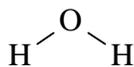


CHEQ 1094 MOLECULAR AND IONIC COMPOUNDS

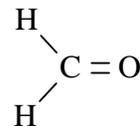
All compounds are either **molecular** or **ionic**. A molecular compound consists of **molecules** whose formula represents the actual number of atoms **bonded** together in the molecule. The atoms are joined to give a definite **shape** which is defined by the angles between the bonds and by the bond lengths. Some examples are shown below.



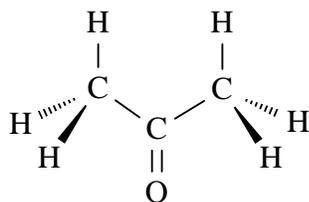
water (H₂O)



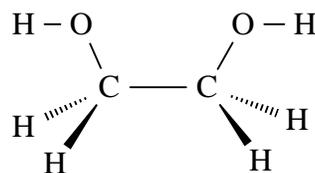
carbon dioxide (CO₂)



formaldehyde (CH₂O)



acetone (C₃H₆O)



ethylene glycol (C₂H₆O₂)

Ionic compounds exist as aggregations of **ions** such that the total charge on the positive ions (**cations**) is equal to the total charge on the negative ions (**anions**). The formula of an ionic compound is the simplest whole number ratio of the cations and anions. For example, a sodium chloride (NaCl) crystal contains billions of Na⁺ ions and Cl⁻ ions in a 1:1 ratio. Each Na⁺ ion is surrounded by *six* Cl⁻ ions and each Cl⁻ ion is surrounded by *six* Na⁺ ions. Hence, no Cl⁻ ion *belongs* to any Na⁺ ion and *vice versa*. In calcium chloride (CaCl₂), there are *two* Cl⁻ ions for each Ca²⁺ ion. **Notice that for ethylene glycol (above) the formula is C₂H₆O₂ and not CH₃O (the simplest ratio of C, H and O atoms).**

NaCl and CaCl₂ contain only **monatomic** ions (ions derived from single atoms) but many ionic compounds contain **polyatomic** ions (ions containing two or more atoms bonded together). Examples are CaCO₃ (Ca²⁺ and CO₃²⁻ ions) and NaOH (Na⁺ and OH⁻ ions).

Because of the strong attraction between cations and anions, a lot of energy is needed to separate anions from cations and hence ionic compounds are all *solids with high melting points*. However, the forces of attraction *between* molecules are much smaller and molecular compounds are *gases, liquids or solids with low melting points*.

Metals tend to form cations and hence most ionic compounds contain a metal. Exceptions are compounds of Sn and Pb with *four* halogen atoms. Thus, SnCl₄ and PbCl₄ (both liquids) are molecular compounds. Most compounds *without* a metal are molecular. Exceptions are compounds containing the ammonium ion (NH₄⁺). Thus, NH₄Cl and (NH₄)₂SO₄ (both solids) are ionic compounds.