

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

Two types of bond strength



There are two types of bond strength: bond dissociation energy (BDE) and bond enthalpy (BHE).

- Bond dissociation energy (BDE) is the energy required to break a bond homolytically, producing two radicals.
- Bond enthalpy (BHE) is the average energy required to break a bond heterolytically, producing an ion pair.



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



The Relative Strength of σ and π Bonds



Bond and Bond Energy



Bond Energy



There are two types of bond energy

Definition of bond energy



Sigma (σ) and pi (π) bonds

Covalent bonds are classified as sigma (σ) and pi (π) bonds.

- Sigma bonds are formed by head-on overlap of orbitals.
- Pi bonds are formed by side-on overlap of orbitals.
- Sigma bonds are stronger than pi bonds.
- Sigma bonds are formed by the overlap of s, sp, or p orbitals.
- Pi bonds are formed by the overlap of p orbitals.



σ bonds are stronger than π 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 bond is nonpolar.
- If the difference in electronegativity is between 0.5 and 1.7, the bond is polar.
- If the difference in electronegativity is greater than 1.7, the bond is ionic.

- A difference of 0.5 or higher can be high for the difference in electronegativity values for carbon, nitrogen, oxygen, and fluorine.

- A difference of 1.7 or higher can be high for the difference in electronegativity values for carbon, nitrogen, oxygen, and fluorine.

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 atom to the more electronegative atom.
- The vector dipole moment is a product of the charge (q) and the distance (r) between the charges ($\mu = qr$).
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Molecular Dipole

To determine the molecular dipole, the vector sum of the dipole moments is calculated.

The polarity of the molecule is a product of the charge (q) and the distance (r) between the charges ($\mu = qr$).



Calculate the vector sum of the dipole moments to find the molecular dipole.

Bond Length and Bond Strength

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

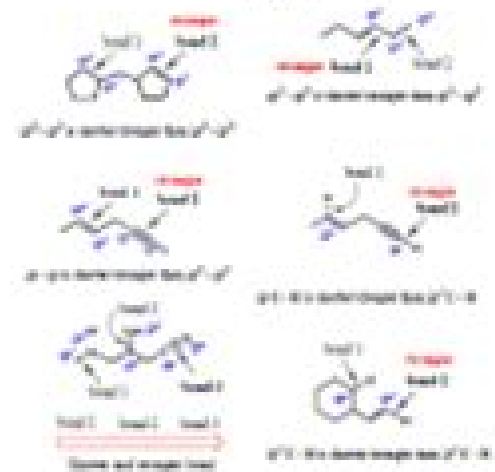


The bond length is the distance between the nuclei of the two atoms.

Average values of C-C and C-H bonds depending on hybridization			
C-C Bond	sp^3-sp^3	sp^2-sp^2	$sp-sp$
Hybridization	sp^3-sp^3	sp^2-sp^2	$sp-sp$
Length	1.54 Å	1.34 Å	1.20 Å
Strength	33 kcal/mol	47 kcal/mol	58 kcal/mol
Hybridization	sp^3-sp^3	sp^2-sp^2	$sp-sp$
C-H Bond	sp^3-sp^3	sp^2-sp^2	$sp-sp$
Length	1.09 Å	1.06 Å	1.06 Å
Strength	99 kcal/mol	110 kcal/mol	120 kcal/mol

Higher s character means shorter and stronger bond

Examples



Organic Chemistry Brown Study Guide

**William H. Brown, Brent L. Iverson, Eric
Anslyn, Christopher S. Foote**



Organic Chemistry Brown Study Guide:

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Table of Contents Organic Chemistry Brown Study Guide

1. Understanding the eBook Organic Chemistry Brown Study Guide
 - The Rise of Digital Reading Organic Chemistry Brown Study Guide
 - Advantages of eBooks Over Traditional Books
2. Identifying Organic Chemistry Brown Study Guide
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Organic Chemistry Brown Study Guide
 - User-Friendly Interface
4. Exploring eBook Recommendations from Organic Chemistry Brown Study Guide
 - Personalized Recommendations
 - Organic Chemistry Brown Study Guide User Reviews and Ratings
 - Organic Chemistry Brown Study Guide and Bestseller Lists
5. Accessing Organic Chemistry Brown Study Guide Free and Paid eBooks
 - Organic Chemistry Brown Study Guide Public Domain eBooks
 - Organic Chemistry Brown Study Guide eBook Subscription Services
 - Organic Chemistry Brown Study Guide Budget-Friendly Options
6. Navigating Organic Chemistry Brown Study Guide eBook Formats

- ePub, PDF, MOBI, and More
- Organic Chemistry Brown Study Guide Compatibility with Devices
- Organic Chemistry Brown Study Guide Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Organic Chemistry Brown Study Guide
 - Highlighting and Note-Taking Organic Chemistry Brown Study Guide
 - Interactive Elements Organic Chemistry Brown Study Guide
- 8. Staying Engaged with Organic Chemistry Brown Study Guide
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Organic Chemistry Brown Study Guide
- 9. Balancing eBooks and Physical Books Organic Chemistry Brown Study Guide
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Organic Chemistry Brown Study Guide
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Organic Chemistry Brown Study Guide
 - Setting Reading Goals Organic Chemistry Brown Study Guide
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Organic Chemistry Brown Study Guide
 - Fact-Checking eBook Content of Organic Chemistry Brown Study Guide
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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