

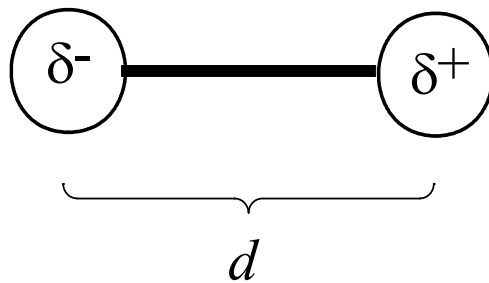
Heteronuclear Bond Polarity

- L All heteronuclear bonds have some polarity.
- L When two different atoms have the same value of electronegativity the bond is very nearly pure covalent and the polarity is very small, *but there is still some polarity*.

Comparison of N and Cl Electronegativity on Different Electronegativity Scales

Scale	Basis	χ_{N}	χ_{Cl}	$\Delta\chi_{\text{N-Cl}}$
Original Pauling	<i>D</i>	3.0	3.0	0
Recalculated Pauling	<i>D</i>	3.04	3.16	-0.12
Allred-Rochow	<i>Z*</i>	3.07	2.83	+0.24

Dipole Moment of a Diatomic Molecule



$$\text{dipole moment} = \mu = \delta d$$

Units: debye (D) = 3.34×10^{-30} C·m

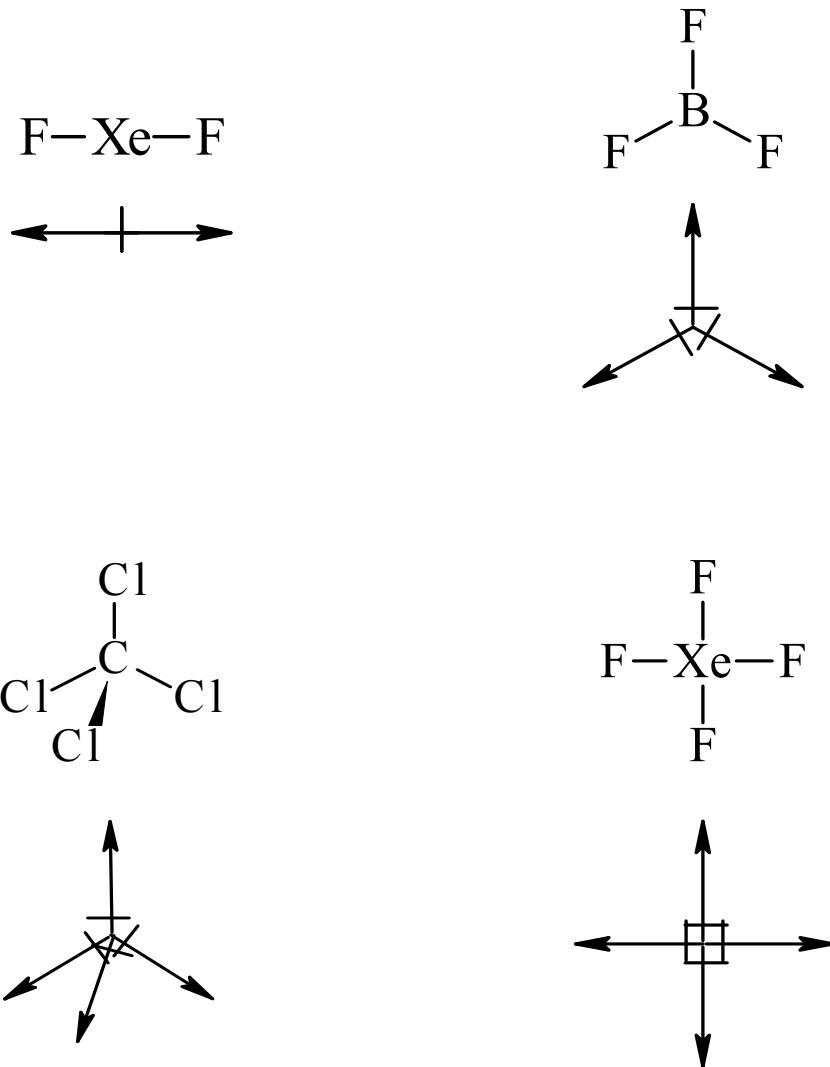
Molecule	μ	Molecule	μ
H-H	0 D	H-F	1.82 D
F-F	0 D	H-Cl	1.08 D
Cl-Cl	0 D	H-I	0.44 D

Dipole Moments of Polyatomic Molecules

- L For polyatomic molecules, molecular polarity depends on both *shape* and *composition*.
- U A molecule is nonpolar when all individual bond polarities are counterbalanced by other *identical* bond polarities.
- U A molecule is polar when any one of its individual bond polarities is not counterbalanced by identical bond polarities.
 - T Lack of counter balancing polarities may result from a less symmetrical shape. (*Shape*)
 - T Lack of counterbalancing polarities may result from a unique bond in the molecule with different bond strength or to a different element. (*Composition*)

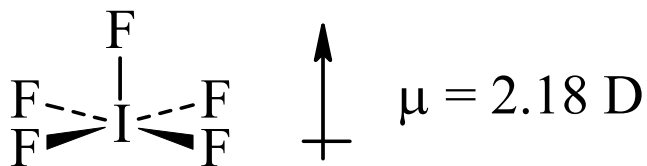
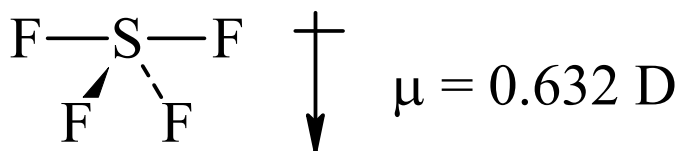
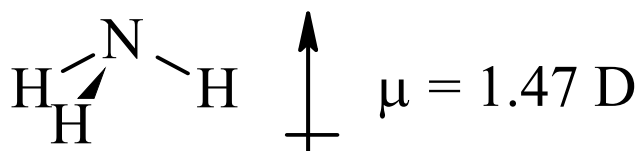
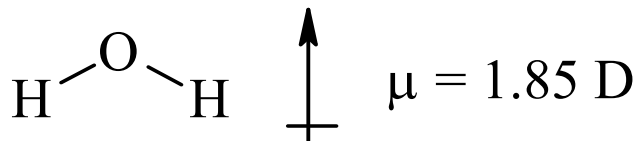
Nonpolar Polyatomic Molecules

- In highly symmetric binary molecules, individual bond polarities may cancel, leaving the molecule with no net dipole moment.



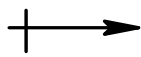
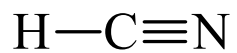
Polar Polyatomic Molecules

- If a binary molecule has a geometry that gives it a sense of up and down or right and left it is polar.

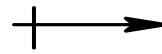
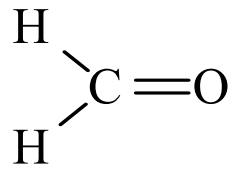


More Complex Molecules

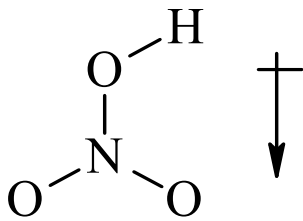
- If a ternary molecule has its bonds asymmetrically arranged, it may be polar even though its shape would be nonpolar for a binary molecule.



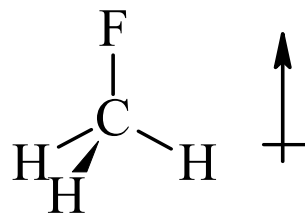
$$\mu = 2.98 \text{ D}$$



$$\mu = 2.33 \text{ D}$$



$$\mu = 2.17 \text{ D}$$



$$\mu = 1.85 \text{ D}$$