

## Lewis Acids and Bases

### 8.12 Incomplete Octets

- Molecular compounds of some elements from groups 2 and 13 (**Be**, **B** and **Al**) form **incomplete octets** – less than  $8e^-$  around the central atom

**Example:** Write the Lewis structure of **BeH<sub>2</sub>**.



⇒ additional bonds can not be used (no remaining  $e^-$ )



⇒ the structure has an incomplete octet for the **Be** atom because the molecule is **electron-deficient**

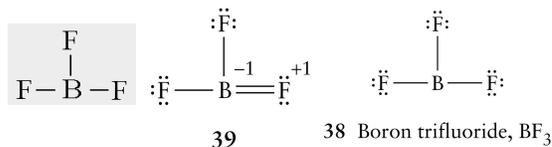
**Example:** Write the Lewis structure of **BF<sub>3</sub>**.

$$n_{\text{tot}} = 3 + 3 \times 7 = 24$$

$$n_{\text{rem}} = 24 - 6 = 18$$

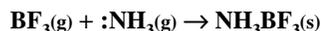
$$n_{\text{need}} = 2 + 3 \times 6 = 20$$

$$n_{\text{need}} > n_{\text{rem}} \quad \text{deficiency of } 2e^- \Rightarrow \text{add } 1 \text{ more bond}$$

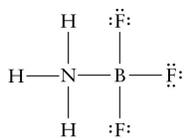


The second resonance structure has only  $6e^-$  around **B** (incomplete octet), but it is the favored structure due to the lower formal charges

- Structures with incomplete octets are **electron-deficient** and tend to react with molecules that have abundance of  $e^-$  in the form of lone pairs



- The lone pair of **N** is used to form the bond between **B** and **N** and completes the octet of **B**

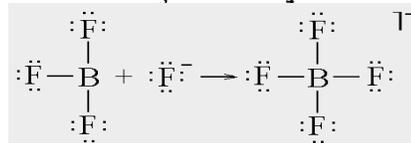
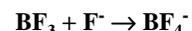
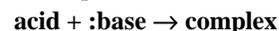


- Coordinate covalent bonds** – bonds in which both electrons come from the same atom

- Once formed, a coordinate covalent bond behaves as a normal covalent bond

### 8.13 Lewis Acid-Base Complexes

- Lewis acid** –  $e^-$  pair acceptor
- Lewis base** –  $e^-$  pair donor



- Normally Lewis acids are species with vacant orbitals, while Lewis bases are species with lone pairs

- Hemoglobin forms an acid-base complex with **O<sub>2</sub>** and **CO** (lone pairs from the **O** atoms in **O<sub>2</sub>** and **CO** are donated to the vacant orbitals of the **Fe** atoms of hemoglobin)

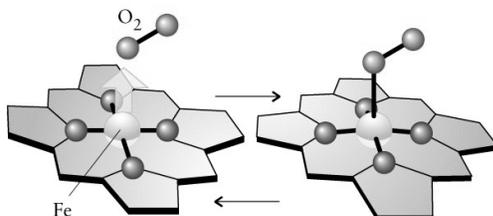


Fig. 8.19

### Ionic Versus Covalent Bonds

- There is no clear cut between ionic and covalent bonds – pure ionic and pure covalent bonds are only limiting models

### 8.14 Correcting the Covalent Model

- Electronegativity (EN)** – the ability of an atom to attract the bonding electrons in a bond (electron-pulling power)
  - EN increases with increasing the ionization energy and electron affinity of atoms
  - EN increases **up** and to the **right** in the periodic table

