5.4: Classification of Compounds

Learning Objectives

- Classify compounds based on their composition.

Nomenclature is the process of naming chemical compounds so they may be easily identified as separate chemicals. The primary function of **chemical nomenclature** is to ensure that a spoken or written chemical name leaves no ambiguity as to which chemical compound the name refers – each chemical name should refer to a single substance. A less important aim is to ensure that each substance has a single name, although a limited number of alternative names is acceptable in many cases. Preferably, the name also conveys some information about the structure or chemistry of a compound. A common name will often suffice to identify a chemical compound in a particular set of circumstances. To be more generally applicable, the name should indicate the chemical formula at a very minimum. To be more specific still, the three-dimensional arrangement of the atoms may need to be specified.

Ionic Compounds vs. Molecular Compounds

The distinction between ionic compounds and molecular compounds was discussed in Section 5.3 and is summarized in Table 5.4.1 below.

Table 5.4.1: Distiguishing Between Ionic Compounds and Molecular Compounds

Ionic Compounds	Molecular Compounds
Consist of metals bonded to nonmetals with one class of exceptions – ammonium compounds	Consist of nonmetals and/or metalloids bonded to other nonmetals and/or metalloids
Atoms joined by ionic bonds	Atoms joined by covalent bonds

Further Classification of Compounds

Students typically become more successful at writing chemical formulas and chemical names when they are able to properly classify compounds. Many compounds are said to be **binary**, which means they consist of two different elements. Other compounds contain **polyatomic ions**, previously identified as groups of covalently bonded atoms that often act as single units in chemical reactions. **Acids** are compounds that contain the element hydrogen, H, typically written at the front of a chemical formula. **Oxyacids** are acids that also contain the element oxygen.

With this in mind, many compounds may be classified into five different categories, each of which uses a slightly different, but related, set of rules. These five common classes of compounds are:

1. Binary ionic compounds
2. Ionic compounds containing polyatomic ions
3. Binary molecular compounds
4. Binary acids
5. Oxyacids

Exercise 5.4.1

Classify each compound into one of the five categories listed above. Provide a short explanation for your choice.

A. H_3PO_4
B. Ag_2S
C. HI
D. SF_6
E. Na_2SO_4

F. $Ti(C_2H_3O_2)_4$

Answer A

H_3PO_4 is an **oxyacid**. H is written at the front of the formula, making it an acid. Since it also contains O, it is an oxyacid.

Answer B

Ag_2S is a **binary ionic compound**. Ag_2S has two elements, which makes it binary. Ag is a metal and S is a nonmetal, making the compound ionic.

Answer C

HI is a **binary acid**. HI has two elements, which makes it binary. H is written at the front of the formula, making it an acid.

Answer D

SF_6 is a **binary molecular compound**. SF_6 has two elements, which makes it binary. S and F are both nonmetals, making the compound molecular.

Answer E

Na_2SO_4 is an **ionic compound containing a polyatomic ion**. Na_2SO_4 has three elements, so it cannot be binary. Na is a metal and both S and O are nonmetals, making the compound ionic.

Answer F

$Ti(C_2H_3O_2)_4$ is an **ionic compound containing a polyatomic ion**. $Ti(C_2H_3O_2)_4$ has four elements, so it cannot be binary. Ti is a metal, while C, H, and O are all nonmetals, making the compound ionic.