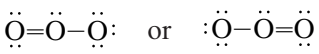
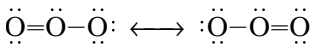
Resonance Structures

Some molecules and ions cannot be represented adequately by a single Lewis structure. One such molecule is ozone, O_3, which can be represented by either of the following Lewis structures.



Notice that each structure indicates that the ozone molecule has two types of O−O bonds, one single and one double. Chemists once speculated that ozone split its time existing as one of these two structures, constantly alternating, or "resonating," from one to the other. Experiments, however, revealed that the oxygen-oxygen bonds in ozone are identical. Therefore, scientists now say that ozone has a single structure that is the average of these two structures. Together the structures are referred to as *resonance structures* or *resonance hybrids*. **Resonance** *refers to bonding in molecules or ions that cannot be correctly represented by a single Lewis structure.* To indicate resonance, a double-headed arrow is placed between a molecule's resonance structures.



Covalent-Network Bonding

All the covalent compounds that you have read about so far are molecular. They consist of many identical molecules held together by forces acting between the molecules. (You will read more about these intermolecular forces in Section 5.) There are many covalently bonded compounds that do not contain individual molecules, but instead can be pictured as continuous, three-dimensional networks of bonded atoms. You will read more about covalently bonded networks in Chapter 7.

SECTION REVIEW

1. Define the following:
   a. bond length **b.** bond energy
2. State the octet rule.
3. How many pairs of electrons are shared in the following types of covalent bonds?
   a. a single bond
   b. a double bond
   c. a triple bond
4. Draw the Lewis structures for the following molecules:
   a. IBr **d.** $SiCl_4$
   b. CH_3Br **e.** F_2O
   c. C_2HCl

Critical Thinking

5. **APPLYING MODELS** Compare the molecules H_2NNH_2 and HNNH. Which molecule has the stronger N-N bond?