

Reactions of Amines and Epoxides

Preparation of Amines

Amines are colorless, basic, and have a strong, fishy odor. They are prepared by the reduction of nitriles.



A summary of Ring-Opening Reactions of Epoxides with Strong and Weak Nucleophiles



Epoxide Reactions and Mechanisms

Bond Types, Strength, Length, Polarity and Dipole Moment

Free-radical halogenation



There are two types of bonding: ionic bonding and covalent bonding.

• **Ionic bonds** are formed by the transfer of electrons from one element to another (ionization potential) and electron affinity (electron). Examples:



• **Covalent bonds** are formed by sharing of electrons between two atoms.



The Relative Electronegativity of Atoms



Bond and Bonding



Bonding



There are two types of bonding

Definition of Polarity



Sigma and pi bonds

Covalent bonds are classified as sigma and pi bonds.

• **Sigma bonds** are formed by head-on overlap of orbitals.

• **pi bonds** are formed by side-on overlap of orbitals.

• **One single bond is a sigma bond.**

• **Two multiple bonds consist of one sigma and two pi bonds.**



pi bonds are stronger than sigma bonds.

Polar and Nonpolar Covalent Bonds

Depending on the difference in the electronegativity values, covalent bonds can be polar and nonpolar.

• **Polar bonds** are formed by the difference in electronegativity values of the two atoms, forming a dipole moment.

• **Nonpolar bonds** are formed by the same electronegativity values of the two atoms, forming a nonpolar bond.

• **If the difference in electronegativity is between 0.5 and 1.7, the bond is polar.**

• **If the difference in electronegativity is between 1.7 and 2.0, the bond is ionic.**

• **A difference of 2.0 or higher indicates that the electrons are not shared, but are lost to the more electronegative atom.**

Dipole Moment

The polarity of a bond is described by the dipole moment (μ).

It is a vector quantity.



It is a vector quantity.

• The dipole moment is a vector pointing from the less electronegative to the more electronegative atom.

• The more electronegative atom has a partial negative charge (δ⁻) and the less electronegative atom has a partial positive charge (δ⁺).

• **δ⁻ (delta minus)** indicates an electron deficient atom.

• **δ⁺ (delta plus)** indicates an electron rich atom.

Molecular Dipole

To determine the molecular polarity, the vector sum of the dipoles is used.

The geometry of the molecule is important. Symmetrical molecules are nonpolar, even if the bonds are polar. Asymmetrical molecules are polar.



Consider the vector sum of the dipoles to determine the molecular polarity.

Bond Length and Bond Strength

The length of a bond is the distance between the nuclei of the two atoms.

Bond	H-H	H-Cl	H-Br	H-I
Length	109 pm	127 pm	141 pm	154 pm
Strength	436 kJ/mol	431 kJ/mol	366 kJ/mol	298 kJ/mol

Double bonds are stronger than single bonds, and triple bonds are stronger than double bonds.

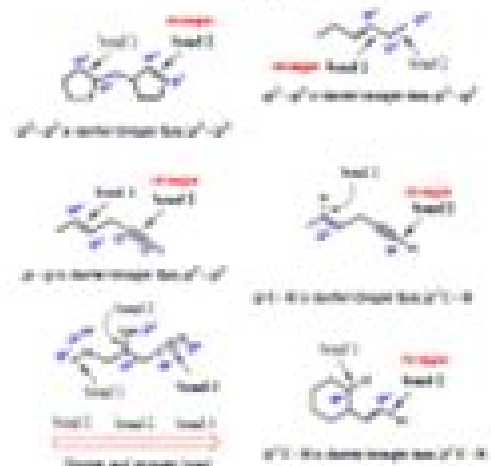


The length of a bond is the distance between the nuclei of the two atoms.

	sp ³ -sp ³	sp ² -sp ²	sp-sp
Length	154 pm	134 pm	121 pm
Strength	376 kJ/mol	612 kJ/mol	837 kJ/mol
Hybridization	sp ³ -sp ³	sp ² -sp ²	sp-sp
Electronegativity	2.1	2.5	3.0
Length	154 pm	134 pm	121 pm
Strength	376 kJ/mol	612 kJ/mol	837 kJ/mol

Higher electronegativity values indicate stronger bonds.

Examples



CH₃Cl is a polar molecule because of the difference in electronegativity between C and Cl.

CH₄ is a nonpolar molecule because of the same electronegativity between C and H.

CH₃OH is a polar molecule because of the difference in electronegativity between O and H.

CH₃SH is a nonpolar molecule because of the same electronegativity between S and H.

CH₃Cl is a polar molecule because of the difference in electronegativity between C and Cl.

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CH₃Cl is a polar molecule because of the difference in electronegativity between C and Cl.

Organic Chemistry I Study Guide

**Robert Thornton Morrison, Robert
Neilson Boyd**



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