (size): K>Li>C>O>F
increasing 1st Ionization Energy: K<Li<C<O<F
increasing electron affinity: K<Li<C<O<F
decreasing metallic behavior: K>Li>C>O>F

7. a. $\text{S}^{2-}$ is larger than S because they have the same number of protons, but $\text{S}^{2-}$ has two more electrons. The electrons will repel each other, causing the ion to be larger.
   b. Sr is larger than $\text{Sr}^{2+}$ because when Sr loses two electrons to become $\text{Sr}^{2+}$ the remaining electrons are held more tightly by the nucleus