

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 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 double bonds consist of one sigma and one pi bond.**



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).

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 dipoles is used.

The geometry of the molecule is important. Symmetrical molecules are nonpolar even if the dipoles are present. A good example is carbon dioxide.



Carbon dioxide is a linear molecule and the dipoles cancel.

Bond Length and Bond Strength

The length of a bond is important.

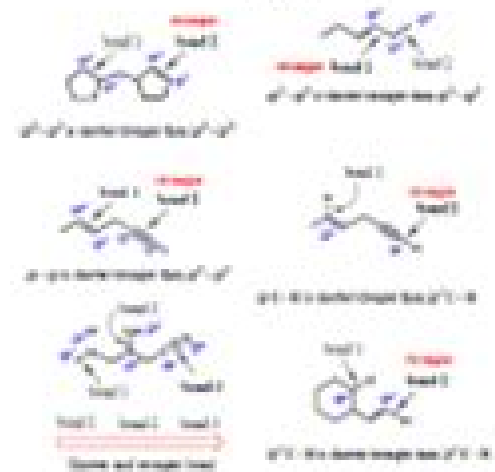


The length of a bond is important.

Average values of C-C and C-H bonds depending on hybridization			
C-C Bond	sp ³ -C-CH ₃	sp ² -C-CH ₃	sp-C-CH ₃
Hybridization	sp ³ -sp ³	sp ² -sp ²	sp-sp ²
Length	1.54 Å	1.48 Å	1.43 Å
Strength	33 kcal/mol 138 kJ/mol	37 kcal/mol 155 kJ/mol	40 kcal/mol 167 kJ/mol
Hybridization	sp ³ -sp ³	sp ² -sp ²	sp-sp ²
Hybridization	sp ³ -sp ³	sp ² -sp ²	sp-sp ²
Length	1.54 Å	1.48 Å	1.43 Å
Strength	33 kcal/mol 138 kJ/mol	37 kcal/mol 155 kJ/mol	40 kcal/mol 167 kJ/mol

Higher s character = stronger and shorter bond

Examples



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1. Understanding the eBook Organic Chemistry 2 Final Exam Study Guide
 - The Rise of Digital Reading Organic Chemistry 2 Final Exam Study Guide
 - Advantages of eBooks Over Traditional Books
2. Identifying Organic Chemistry 2 Final Exam 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 2 Final Exam Study Guide
 - User-Friendly Interface
4. Exploring eBook Recommendations from Organic Chemistry 2 Final Exam Study Guide
 - Personalized Recommendations
 - Organic Chemistry 2 Final Exam Study Guide User Reviews and Ratings

- Organic Chemistry 2 Final Exam Study Guide and Bestseller Lists
- 5. Accessing Organic Chemistry 2 Final Exam Study Guide Free and Paid eBooks
 - Organic Chemistry 2 Final Exam Study Guide Public Domain eBooks
 - Organic Chemistry 2 Final Exam Study Guide eBook Subscription Services
 - Organic Chemistry 2 Final Exam Study Guide Budget-Friendly Options
- 6. Navigating Organic Chemistry 2 Final Exam Study Guide eBook Formats
 - ePub, PDF, MOBI, and More
 - Organic Chemistry 2 Final Exam Study Guide Compatibility with Devices
 - Organic Chemistry 2 Final Exam Study Guide Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Organic Chemistry 2 Final Exam Study Guide
 - Highlighting and Note-Taking Organic Chemistry 2 Final Exam Study Guide
 - Interactive Elements Organic Chemistry 2 Final Exam Study Guide
- 8. Staying Engaged with Organic Chemistry 2 Final Exam Study Guide
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Organic Chemistry 2 Final Exam Study Guide
- 9. Balancing eBooks and Physical Books Organic Chemistry 2 Final Exam Study Guide
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Organic Chemistry 2 Final Exam Study Guide
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Organic Chemistry 2 Final Exam Study Guide
 - Setting Reading Goals Organic Chemistry 2 Final Exam Study Guide
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Organic Chemistry 2 Final Exam Study Guide
 - Fact-Checking eBook Content of Organic Chemistry 2 Final Exam 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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