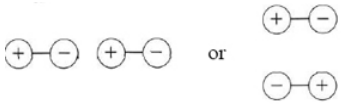
8.3: Dipole Forces

You may be wondering, why should neutral molecules attract each other at all? If the molecules are polar, the explanation is fairly obvious. When two polar molecules approach each other, they can arrange themselves in such a way that the negative side of one molecule is close to the positive end of the other:



Two arrangements of polar molecules are shown. One involves the head on attraction between opposite charges. The other arrangement shows one polar molecule on top of another molecule. The positive side of one molecule attracts the negative side of the other molecule and vice versa.

The molecules will then attract each other because the charges which are closest together are opposite in sign. (This behavior is very similar to the attraction between two bar magnets placed end to end or side by side with the north poles opposite the south poles.) Forces between polar molecules which arise in this way are called **dipole forces**. The existence of dipole forces explains why polar molecules have higher boiling points and melting points than do nonpolar molecules. In the following table, we compare the boiling points of several pairs of molecules. In each pair, one molecule is polar and the other is nonpolar, but otherwise they are as similar as possible. The polar substance always has the higher boiling point, indicating greater attractive forces between separate molecules, that is, larger intermolecular forces.

Table 8.3.1 Boiling Points of Otherwise Similar Polar and Nonpolar Substances.

Nonpolar Molecules				**Polar Molecules**			
Molecule	Molar Mass / g mol^{-1}	Total Number of Electrons	Boiling Point (in degrees C)	Molecule	Molar Mass / g mol^{-1}	Total Number of Electrons	Boiling Point (in degrees C)
N_2	28	14	-196	CO	28	14	-192
SiH_4	32	18	-112	PH_3	34	18	-85
GeH_4	77	36	-90	AsH_3	78	36	-55
Br_2	160	70	59	ICl	162	70	97