

Chapter 4

Compounds and Their Bonds

4.5 Polyatomic Ions

4.6 Covalent Compounds

4.7 Bond Polarity

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Covalent Bonds

- Formed between two nonmetals in 4A, 5A, 6A, and 7A
- Nonmetals have high electronegativity values
- Electrons are shared

single bond shares one pair electrons

double bond shares two pairs electrons

triple bond shares three pairs electrons

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Learning Check

Indicate whether a bond between the following would be 1) **ionic** 2) **covalent**

- ___ A. sodium and oxygen
 ___ B. nitrogen and oxygen
 ___ C. phosphorus and chlorine
 ___ D. calcium and sulfur
 ___ E. chlorine and bromine

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Solution

Indicate whether a bond between the following would be 1) **ionic** 2) **covalent**

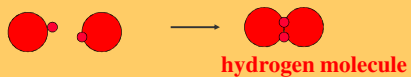
- 1 A. sodium and oxygen
2 B. nitrogen and oxygen
2 C. phosphorus and chlorine
1 D. calcium and sulfur
2 E. chlorine and bromine

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Covalent Bonds

Two nonmetal atoms form a covalent bond because they have less energy after they bonded

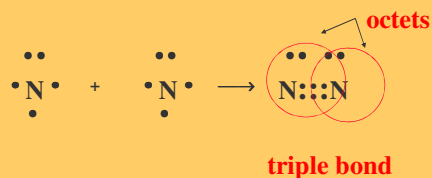


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Diatomic Molecules

Gases that exist as diatomic molecules are H_2 , F_2 , N_2 , O_2 , Cl_2 , Br_2 , I_2



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Learning Check

Use the name of the element to name the following diatomic molecules.

H_2 **hydrogen**

N_2 **nitrogen**

Cl_2 _____

O_2 _____

I_2 _____

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Solution

Use the name of the element to name the following diatomic molecules.

H_2 **hydrogen**

N_2 **nitrogen**

Cl_2 **chlorine**

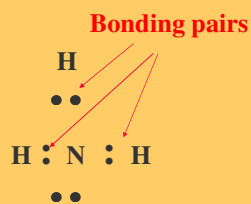
O_2 **oxygen**

I_2 **iodine**

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Covalent Bonds in NH_3



Lone pair of electrons

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Naming Binary Covalent Compounds

Two nonmetals

- Name each element
- End the last element in -ide
- Add prefixes to show more than 1 atom

Prefixes

mon	1	penta	5
di	2	hexa	6
tri	3		
tetra	4		

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Learning Check

Fill in the blanks to complete the following names of covalent compounds.

CO carbon _____oxide

CO₂ carbon _____

PCl₃ phosphorus _____chloride

CCl₄ carbon _____chloride

N₂O _____nitrogen _____oxide

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Solution

CO carbon **mon**oxide

CO₂ carbon **di**oxide

PCl₃ phosphorus **tri**chloride

CCl₄ carbon **tetra**chloride

N₂O **di**nitrogen **mon**oxide

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- A. P_2O_5 1) phosphorus oxide
 2) phosphorus pentoxide
 3) diphosphorus pentoxide
- B. Cl_2O_7 1) dichlorine heptoxide
 2) dichlorine oxide
 3) chlorine heptoxide
- C. Cl_2 1) chlorine
 2) dichlorine
 3) dichloride

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Solution

- A. P_2O_5 3) diphosphorus pentoxide
- B. Cl_2O_7 1) dichlorine heptoxide
- C. Cl_2 1) chlorine

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Electronegativity

- The attraction of an atom for electrons is called its electronegativity.
- Fluorine has the greatest electronegativity.
- The metals have low electronegativities.

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Bond Polarity: Nonpolar

Nonpolar covalent bond

- Electrons are shared between atoms with the same electronegativity values.
- Difference = 0
- Examples:



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Bond Polarity: Polar

Polar covalent bond

- Electrons are shared between different nonmetal atoms Examples:



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Bond Polarity: Ionic

Ionic bond

- Electrons are transferred between metal and nonmetal atoms
- NaCl KF

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Learning Check

Identify the type of bond between the following atoms

- A. K-N
 1) nonpolar 2) polar 3) ionic
- B. N-O
 1) nonpolar 2) polar 3) ionic
- C. Cl-Cl
 1) nonpolar 2) polar 3) ionic

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Solution

- A. K-N 3) ionic
- B. N-O 2) polar
- C. Cl-Cl 1) nonpolar

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Polyatomic Ions

A group of atoms with an overall charge.

- NH_4^+ ammonium OH^- hydroxide
- NO_3^- nitrate NO_2^- nitrite
- CO_3^{2-} _____
- HCO_3^- hydrogen carbonate (bicarbonate)

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More Polyatomic Ions

Sulfur

SO_4^{2-} sulfate SO_3^{2-} sulfite

HSO_4^- hydrogen sulfate

HSO_3^- hydrogen sulfite

Phosphate

PO_4^{3-} phosphate PO_3^{3-} _____

HPO_4^{2-} _____

H_2PO_4^- dihydrogen phosphate

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Naming Ternary Compounds

- Contain at least 3 elements
- Name the nonmetals as a **polyatomic ion**
- Examples:

NaNO_3 Sodium **nitrate**

K_2SO_4 Potassium **sulfate**

$\text{Al}(\text{HCO}_3)_3$ Aluminum **bicarbonate**
 or
 Aluminum **hydrogen carbonate**

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Learning Check

Match each set with the correct name:

- A. Na_2CO_3 1) magnesium sulfite
- MgSO_3 2) magnesium sulfate
- MgSO_4 3) sodium carbonate
- B. $\text{Ca}(\text{HCO}_3)_2$ 1) calcium carbonate
- CaCO_3 2) calcium phosphate
- $\text{Ca}_3(\text{PO}_4)_2$ 3) calcium bicarbonate

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Solution

- A. Na_2CO_3 3) sodium carbonate
 MgSO_3 1) magnesium sulfite
 MgSO_4 2) magnesium sulfate
- B. $\text{Ca}(\text{HCO}_3)_2$ 3) calcium bicarbonate
 CaCO_3 1) calcium carbonate
 $\text{Ca}_3(\text{PO}_4)_2$ 2) calcium phosphate

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Learning Check

- A. aluminum nitrate
 1) AlNO_3 2) $\text{Al}(\text{NO})_3$ 3) $\text{Al}(\text{NO}_3)_3$
- B. copper(II) nitrate
 1) CuNO_3 2) $\text{Cu}(\text{NO}_3)_2$ 3) $\text{Cu}_2(\text{NO}_3)$
- C. Iron (III) hydroxide
 1) FeOH 2) Fe_3OH 3) $\text{Fe}(\text{OH})_3$
- D. Tin(IV) hydroxide
 1) $\text{Sn}(\text{OH})_4$ 2) $\text{Sn}(\text{OH})_2$ 3) $\text{Sn}_4(\text{OH})$

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Solution

- A. aluminum nitrate
 3) $\text{Al}(\text{NO}_3)_3$
- B. copper(II) nitrate
 2) $\text{Cu}(\text{NO}_3)_2$
- C. Iron (III) hydroxide
 3) $\text{Fe}(\text{OH})_3$
- D. Tin(IV) hydroxide
 1) $\text{Sn}(\text{OH})_4$

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