

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

Types of Bonding Interactions

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).



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



The Relative Strength of Ions



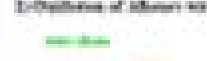
Bond and Bonding Interactions



Bonding Interactions



There are two types of bonding interactions



Sigma and pi bonds

Covalent bonds are classified into sigma and pi bonds.

- **Sigma bonds** are formed by head-on overlap of orbitals.
- **pi bonds** are formed by side-on overlap of orbitals.
- **Single bonds** are sigma bonds.
- **Double bonds** are sigma and 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.



- If the difference in electronegativity is less than 0.5, the electrons are shared equally (nonpolar bond).
- If the difference in electronegativity is between 0.5 and 1.7, the electrons are shared unequally (polar bond).
- If the difference in electronegativity is greater than 1.7, the electrons are not shared (ionic bond).

- A difference of 1.7 or higher can be high for the electrons are not shared (ionic bond).

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Dipole Moment

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



- 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 dipole moments.

The polarity of the molecule is determined by the vector sum of the dipole moments. A good example is carbon dioxide.



Carbon dioxide is a linear molecule and the dipole moment is zero.

Bond Length and Bond Strength

The length of the bond is determined by the overlap of the orbitals.



Double bonds are stronger than single bonds and are shorter.

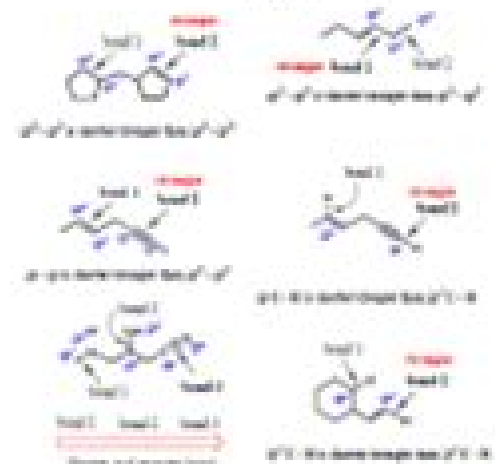


The length of the bond is determined by the overlap of the orbitals.

Average values of C-C and C-H bonds depending on hybridization			
C-C Bond	sp ³ -sp ³	sp ² -sp ²	sp ³ -sp ³
Hybridization	sp ³ -sp ³	sp ² -sp ²	sp ³ -sp ³
Length	1.54 Å	1.34 Å	1.54 Å
Strength	33 kcal/mol	112 kcal/mol	33 kcal/mol
Hybridization	sp ³ -sp ³	sp ² -sp ²	sp ³ -sp ³
Length	1.54 Å	1.34 Å	1.54 Å
Strength	33 kcal/mol	112 kcal/mol	33 kcal/mol

Higher s character = stronger and shorter bond

Examples



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Organic Chemistry K. Peter C. Vollhardt, Neil E. Schore, 1998-08

Student Study Guide and Solutions Manual to accompany Organic Chemistry, 2e David R. Klein, 2014-01-07 This is the Student Study Guide and Solutions Manual to accompany Organic Chemistry 2e Organic Chemistry 2nd Edition is not merely a compilation of principles but rather it is a disciplined method of thought and analysis Success in organic chemistry requires mastery in two core aspects fundamental concepts and the skills needed to apply those concepts and solve problems Readers must learn to become proficient at approaching new situations methodically based on a repertoire of skills These skills are vital for successful problem solving in organic chemistry Existing textbooks provide extensive coverage of the principles but there is far less emphasis on the skills needed to actually solve problems

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Study Guide and Solutions Manual for Organic Chemistry Paula Yurkanis Bruice, 2011

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ORGANIC CHEMISTRY STUDY GUIDE Marc Loudon, A Self-Study Guide to the Principles of Organic Chemistry Jiben Roy, 2013-06-25

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