CHEM 202 Accelerated General Chemistry I Week 11 – Trends and Chemical Bonding I MERIT WS 11.2 TA: Alex Wang November 4, 2021 Section AQG



1. Which has a larger second ionization energy, lithium or beryllium?

2. Consider the following statement: "The ionization energy for the potassium atom is negative because when K loo ses an electron to become K⁺ it achieves a noble gas configuration." Indicate what is incorrect. Explain.

3. In going across a row of the periodic table, electrons are added, and ionization energy generally increases. In going down a column of the periodic table, electrons are also being added but ionization energy generally decreases. Explain.

4. Prove mathematically that is it more energetically favorable for a fluorine atom to take an electron from a sodium atom than for a fluorine atom to take an electron from another fluorine atom

- 5. Consider the following questions pertaining to periodic trends.
 - a. Circle the element in each pair has the larger radius.

i. Mg or Mg²⁺
ii. O or O²⁻
iii. K⁺ or Cl
iv. P³⁻ or S²⁻
b. In each of the following pairs, circle the species with the higher first ionization energy:

i. Li or Cs ii. Cl or Ar iii. Ca or Br iv. Na or Ne v. B or Be

6. Draw the Lewis Structures for the following compounds and note whether they are polar or nonpolar.

Sulfur Tetrafluoride (SF4)	Boron Trifluoride (BF3)
Polarity:	Polarity:

Xenon Pentafluoride Cation ([XeF ₅] ⁺)	Carbon Dioxide (CO ₂)
Polarity:	Polarity:

 Using the following data, estimate the standard heat of formation for magnesium fluoride.
 Lattice energy: -2913 kJ/mole
 First ionization energy of Mg: 735 kJ/mole
 Second ionization energy of Mg: 1445 kJ/mole
 Electron affinity of F: -328 kJ/mole
 Bond energy of F2: 154 kJ/mole
 Enthalpy of sublimation of Mg: 150 kJ/mole

8. A promising new material with great potential as a fuel in solid rocket motors is ammonium dinitramide $[NH_4N(NO_2)_2]$.

Draw Lewis structures (including resonance forms) for the dinitramide ion $[N(NO_2)_2]$.

- a. Predict the bond angles around each nitrogen in the dinitramide ion.
- b. Ammonium dinitramide can decompose explosively to nitrogen, water, and oxygen. Write a balanced equation for this reaction, and use bond energies to estimate ΔH for the explosive decomposition of this compound.
- c. To estimate ΔH from bond energies, you made several assumptions. What are some of your assumptions?

- 9. Think of forming an ionic compound as three steps (this is a simplification, as with all models): (1) removing an electron from the metal, (2) adding an electron to the nonmetal, and (3) allowing the metal cation and nonmetal anion to come together.
 - a. What is the sign of the energy change for each of these three processes?
 - b. In general, what is the sign of the sum of the first two processes? Use examples to support your answer.
 - c. What must be the sign of the sum of the three processes?
 - d. Given your answer to part c, why do ionic bonds occur?
 - e. Given your explanations to part d, why is NaCl stable but not Na_2Cl_2 and $NaCl_2$? What about MgO compared to MgO₂ and Mg₂O?

10. Given the following information:

Heat of sublimation of Li(s)=166 kJ/mol Bond energy of HCl=427 kJ/mol Ionization energy of Li(g)=520. kJ/mol Electron affinity of Cl(g)=-349 kJ/mol Lattice energy of LiCl(s)=-829 kJ/mol Bond energy of H₂=432 kJ/mol

Calculate the net change in energy for the following reaction: $2Li(s)+2HCl(g)\rightarrow 2LiCl(s)+H_2(g)$ 11. Use the following data (all in kJ/mol) to determine the second electron affinity (EA) value for the sulfur atom. The standard states for sodium and sulfur are Na(s) and S(s), respectively.

	ΔH _f 0	Lattice Energy	1 st IE for Metal	1 st EA for Non- Metal	∆H _{sub} for Metal	∆H _{sub} for Non- Metal
Na ₂ S	-365	-2203	495	-200	109	277