

# 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 halogen bond: ionic and covalent bond.

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



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



### The Relative Strength of $\sigma$ and $\pi$ Bonds



### Bond and Bonding in a Molecule



### Bonding in a Molecule



### There are two types of bond: ionic and covalent.



## Sigma ( $\sigma$ ) and pi ( $\pi$ ) bonds

Covalent bonds are classified into sigma ( $\sigma$ ) and pi ( $\pi$ ) bonds.

- Sigma bonds are formed by head-on overlap of orbitals.
- Pi bonds are formed by side-on overlap of orbitals.

- A single bond is a sigma bond.
- A double bond consists of one sigma and one pi bond.



$\sigma$  bonds are stronger than  $\pi$  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). For example, the C-C and C-H bonds.

- If the difference in electronegativity is between 0.5 and 1.7, the electrons are shared unequally (polar bond). For example, the C-O and C-N bonds.

- A difference of 1.7 or higher is ionic (the electrons are not shared, but are lost to form an ionic bond).

## Dipole Moment

The polarity of a bond is described by the dipole moment ( $\mu$ ).



- 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 ( $\delta^-$ ) and the less electronegative atom has a partial positive charge ( $\delta^+$ ).

- $\delta^-$  (delta minus) indicates an electron deficient atom.

- $\delta^+$  (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.



Cancel the vector as the other pointing point in the same way.

## Bond Length and Bond Strength

The longer the bond, the weaker it is.



Double bonds are stronger than single bonds and are shorter.

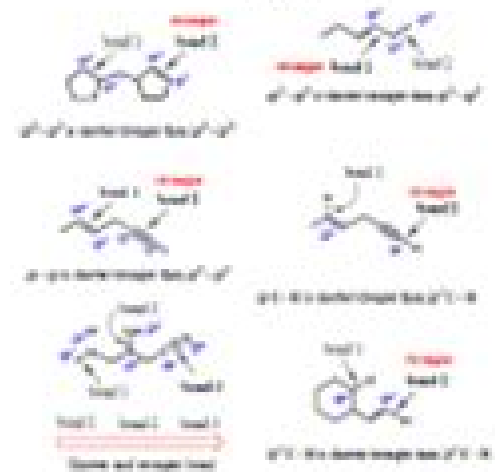


The longer the bond, the weaker it is.

| 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      | 1.08 Å       | 1.06 Å       |
| Strength                                                       | 98 kcal/mol | 110 kcal/mol | 120 kcal/mol |

Higher s character = shorter and stronger bond

## Examples



giving information on the strength of the bond.



# Organic Reactions Study Guide

**Lauren Gardner**



## Organic Reactions Study Guide:

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Milin Kurup, 2020-04-22 This Organic Study Guide and workbook was created by the author in hopes to help students have an organized collection of all reactions studied in Organic 1 and Organic 2 Many students in this class also have hopes of using this study guide as an MCAT review guide this organized set can be useful for students to review before class exams and standardized test This was created by a renowned student Milin Kurup at the University of Florida double majoring in Microbiology and Cognitive and Behavioral Neuroscience As a student of Professor Dr Laura Peterson UF Chemistry Organic Division this guide included all notes a series of 140 chemical reactions and key mechanisms necessary for a comprehensive understanding of the subject

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Denise Guinn, Rebecca Brewer, Rachel C. Lum, 2009-09-15 The Student Study Guide and Solutions Manual provides students with a combined manual designed to help them avoid common mistakes and understand key concepts After a brief review of each section's critical ideas students are taken through stepped out worked examples try it yourself examples and chapter quizzes all structured to reinforce chapter objectives and build problem solving techniques The solutions manual includes detailed solutions to all odd numbered exercises in the text

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## **Table of Contents Organic Reactions Study Guide**

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

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