


Problem Set 3 Periodic Properties and Trends

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<p>Group the following electron configurations in pairs that would represent similar chemical properties of their atoms:</p> <p>a) $1s^22s^22p^5$ b) $1s^22s^1$ c) $1s^22s^22p^6$ d) $1s^22s^22p^63s^23p^5$ e) $1s^22s^22p^63s^23p^64s^1$ f) $1s^22s^22p^63s^23p^64s^23d^{10}4p^6$</p>	<p>111. Element 106 has been named seaborgium, Sg, in honor of Glenn Seaborg, discoverer of the first transuranium element.</p> <p>a. Write the expected electron configuration for element 106. b. What other element would be most like element 106 in its properties?</p>
3	4
<p>7.11 (a) What is meant by the term <i>effective nuclear charge</i>? (b) How does the effective nuclear charge experienced by the valence electrons of an atom vary going from left to right across a period of the periodic table?</p>	<p>7.26 Using only the periodic table, arrange each set of atoms in order of increasing radius: (a) Ba, Ca, Na; (b) Sn, Sb, As; (c) Al, Be, Si.</p>
5	6
<p>7.29 Consider a reaction represented by the following spheres:</p> <div style="text-align: center;"> <p>Reactants</p>  <p>Products</p> </div> <p>Which sphere represents a metal and which a nonmetal? Explain.</p>	<p>53. For each of the following groups, place the atoms and/or ions in order of decreasing size.</p> <p>a. Cu, Cu^+, Cu^{2+} b. Ni^{2+}, Pd^{2+}, Pt^{2+} c. O, O^-, O^{2-} d. La^{3+}, Eu^{3+}, Gd^{3+}, Yb^{3+} e. Te^{2-}, I^-, Cs^+, Ba^{2+}, La^{3+}</p>
7	8
<p>7.28 Explain the following variations in atomic or ionic radii: (a) $\text{I}^- > \text{I} > \text{I}^+$, (b) $\text{Ca}^{2+} > \text{Mg}^{2+} > \text{Be}^{2+}$, (c) $\text{Fe} > \text{Fe}^{2+} > \text{Fe}^{3+}$.</p>	<p>7.42 (a) Why does Li have a larger first ionization energy than Na? (b) The difference between the third and fourth ionization energies of scandium is much larger than the difference between the third and fourth ionization energies of titanium. Why? (c) Why does Li have a much larger second ionization energy than Be?</p>
9	10
<p>Two atoms have the electron configurations $1s^22s^22p^6$ and $1s^22s^22p^63s^1$. The first ionization energy of one is 2080 kJ/mol, and that of the other is 496 kJ/mol. Match each ionization energy with one of the given electron configurations. Justify your choice.</p>	<p>115. Consider the following ionization energies for aluminum:</p> $\text{Al}(g) \longrightarrow \text{Al}^+(g) + e^- \quad I_1 = 580 \text{ kJ/mol}$ $\text{Al}^+(g) \longrightarrow \text{Al}^{2+}(g) + e^- \quad I_2 = 1815 \text{ kJ/mol}$ $\text{Al}^{2+}(g) \longrightarrow \text{Al}^{3+}(g) + e^- \quad I_3 = 2740 \text{ kJ/mol}$ $\text{Al}^{3+}(g) \longrightarrow \text{Al}^{4+}(g) + e^- \quad I_4 = 11,600 \text{ kJ/mol}$ <p>a. Account for the trend in the values of the ionization energies. b. Explain the large increase between I_3 and I_4.</p>

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3. The first four ionization energies for the elements *X* and *Y* are shown below. The units are not kJ/mol.

	<i>X</i>	<i>Y</i>
First	170	200
Second	350	400
Third	1800	3500
Fourth	2500	5000

Identify the elements *X* and *Y*. There may be more than one correct answer, so explain completely.

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6. Explain why a graph of ionization energy versus atomic number (across a row) is not linear. Where are the exceptions? Why are there exceptions?

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- 8.38 By referring only to the periodic table, select (a) the most electronegative element in group 6A; (b) the least electronegative element in the group Al, Si, P; (c) the most electronegative element in the group Ga, P, Cl, Na; (d) the element in the group K, C, Zn, F, that is most likely to form an ionic compound with Ba.

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27. Without using Fig. 8.3, predict the order of increasing electronegativity in each of the following groups of elements.
- a. C, N, O c. Si, Ge, Sn
b. S, Se, Cl d. Tl, S, Ge

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149. The successive ionization energies for an unknown element are

$$I_1 = 896 \text{ kJ/mol}$$

$$I_2 = 1752 \text{ kJ/mol}$$

$$I_3 = 14,807 \text{ kJ/mol}$$

$$I_4 = 17,948 \text{ kJ/mol}$$

To which family in the periodic table does the unknown element most likely belong?

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150. An unknown element is a nonmetal and has a valence electron configuration of ns^2np^1 .
- How many valence electrons does this element have?
 - What are some possible identities for this element?
 - What is the formula of the compound this element would form with potassium?
 - Would this element have a larger or smaller radius than barium?
 - Would this element have a greater or smaller ionization energy than fluorine?