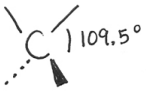
Bonding Patterns

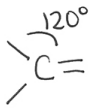
Carbon, nitrogen, oxygen and hydrogen are the most common atoms in organic molecules. Carbon, nitrogen and oxygen also are able to form multiple bonds such as double and triple bonds. These multiple bonds occur in many common chemical compounds. It is important to be able to recognize the bonding patterns of carbon, nitrogen and oxygen. The bonding pattern of hydrogen is very simple - it always forms one single bond.

Bonding Patterns of Carbon



4 single bonds
tetrahedral

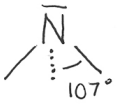
2 double bonds
linear



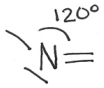
2 single bonds
1 double bond
trigonal planar

1 single bond
1 triple bond
linear

Bonding Patterns of Nitrogen



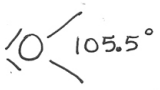
3 single bonds
1 lone pair
trigonal pyramidal



1 single bond
1 double bond
1 lone pair
bent (angular)

IN≡
1 triple bond
1 lone pair

Bonding Patterns of Oxygen



2 single bonds
2 lone pairs
bent (angular)

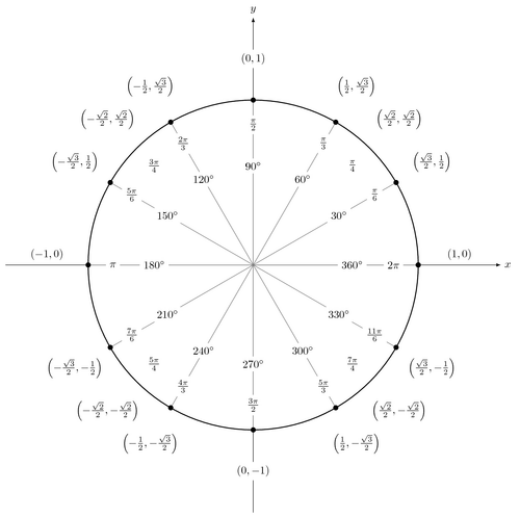
1 double bond
2 lone pairs

Determine the bonding pattern for carbon, nitrogen and oxygen in the following chemical compounds:

methane, formaldehyde, acetylene, carbon dioxide
water, ammonia, hydrazine, diazene

Draw these molecules and label all bond angles.

There are some molecules where an atom takes on the bonding pattern of a different atom. This occurs when the best Lewis Dot structure predicts that one atom will provides both electrons in a covalent bond. This also occurs when chemical compounds utilize electrons that are normally unshared to form covalent bonds.

Consider the bonding of carbon monoxide and ozone and the ammonium ion. Draw these compounds and label all bond angles. Explain the geometries of these molecules and explain how they are different from the typical patterns.

Some Typical Angles as Illustrated on the Unit Circle