ChemQuest 27

Covalent Bonding

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hour: \_\_\_\_\_

# **Information**: Terminology

Recall that an ionic bond results from the combination of a metal and a nonmetal. (Note: hydrogen is a nonmetal even though it is on the left side of the periodic table.)

A covalent bond is the type of bond between two nonmetals. Covalent bonds are formed by neutral atoms that share electrons rather than by charged ions. When a compound is formed by sharing electrons, the compound is called a molecule or molecular compound. It is important to note that ionic compounds are not called molecules. The largest class of molecules is called organic molecules. Carbon is the distinguishing mark of organic compounds.

# **Critical Thinking Questions**

1. Use your knowledge of metals and nonmetals to identify each of the following as having ionic (I) or covalent (C) bonds.

a) CaCl2  b) MgO c) CH4 d) N2O5 e) Al(NO3)3 f) SO2

1. The compound NH4NO3 is an ionic compound even though there isn’t a metal in the compound. Explain why? (Hint: Think about what NH4NO3 is made of.)
2. Circle any of the following compounds that would properly be called a “molecule”.

a) H2O b) CCl4 c) NaCl d) Mg3P2 e) N2O5

1. Which compound from question 3 would be classified as “organic”? Why?

# **Information**: Naming Covalent Compounds

There are several prefixes used to name molecules. The name “carbon oxide” is not sufficient because carbon and oxygen sometimes form CO2 and sometimes CO. Prefixes are necessary to distinguish between them.

|  |  |
| --- | --- |
| Formula | **Name** |
| N2O4 | dinitrogen tetraoxide |
| SF6 | sulfur hexafluoride |
| XeCl5 | xenon pentachloride |
| SO3 | sulfur trioxide |
| CO | carbon monoxide |

# **Critical Thinking Questions**

1. Fill in the table to indicate which prefix is used to represent the numbers. The first one is done for you.

|  |  |
| --- | --- |
| Number | **Prefix** |
| 1 | mono |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |

1. Name each of the following molecules using the appropriate prefixes, similar to the table in the information section.

a) N2O5 b) CF4

c) SCl3 d) SO

# **Information**: Empirical Formulas

Molecules can be represented by using either a molecular formula or an empirical formula. The molecular formula tells you exactly how many atoms of each element are in the compound. For example, in the table below, compound #2 has exactly 4 carbons and 8 hydrogrens in each molecule. Observe the table below that shows five organic molecules along with a molecular and empirical formula for each one:

|  |  |  |
| --- | --- | --- |
| Molecule | Molecular Formula | Empirical Formula |
| #1 | C2H4 | CH2 |
| #2 | C4H8 | CH2 |
| #3 | C3H8 | C3H8 |
| #4 | C8H18 | C4H9 |

# **Critical Thinking Questions**

1. Here’s a math question. ☺ Reduce, or simplify, the following fractions.
2.  b) 
3. Look at Molecule #2 and Molecule #4 in the table in the above information section. How is Molecule #2 similar to question 7a above? How is Molecule #4 similar to question 7b?
4. What is an empirical formula?
5. How can molecules #1 and #2 have the same empirical formula even though they are different molecules?
6. Given the empirical formula for a compound is it possible to determine the molecular formula? If so, explain how.
7. Given the molecular formula for a compound is it possible to determine its empirical formula? If so, explain how.
8. Give the empirical formula for each of the molecules below:

a) N2O6 b) C2H4O2 c) C4H14 d) C3H5