CHEMICAL BONDS AND ELECTRONEGATIVITY

Suggested Problems pp 382-387: 25, 31, 33, 39, 43, 45, 67, 71, 73, 81, 85, 87, 93, 99, 103

24. Using only a periodic table, predict the order of increasing electronegativity in each of the following groups of elements.

a. Na, K, Rb
b. B, O, Ga
c. F, Cl, Br
d. S, O, F

30. Using only a periodic table, predict whether each of the following bonds will be ionic, polar, or nonpolar. For polar bonds, indicate the bond polarity by labeling the dipoles.

a. C–O
b. C–H
c. H–Cl
d. Br–Ba
e. H–N
f. O–N

32. Using only a periodic table, rank the following bonds in order of increasing ionic character: N–O, Ca–O, C–F, Br–Br, K–F.

IONS AND LATTICE ENERGY

40. For each of the following groups, place the atoms and/or ions in order of decreasing size.

a. V, V^{2+}, V^{3+}, V^{5+}

b. Na^{+}, K^{+}, Rb^{+}, Cs^{+}

c. Te^{2-}, I^{-}, Cs^{+}, Ba^{2+}

d. P, P^{-}, P^{2-}, P^{3-}

e. O^{2-}, S^{2-}, Se^{2-}, Te^{2-}

44. Which compound in each of the following pairs of ionic substances has the most exothermic lattice energy? Justify your answers.

a. LiF, CsF

b. NaBr, NaI

c. $BaCl_2$, BaO

d. Na_2SO_4, $CaSO_4$

e. KF, K_2O

f. Li_2O, Na_2S

46. Use the following data to estimate ΔH_f^0 for magnesium fluoride.

$$Mg(s) + F_2(g) \rightarrow MgF_2(s)$$

Lattice energy	-3916 kJ/mol
First ionization energy of Mg	735 kJ/mol
Second ionization energy of Mg	1445 kJ/mol
Electron affinity of F	-328 kJ/mol
Bond energy of F_2	154 kJ/mol
Enthalpy of sublimation of Mg	150. kJ/mol

48. Compare the electron affinity of fluorine to the ionization energy of sodium. Is the process of an electron being "pulled" from the sodium atom to the fluorine atom exothermic or endothermic? Why is NaF a stable compound? Is the overall formation of NaF endothermic or exothermic? How can this be?

52. The lattice energies of $FeCl_3$, $FeCl_2$, and Fe_2O_3 are (in no particular order) -2631, -5359, and -14,774 kJ/mol. Match the appropriate formula to each lattice energy. Explain.

LEWIS STRUCTURES AND RESONANCE

68. Write Lewis structures that obey the octet rule for each of the following molecules and ions. (In each case the first atom listed is the central atom.)

a. $POCl_3$

b. SO_4^{2-}

c. XeO_4

d. PO_4^{3-}

e. ClO_4^-

f. NF_3

g. SO_3^{2-}

h. PO_3^{3-}

i. ClO_3^-

j. ClO_2^-

68.5. What conclusions can you draw concerning structures of species containing the same number of atoms and the same number of valence electrons?

72. SF_6, ClF_5, and XeF_4 are three compounds whose central atoms do not follow the octet rule. Draw Lewis structures for these compounds.

74. Some of the important pollutants in the atmosphere are ozone (O_3), sulfur dioxide, and sulfur trioxide. Write Lewis structures for these three molecules. Show all resonance structures where applicable.

80. Order the following species with respect to carbon-oxygen bond length (longest to shortest): CO, CO_2, CO_3^{2-}, CH_3OH

80.5. What is the order from the weakest to the strongest carbon-oxygen bond?

FORMAL CHARGE

82. Determine the Lewis structures that involve minimum formal charges for each of the following species.

a. $POCl_3$

b. SO_4^{2-}

c. ClO_4^-

d. PO_4^{3-}

e. SO_2Cl_2

f. XeO_4

g. ClO_3^-

h. NO_4^{3-}

84. Oxidation of the cyanide ion produces the stable cyanate ion, OCN^-. The fulminate ion, CNO^-, on the other hand, is very unstable. Fulminate salts explode when struck; $Hg(CNO)_2$ is used in blasting caps. Write the Lewis structures and assign formal charges for the cyanate and fulminate ions. Why is the fulminate ion so unstable? (C is the central atom in OCN^- and N is the central atom in CNO^-)

MOLECULAR STRUCTURE AND POLARITY

88.Predict the molecular structure and bond angles for each molecule or ion in #68 (p 4) and #82 (p 6).

1. Account for the following statements or observations in terms of atomic-level, ionic-level, or molecular-level explanations.
    a. Magnesium exists as 2+ ions rather than 1+ ions in all its compounds despite the fact that the second ionization energy of a magnesium atom is more than twice as great as the first ionization energy. Use lattice energy as the basis for your explanation.

    b. Titanium forms ions with different charges (+2, +3, and +4). The first two of these ions are colored while the last is colorless. Visible color typically corresponds to electronic transitions.

    c. A molecule of nitrogen has a shorter bond length than does a molecule of fluorine even though the fluorine atom has a smaller radius.

    d. Nitrogen forms NF_3 but not NF_5 whereas phosphorus forms PF_3 and PF_5. The trifluorides are both polar and the pentafluoride is non-polar.

118. 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 H_2	432 kJ/mol

Calculate the net change in energy for the following reaction:

$$2\ Li(s) + 2\ HCl(g) \rightarrow 2\ LiCl(s) + H_2(g)$$