

Warm Up:

What is the formula of the ion when the following elements achieve noble-gas electron configuration?

K

O

F

N

P

Objectives:

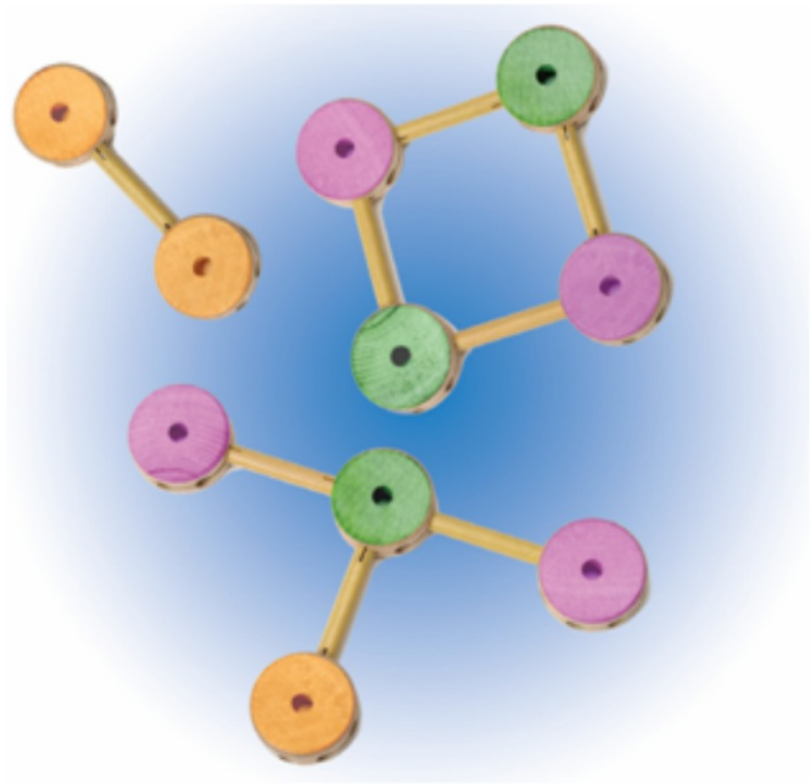
TSWBAT:

use Lewis Dot Structures and the Octet Rule to predict covalent bonding in simple compounds.

Molecular Compounds

(this is where the fun begins!)

These toy models are made from circular pieces joined together in units by sticks. Atoms can also be arranged in different ways to make a variety of products.



**Clemson site for FREE college
if you major in science or
engineering:**

clemson.edu/ces/psu/letter.html

Covalent Bonds

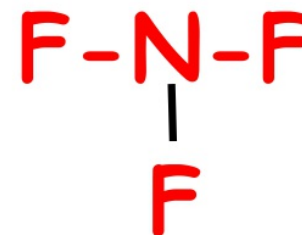
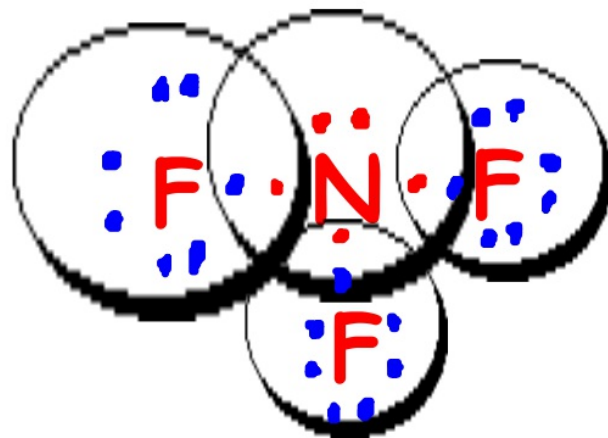
The atoms held together by sharing electrons are joined by a covalent bond.

Some compounds are so different from ionic compounds that attractions between ions fail to explain their bonding.

A covalent bond is 2 electrons (or a pair) shared between the nuclei of two atoms.

This "sharing" is not always equal-remember electronegativity? Some elements pull the shared electrons more towards themselves than other elements.

In a covalent bond, both atoms "think" they own both electrons in a bond even though they are really sharing them. Each atom "counts" both shared electrons when it tries to get an octet.



Warm Up

An ionic compound is composed of
_____.

A molecular compound is composed
of _____.

A compound composed of molecules is called a molecular compound.
Water and carbon monoxide are molecular compounds.



Water (H₂O)



Carbon monoxide (CO)

Definitions:

A molecule is a neutral group of atoms joined together by covalent bonds. Air contains oxygen molecules.

A diatomic molecule is a molecule consisting of two atoms. An oxygen molecule is a diatomic molecule.

What would a triatomic molecule be?
What about monatomic?

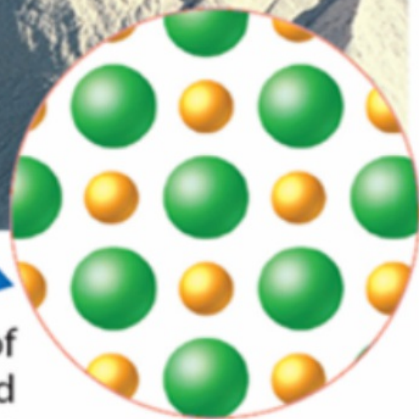
Key Fact:



Molecular compounds tend to have relatively lower melting and boiling points than ionic compounds.

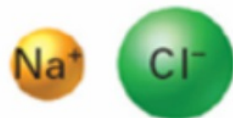
Comparison of ionic and molecular compounds

Ionic compound – Table Salt



Array of sodium ions and chloride ions

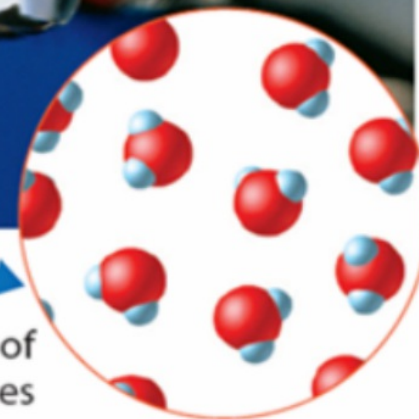
Formula unit of sodium chloride:



Chemical formula:

NaCl

Molecular compound – Water



Collection of water molecules

Molecule of water:



Chemical formula:

H₂O

A molecular formula is the chemical formula of a molecular compound.

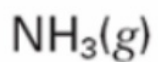


A molecular formula shows how many atoms of each element a molecule contains

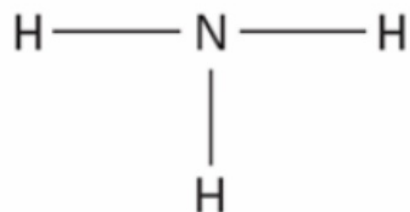
e.g. Water, H_2O , contains 2 hydrogen atoms and 1 oxygen atom.

Examples of how we portray bonding:

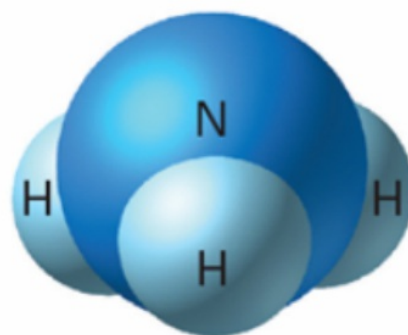
Ammonia



Molecular formula



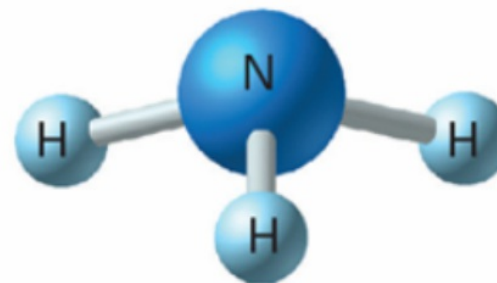
Structural formula



Space-filling
molecular model



Perspective
drawing



Ball-and-stick
molecular model

Warm Up

Metals

Non metals

For the above two categories of elements which combine to form:

1. Ionic compounds
2. Covalent (or molecular) compounds?

Warm Up

Classify the following as ionic or covalent compounds:

NaCl

SO₂

SeBr₂

MgCl₂

Examples of molecular compound formulas



Hydrogen atom (H)



Carbon atom (C)



Oxygen atom (O)



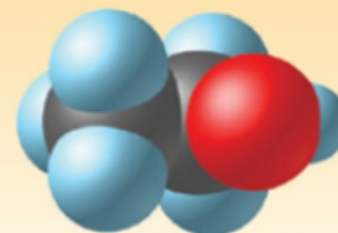
Water (H₂O)

1 molecule of H₂O
contains
2 hydrogen atoms
1 oxygen atom



Carbon dioxide (CO₂)

1 molecule of CO₂
contains
2 oxygen atoms
1 carbon atom



Ethanol (C₂H₆O)

1 molecule of C₂H₆O
contains
6 hydrogen atoms
2 carbon atoms
1 oxygen atom

Learning Check:

1. Compared to ionic compounds, molecular compounds tend to have relatively
 - a. low melting points and high boiling points.
 - b. low melting points and low boiling points.
 - c. high melting points and high boiling points.
 - d. high melting points and low boiling points.

Learning Check:

2. A molecular compound usually consists of

- a. two metal atoms and a nonmetal atom.
- b. two nonmetal atoms and a metal atom.
- c. two or more metal atoms.
- d. two or more nonmetal atoms.

Learning Check:

3. A molecular formula shows

a. how many atoms of each element a molecule contains.

b. a molecule's structure.

c. which atoms are bonded together.

d. how atoms are arranged in space.

Warm Up

Classify the following compounds as either ionically bonded or covalently bonded:

LiCl

CaO

PCl₃

N₂O₃

HF

Types of covalent bonds:

Single Covalent Bond: two atoms held together by sharing a pair (2) of electrons.

Example: hydrogen molecule



Electron Dot
Depiction

or



Structural
Formula

Examples of single bonds: Methane CH_4

Note! The molecular formula for a hydrogen molecule is H_2 . While this does tell you about the number and type of elements present in this molecule it says NOTHING about how the H atoms are bonded together.

Another example of a single covalent bond:

Fluorine. Fluorine is one of 7 elements that is always diatomic.



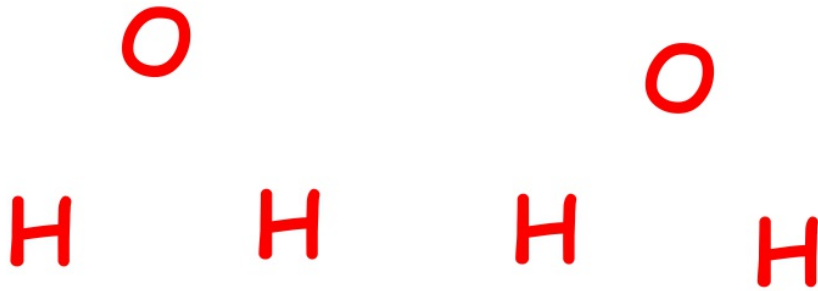
Each fluorine atom shares one pair of electrons but also 3 unshared pairs of electrons.

You are responsible for memorizing the 7 elements that occur in nature as diatomic molecules. They are:

(note: not all of these have a single bond:)



More examples of covalent bonding: Water



Def: Lone Pairs: pairs of valence electrons not involved in bonding with another atom. Also called "unshared pairs."

Practice (10 minutes)

p. 220

#7 and #8

#7a

Cl-Cl

F-F

#7b

Br-Br

These 4
diatomic
molecules are
held
together with
a single bond.

#7c

I-I

#8a

#8b

Warm Up

Draw the Lewis Dot structure showing the bonding of:



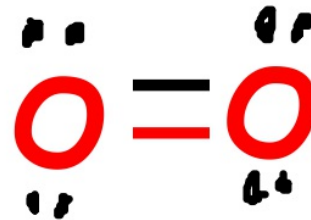
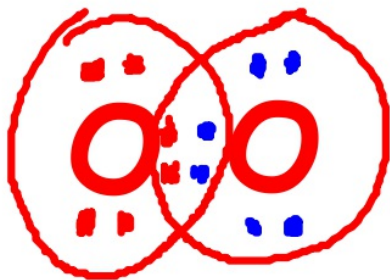
Objectives:

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Double Bond: a covalent bond in which
two pairs of electrons are shared
between 2 atoms

Example: Diatomic oxygen



Triple Bond: a covalent bond in which three pairs of electrons are shared between 2 atoms

Examples: Diatomic Nitrogen



Def: Coordinate Covalent Bond

A covalent bond in which BOTH electrons are donated by one atom.

Once a coordinate covalent bond forms it is no different than any other covalent bond. We often depict these bonds with an arrow coming from the donating atom. See side board.

Examples of coordinate covalent bonds:

(We will use p. 224 to help us)

Carbon monoxide: CO

Ammonium ion: NH_4^+

Sulfur Dioxide: SO_2

Sulfur Trioxide: SO_3

Dinitrogen oxide: N_2O