## –OH in a Molecule

Molecular compounds containing —OH groups can be acidic or amphoteric. The covalently bonded —OH group in an acid is referred to as a *hydroxyl group*. For the compound to be acidic, a water molecule must be able to attract a hydrogen atom from a hydroxyl group. This occurs more easily when the O—H bond is very polar. Any feature of a molecule that increases the polarity of the O—H bond increases the acidity of a molecular compound. The small, more-electronegative atoms of nonmetals at the upper right in the periodic table form compounds with acidic hydroxyl groups. All oxyacids are molecular electrolytes that contain one or more of these O—H bonds. Such compounds include chloric and perchloric acids.

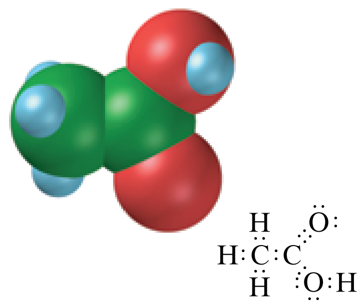
**Figure 12** shows the electron-dot formulas of the four oxyacids of chlorine. Notice that all of the oxygen atoms are bonded to the chlorine atom. Each hydrogen atom is bonded to an oxygen atom. Aqueous solutions of these molecules are acids because the O—H bonds are broken as the hydrogen is pulled away by water molecules.

The behavior of a compound is affected by the number of oxygen atoms bonded to the atom connected to the —OH group. The larger the number of such oxygen atoms is, the more acidic the compound is. The electronegative oxygen atoms draw electron density away from the O—H bond and make it more polar. For example, chromium forms three different compounds containing —OH groups, as shown below.

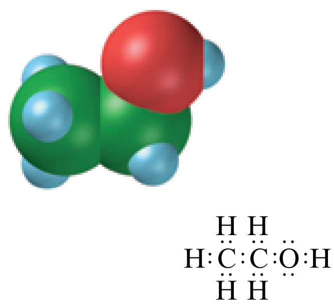
| *basic* | *amphoteric* | *acidic* |
|---|---|---|
| $Cr(OH)_2$ | $Cr(OH)_3$ | $H_2CrO_4$ |
| chromium(II) hydroxide | chromium(III) hydroxide | chromic acid |

Notice that as the number of oxygen atoms increases, so does the acidity of the compound.

Consider also the compounds shown in **Figure 13.** In acetic acid, but not in ethanol, a second oxygen atom is bonded to the carbon atom connected to the —OH group. That explains why acetic acid is acidic but ethanol is not, even though the same elements form each compound.



**(a)** $CH_3COOH$
Acetic acid



**(b)** $C_2H_5OH$
Ethanol

**FIGURE 13** (a) Acetic acid is acidic. The second oxygen atom on the carbon draws electron density away from the —OH group, making the O—H bond more polar. (b) Ethanol is essentially neutral. It has no second oxygen atom, so ethanol is less polar than acetic acid, and is a much weaker acid.

## Neutralization Reactions

There are many common examples of acidic compounds reacting with basic compounds, each neutralizing the other. Sodium bicarbonate, $NaHCO_3$, and tartaric acid, $H_2C_4H_4O_6$, are two components in baking powder. When allowed to react in solution, the two compounds produce carbon dioxide. The escaping carbon dioxide causes foods, such as biscuits, to rise. Another example is an antacid soothing an overly acidic stomach by neutralizing the stomach acid.