9 • Bonding & Molecular Structure

STUDY QUESTIONS

1. Classify the following substances as covalent molecules or ionic compounds:
   a. MgO
   b. NI_3
   c. CuS
   d. NO_2
   e. LiCl
   f. SF_4
   g. XeF_4
   h. CsF

2. How many valence electrons do the following atoms or ions have? Write their Lewis symbols.
   a. Ca
   b. S
   c. P
   d. O^{2-}
   e. Mg^{2+}
   f. C^{4-}
   g. Li
   h. Ne

3. Which of the following molecules do not obey the octet rule?
   a. $AlCl_3$
   b. PCl_3
   c. PCl_5
   d. $SiCl_4$
   e. SF_6
   f. $BeCl_2$
   g. NO_2
   h. XeF_4

4. Order the following salts in increasing lattice energy?
   CaS, MgO, KCl, CsI, NaF

5. Draw Lewis electron dot structures for the following molecules.
   a. NCl_3
   b. BCl_3
   c. ClO_2^-
   d. SF_4
   e. OCS
   f. SO_2

6. Assign formal charges to all the atoms in the following species:
   a. chlorite ion ClO_2^-
   b. hydroxylamine $HONH_2$
   c. phosphorous acid H_3PO_3
   d. ozone O_3
   e. nitrogen dioxide NO_2

7. Estimate, using the bond energies in Table 9.9 on page 403 of the text, the enthalpy change $\Delta H°$ for the conversion of propene to isopropanol:
   $CH_3–CH=CH_2 + H_2O \rightarrow CH_3–CH(OH)–CH_3$

8. When ethanol burns in air, heat is released. Estimate the enthalpy of combustion of ethanol vapor $\Delta H°$ from the average bond energies listed in Table 9.9. Use thermochemical data in Chapter 6 to calculate the same thing. Compare the two values obtained.

9. What is the bond order of the listed bonds in the following molecules or ions?
   a. C–O in carbonate ion
   b. C–O in acetic acid
   c. N–O in nitrite ion
   d. C–C acetylene
   e. O–O in oxygen in O_2
   f. C–N in hydrogen cyanide
   g. S–F in sulfur tetrafluoride
   h. C–O in carbon dioxide

10. Draw possible resonance structures for
   a. NO_2^-
   b. HCO_2^-
   c. NO_2Cl

11. What molecular shapes are associated with the following electron pairs around the central atom?
   a. 3 bonding pairs and 2 lone pairs
   b. 4 bonding pairs and 1 lone pair
   c. 3 bonding pairs and 1 lone pair
   d. 2 bonding pairs and 2 lone pairs
   e. 2 bonding pairs and 3 lone pairs
   f. 5 bonding pairs and 1 lone pair

12. What shapes are the following molecules or polyatomic ions?
   a. O_3
   b. GaH_3
   c. SO_2Cl_2
   d. XeO_4
   e. NO_2^+
   f. ClO_4^-
   g. IF_4^-
   h. ClF_2^-

13. Determine whether the following molecules are polar or nonpolar:
   a. CCl_4
   b. XeF_4
   c. PCl_5
   d. PCl_3
   e. BF_3
   f. $BeCl_2$
   g. SCl_2
   h. CS_2