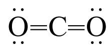
SAMPLE PROBLEM F

a. Use VSEPR theory to predict the shape of a molecule of carbon dioxide, CO_2.
b. Use VSEPR theory to predict the shape of a chlorate ion, ClO_3^-.

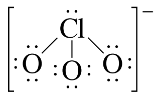
SOLUTION

a. The Lewis structure of carbon dioxide shows two carbon-oxygen double bonds and no unshared electron pairs on the carbon atom. To simplify the molecule's Lewis structure, we represent the covalent bonds with lines instead of dots.



This is an AB_2 molecule, which is linear.

b. The Lewis structure of a chlorate ion shows three oxygen atoms and an unshared pair of electrons surrounding a central chlorine atom. Again, lines are used to represent the covalent bonds.

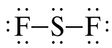


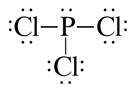
The chlorate ion is an AB_3E type. It has trigonal-pyramidal geometry, with the three oxygen atoms at the base of the pyramid and the chlorine atom at the top.

PRACTICE

Answers in Appendix E

1. Use VSEPR theory to predict the molecular geometries of the molecules whose Lewis structures are given below.

a. 

b. 

extension

Go to **go.hrw.com** for more practice problems that ask you to use VSEPR theory.

Keyword: HC6BNDX

Hybridization

VSEPR theory is useful for explaining the shapes of molecules. However, it does not reveal the relationship between a molecule's geometry and the orbitals occupied by its bonding electrons. To explain how the orbitals of an atom become rearranged when the atom forms covalent bonds, a different model is used. This model is called **hybridization,** *which is the mixing of two or more atomic orbitals of similar energies on the same atom to produce new hybrid atomic orbitals of equal energies.*

Methane, CH_4, provides a good example of how hybridization is used to explain the geometry of molecular orbitals. The orbital notation for a carbon atom shows that it has four valence electrons, two in the $2s$ orbital and two in $2p$ orbitals.