Solubility and Functional Group Tests

Each functional group has a particular set of chemical properties that allow it to be identified. Some of these properties can be demonstrated by observing solubility behavior, while others can be seen in chemical reactions that are accompanied by color changes, precipitate formation, or other visible effects.

1. Solubility Tests

The solubility of an organic compound in water, dilute acid, or dilute base can provide useful information about the presence or absence of certain functional groups. A flowchart showing the sequence of solubility tests along with the appropriate conclusions is shown in Figure 1.

Solubility in water: Most organic compounds are not soluble in water, except for low molecular-weight amines and oxygen-containing compounds. Low molecular-weight compounds are generally limited to those with fewer than five carbon atoms.

• Carboxylic acids with fewer that five carbon atoms are soluble in water and form solutions that give an acidic response (pH < 7) when tested with litmus paper.

• Amines with fewer than five carbons are also soluble in water, and their solutions give a basic response (pH > 7) when tested with litmus paper.

• Ketones, aldehydes, and alcohols with fewer that five carbon atoms are soluble in water and form neutral solutions (pH = 7).

Solubility in NaOH: Solubility in 6M NaOH is a positive identification test for acids. A carboxylic acid that is insoluble in pure water will be soluble in base due to the formation of the sodium salt of the acid as the acid is neutralized by the base.

Solubility in HCl: Solubility in 6M HCl is a positive identification test for bases. Amines that are insoluble in pure water will be soluble in acid due to the formation of an ammonium chloride salt.