Chapter 5

Chemical Bonding: The Covalent Bond Model

What's the fuel in space shuttle?

→ **CO 5.1**
Space Shuttle liftoff

NASA

Hydrogen molecule: A covalent bond

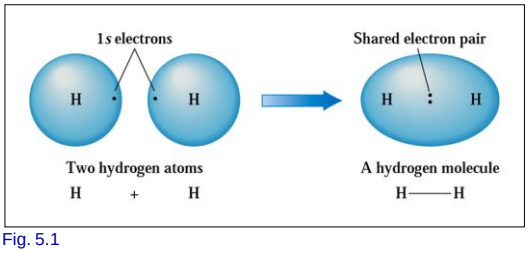
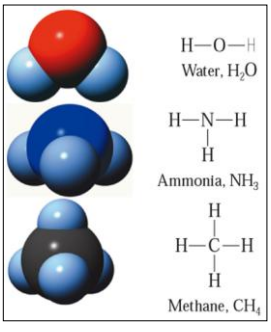


Fig. 5.1
Electron sharing can occur only when electron orbitals from two different atoms overlap.

Number of covalent bonds and Lewis symbol



← Fig. 5.2
The number of covalent bonds formed by a nonmetallic element is directly correlated with the number of electrons it must share in order to obtain an octet of electrons.

Covalent and Coordinate covalent Bond

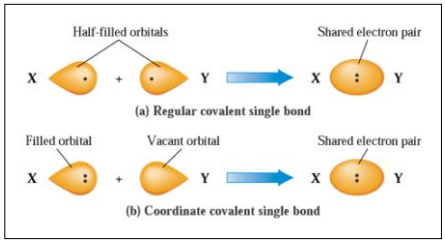
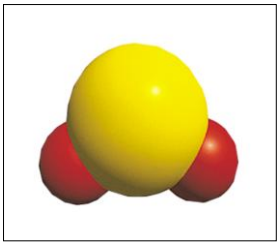


Fig. 5.3 **(a) A "regular" covalent single bond is the result of overlap of two half-filled orbitals. (b) A coordinate covalent single bond is the result of overlap of a filled and a vacant orbital.**

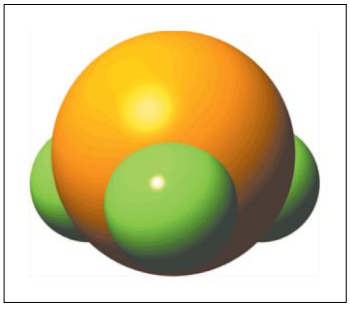
Molecular structure

→ Fig. 5.4
The sulfur dioxide molecule.

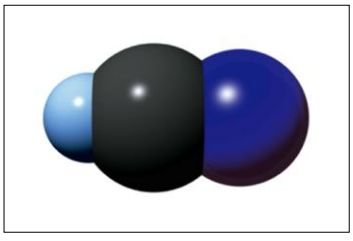


Pyramidal molecule

→ Fig. 5.5
The phosphorus trifluoride molecule.



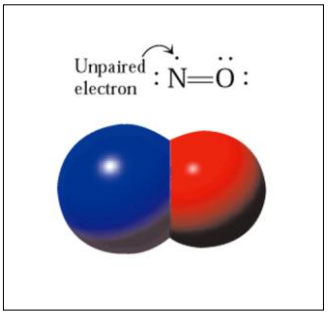
Linear Molecule



← Fig. 5.6
The hydrogen cyanide molecule.

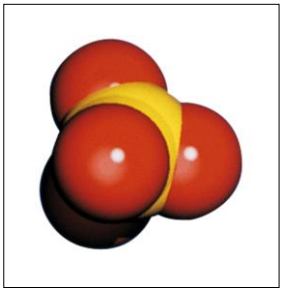
Unpaired electrons

→ CC 5.1

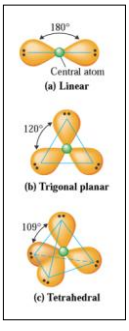


Polyatomic ions held by covalent bonds

→ Fig. 5.7
The sulfate ion.



Electron pair repulsions



← Fig. 5.8
Arrangement of valence electron pairs about a central atom that minimize repulsions between the pairs.

Where you find covalent molecules?

→ CC 5.2

Space filling models

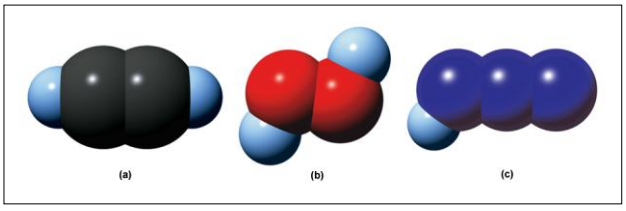
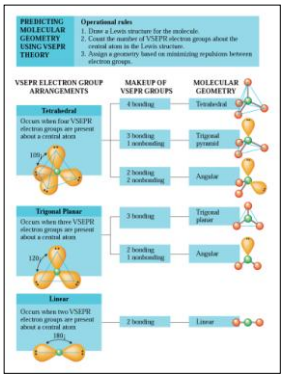


Fig. 5.9

(a) Acetylene molecule. (b) Hydrogen peroxide molecule. (c) Hydrogen azidde molecule.

VSEPR theory and molecular geometry



Linus Pauling and Electronegativity

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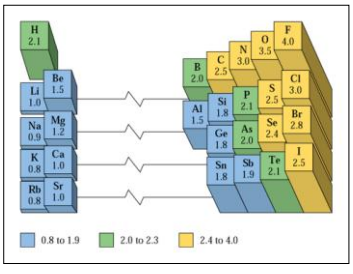
← Fig. 5.10

Linus Pauling received the Nobel Prize in chemistry in 1954 for his work on the nature of the chemical bond.

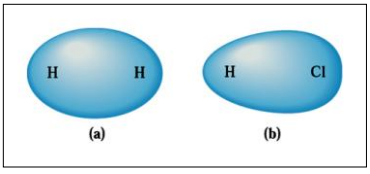
Electronegativity Trends

→ Fig. 5.11

Abbreviated periodic table showing Pauling electronegativity values for selected representative elements.



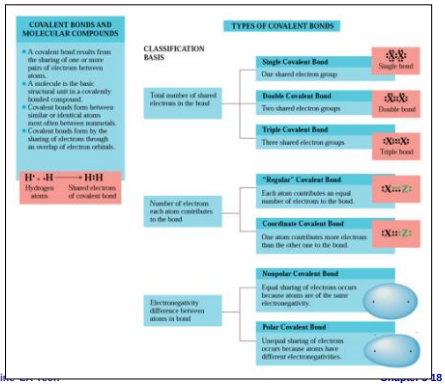
Polarity in heteonuclear diatomic molecules



← Fig. 5.12
(a) In the nonpolar covalent bond present, there is a symmetrical distribution of electron density. (b) In the polar covalent bond present, electron density is displaced because of its electronegativity.

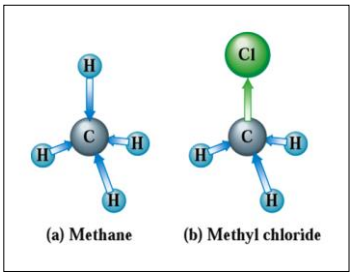
Types of covalent bond

→ CAG 5.2



Predicting polarity of molecule

→ Fig. 5.13
(a) Methane is a nonpolar tetrahedral molecule.
(b) Methyl chloride is a polar tetrahedral molecule.



Prefixes for naming covalent compounds

→ Table 5.1

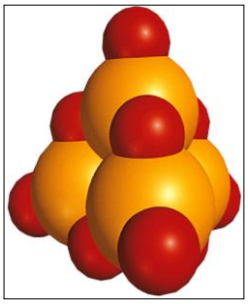
Prefix	Number
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8
nona-	9
deca-	10

Common names of covalent compunds

→ Table 5.2

Compound Formula	Accepted Common Name
H_2O	water
H_2O_2	hydrogen peroxide
NH_3	ammonia
N_2H_4	hydrazine
CH_4	methane
C_2H_6	ethane
PH_3	phosphine
AsH_3	arsine

Naming covalent compounds



← Fig. 5.14
The tetraphosphorous decoxide molecule.