Chemistry 202: Quiz #7

1. The first four successive ionization energies for elements X and Y (both in the same Group on the periodic table) are given in the table below (the units are not kJ/mol):

	X	**Y**
First	170	200
Second	350	400
Third	1800	3500
Fourth	2500	5000

Which of the following **cannot** be element Y?

a) Be b) Mg c) Ca d) Sr e) Y could be any of these (a-d).

2. Consider the most stable species of an element as an isolated atom/ion and the most stable species of this element in an ionic compound. For which of the following are these the same?

a) sodium
b) magnesium
c) oxygen
d) All of the above (a-c).
e) None of the above (a-c).

3. How many of the following statements are **true**?

- The electron affinity values for the first 20 elements can be endothermic or exothermic, but are mostly exothermic.
- The ionization energy values for the first 20 elements can be endothermic or exothermic, but are mostly exothermic.
- The ionization energy values for the first 20 elements can be endothermic or exothermic, but are mostly endothermic.
- If we know the ionization energy value for element X, we can determine the electron affinity value for the ion X^-.

a) 0 b) 1 c) 2 d) 3 e) 4

4. Which of the following best explains the ratio of $\frac{2^{nd}\text{ ionization energy}}{1^{st}\text{ ionization energy}}$ for Ne and F?

a) The ratio for Ne is much greater than that for F because Ne has more protons than F.
b) The ratio for Ne is much greater than that for F because Ne has a filled outer shell of electrons.
c) The ratio for Ne is much less than that for F because the 1^{st} ionization energy for Ne is greater than the 1^{st} ionization energy of F.
d) The ratio for Ne is much less than that for F because Ne has a filled outer shell of electrons.
e) The ratio for Ne is about the same as that for F since all electrons are removed from the same energy level.

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5. If we have access to the following values:

- The first and second ionization energies for Na.
- The ionization energy for Mg^{2+}.
- The third electron affinity value for P.
- The electron affinity value for O.

How many of the following could be determined?

I. The ionization energy of Na^+.
II. The electron affinity of Na.
III. The lattice energy for Na_3P.
IV. The electron affinity value of Mg^+.
V. The electron affinity value of Mg^{2+}.
VI. The ionization energy of O.

a) 0 b) 1 c) 3 d) 4 e) 5

6. All of the following have similar values of $\frac{2^{nd}\text{ ionization energy}}{1^{st}\text{ ionization energy}}$ except for which one?

a) Li b) Be c) C d) N e) Ne

7. Gosh, the study of thermodynamics is great! It takes all the stuff we know and explains it with grace and elegance (and numbers!). Look at the questions on Exam II, or question 21 on this exam, for example. Or, consider that we know that **a bond made between atoms with a small (or zero) difference in electronegativity values (ΔEN) is covalent or polar, but not ionic**.

In the videos, I discuss a case with ionic bonds, so let's evaluate two cases in which the bonds are not ionic. In both cases, **use numbers and explanations** of the second law of thermodynamics to **show why the product is what we predict from electronegativity differences**.

Case 1: The atoms are the same (ΔEN = 0). For example consider a sample of chlorine atoms [which we can symbolize as Cl(*g*)]. We know the natural state of chlorine is $Cl_2(g)$, so the chlorine atoms will naturally form $Cl_2(g)$. There will **not** be a transfer of electrons such that we form Cl^+ and Cl^-, and then ionic chlorine.

Case 2: The atoms are close to each other on the periodic table (ΔEN = intermediate). Consider, for example, carbon and oxygen. When we react carbon (graphite) with the right amount of oxygen gas, we know we will form CO(*g*). We do **not** form ionic CO(*s*) in which the charges are C^+ and O^-, or C^{2+} and O^{2-}.

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For each case, **use the given data** to **show that the covalent/polar product is predicted by thermodynamics** (as opposed to the other suggested ionic products given in both case descriptions above – that is, show the covalent molecules are thermodynamically favorable over ionic structures).

Include a discussion of ΔS, ΔS_{surr} and ΔS_{univ} for both cases to **support the numbers** you are determing.

In addition to the bond energy data you have been given (Table 13.6), use the following information:

- Ionization energy value for Cl = 1255 kJ/mol
- Electron affinity value for Cl = –350. kJ/mol
- $\Delta H_{sublimation}$ for graphite: C(*s*) = 717 kJ/mol
- Successive ionization energy values for C = 1100. kJ/mol; 2325 kJ/mol
- Successive electron affinity values for O = –150. kJ/mol; 887 kJ/mol
- Assume the lattice energy for any (+1)(–1) lattice ≈ –1000 kJ/mol , and for a lattice with (+2)(–2), lattice energy ≈ –4000 kJ/mol.

Show all work and **explain your reasoning**.

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KEY:

MC: 1. e, 2. e, 3. b, 4. e, 5. b, 6. a

7. See videos, lectures, and the textbook.