

## 4.4 Polar Molecules

### Rules for Polar and Non-polar Molecules

- The following rules can be used to predict, from the molecular formula, whether a molecule is polar or non-polar.

#### Polar Molecules

Type	Examples	
AB	HCl <sub>(g)</sub> , CO <sub>(g)</sub>	diatomic with different molecules
N <sub>x</sub> A <sub>y</sub>	NH <sub>3(g)</sub> , NF <sub>3(g)</sub>	containing N and other atoms
O <sub>x</sub> A <sub>y</sub>	H <sub>2</sub> O <sub>(l)</sub> , OCl <sub>2(g)</sub>	containing O and other atoms
C <sub>x</sub> A <sub>y</sub> B <sub>z</sub>	CHCl <sub>3(l)</sub> , C <sub>2</sub> H <sub>5</sub> OH <sub>(l)</sub>	containing C and 2 other kinds of atoms

#### Non-polar Molecules

Type	Examples	
A <sub>x</sub>	Cl <sub>2(g)</sub> , N <sub>2(g)</sub>	elements
C <sub>x</sub> A <sub>y</sub>	CO <sub>2(g)</sub> , CH <sub>4(g)</sub>	containing C and only 1 other kind of atom

#### Electronegativity

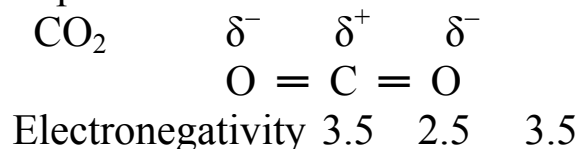
- Pauling invented electronegativity to explain polarity in molecules.
- He arbitrarily assigned values. F the most electronegative element was given a value of 4.
- Electronegativity increases as you move up and to the right on the periodic table.
- Based on the difference of electronegativities between the bonding pair, 3 bond types could form.
  - Covalent bond: a non-polar bond with equal sharing of bonding electrons.
  - Ionic bond: a bond in which the bonding pair of electrons are mostly with one atom/ion
  - Polar Covalent bond: a bond in which electrons are shared somewhat unequally.
- See figure 4 on page 252

#### Polar Molecules

- Just because the bond is polar it does not mean the molecule is polar.

- Arrows are used to show the bond dipole. These arrows are vectors and can be added.
- Bond Dipole: the electronegativity difference of 2 bonded atoms represented by an arrow pointing from the lower ( $\delta^+$ ) to the higher ( $\delta^-$ ) electronegativity.

- E.g. Non-polar



- E.g. Polar: H<sub>2</sub>O

- Both the shape of the molecule and the polarity of the bonds are necessary to determine if a molecule is polar or non-polar.
- All symmetrical molecules, the sum of the bond dipoles are zero and the molecule is non-polar.
- **Tip:** Use vector analysis to determine if it is polar or non-polar. If there is a resultant you will know the direction of the dipole (polar). If you get a null resultant then it is non-polar.

## Homework

- Practice 1,2,3,6,7,8,9,10
- Questions 1,2,4