

Chapter 2. Polar Covalent Bonds; Acids and Bases

ionic bonds

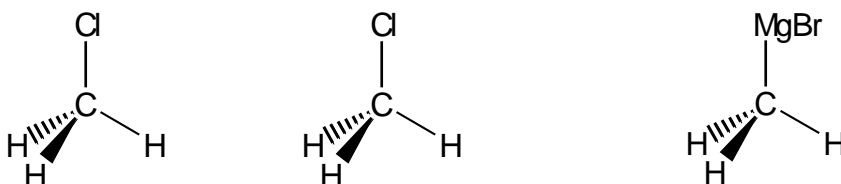
polar covalent bonds

nonpolar covalent bonds

Electronegativity

Memorize this trend in electronegativity:

Important: One of the first things we will consider when we examine an organic compound is the polarity of the carbon bonds.



This illustrates the _____.

The Inductive Effect:

Key point: The **Inductive Effect** occurs through _____ bonds and is due to a difference in _____.

The **Resonance Effect** occurs through _____ bonds and _____ electrons.

Review of Dipole Moment

1. A polar molecule is one with an unequal distribution of _____ as a result of its _____ and _____.
2. A polar molecule has _____.
3. In order to determine if a molecule is polar, you must know its _____.
4. Two ways to determine if a molecule is polar:

5. Examples:



6. One useful generalization: hydrocarbons are _____.

7. Definition of dipole moment:

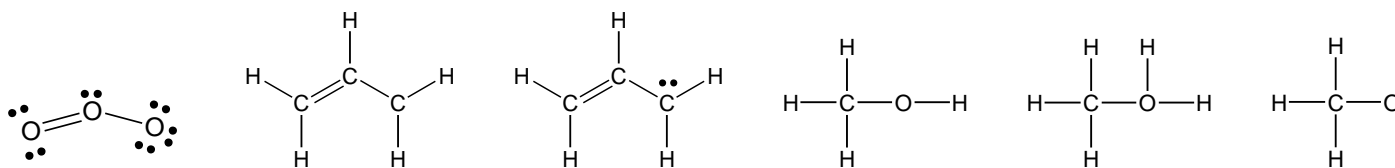
$$\mu =$$

Problem #2.30, page 68: Fluoromethane, (CH_3F , $\mu=1.81$ D) has a smaller dipole moment than chloromethane (CH_3Cl , $\mu = 1.87$ D) even though fluorine is more electronegative than chlorine. Explain.

Formal Charge

1. Formal charge on an atom is defined as the number of valence electrons on the atom minus the number of electrons assigned to the atom. The number assigned corresponds to all the unshared electrons plus one-half of the shared electrons.
2. Shortcut: Formal Charge =
3. If an atom has its "normal" number of bonds, there will not be a FC. Look for a FC for atoms with an "abnormal" number of bonds.

Example: Determine the formal charges of atoms in the molecules below,



Resonance

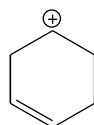
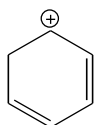
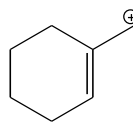
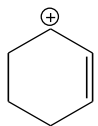
Resonance Structures of the allylic carbocation, $\text{CH}_2=\text{CHCH}_2^+$

1. Resonance is used when _____.
2. To indicate resonance, you must use _____.
3. "Resonance" is not referring to _____ or _____.
4. Resonance means that the true molecule is a _____ of the resonance structures.
5. Be sure to distinguish between these terms: _____ vs _____.
6. Resonance structures are said to _____.
7. Resonance structures are not necessarily _____. Some resonance structures _____.
8. To evaluate resonance structures, consider _____.

Example:

9. In general, the more resonance structures that can be formed, the more _____.
This is due to _____.
10. When drawing resonance structures, move only _____. Never move _____.
11. Resonance only goes through _____.
12. To draw resonance structures, "push" the electrons _____ the negative, or _____ the positive.

Draw all resonance structures for the carbocations below:



Lewis acids and bases

Lewis acid –

Therefore a Lewis acid must be _____
either through _____
or through _____.

Lewis base –

Therefore a Lewis base must have _____

Examples:

Intermolecular Attractive Forces

- Intermolecular forces are often referred to as _____.
- All intermolecular forces are _____ in nature. That is, they involve the attraction of a _____ charge for a _____ charge

Three types of intermolecular attractive forces:

- 1.
- 2.
- 3.

Dipole-Dipole Attractions

- exist between _____ molecules
- For molecules of approximately equal molecular mass and size, dipole-dipole attractions increase with increasing _____:

compound	molar mass	dipole moment (μ)	boiling point ($^{\circ}\text{C}$)
CH ₃ CH ₂ CH ₃			
CH ₃ OCH ₃			
CH ₃ CHO			
CH ₃ CN			

- Example: Which substance is expected to have the higher boiling point, CO₂ or HCl?

Hydrogen Bonds

- A hydrogen bond is an _____ between a _____
_____ on one molecule and a _____
_____ on an adjacent molecule.

polarized hydrogen:

a very electronegative atom:

example:

- A special case of _____.
- Hydrogen bonding is an important source of intermolecular attractions in compounds containing _____, _____, and _____ bonds.
- Example:

London Dispersion Forces

- Attractive forces due to _____
- Large atoms and molecules are more easily polarized than small atoms and molecules; thus, dispersion forces _____ with molecular size.
- Generally, in the absence of other effects, substances consisting of large atoms and molecules will have _____ melting points and boiling points than comparable substances which are smaller.
- Dispersion forces are present in _____ and _____ molecules.

Example: Place the diatomic halogens in order of increasing boiling point.

Summary of intermolecular attractive forces:

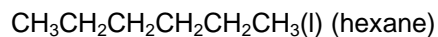
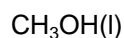
- Everything else being equal, which intermolecular attractive force is the strongest?

“everything else being equal” means

- Everything else being equal, which intermolecular attractive force is the weakest?

“everything else being equal” means

- What types of intermolecular forces are present in



- Be able to identify “**hydrophilic**” and “**hydrophobic**” substances.

hydrophilic:

hydrophobic: