

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

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).



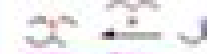
- **Covalent bonds** are formed by sharing of electrons between two atoms.



The Relative Strength of Bonds



Bond and Bonding



Bonding



There are two types of bonding

Definition of bonding



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 bond** is a sigma bond.
- **Double bond** consists of one sigma and one pi bond.



pi bonds are stronger than sigma bonds.

Polar and Nonpolar Covalent Bonds

Depending on the difference in electronegativity:

• **Nonpolar covalent bonds** are formed between two atoms with similar electronegativity.

• **Polar covalent bonds** are formed between two atoms with different electronegativity.



- 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 1.7 or higher indicates that the electrons are not shared equally and a ionic bond is formed.

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 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.



Linear molecules are nonpolar even if the dipoles are present.

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 are shorter.

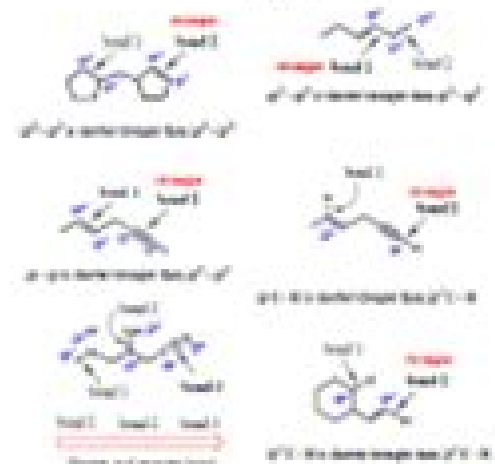


The length of a bond is the distance between the nuclei of the two atoms.

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	154 pm	134 pm	121 pm
Strength	347 kJ/mol	461 kJ/mol	591 kJ/mol
Hybridization	sp^3-sp^2	sp^2-sp	$sp-sp$
Length	147 pm	133 pm	121 pm
Strength	356 kJ/mol	461 kJ/mol	591 kJ/mol

Higher s character means stronger bond

Examples



Pavia Organic Chemistry Lab Study Guide

Jianjun Gao



Pavia Organic Chemistry Lab Study Guide:

Organic Laboratory Experiments of the Future Bruce H. Lipshutz, Hubert Muchalski, 2025-12-05 This lab manual offers students the opportunity to learn organic chemistry through a green chemistry lens resulting in a more sustainable future looking course Lipshutz and Muchalski's Organic Laboratory Experiments of the Future Doing Chemistry in Water approaches the subject with experiments diagrams and illustrations shaped by student feedback and honed through years of research and laboratory experience Organic Laboratory Experiments of the Future Doing Chemistry in Water includes material on reactions run in water including but not limited to ppm Pd catalyzed couplings SNAr reactions nitro group reductions enzyme catalyzed reactions catalytic hydrogenation of olefins olefin metathesis reductive aminations and chemoenzymatic sequences This lab manual is ideal for courses in organic chemistry biochemistry sustainable and green chemistry and environmentally responsible lab courses Provides practical information and techniques for utilizing green chemistry and chemistry in water in particular in the study of modern organic chemistry Includes numerous figures examples illustrative problems and appendices that reinforce laboratory concepts and methods Features coverage on experiments that focus on chemocatalysis as well as biocatalysis reactions that include Nobel Prize winning organometallic chemistry multi step sequences involving chemocatalysis or chemoenzymatic catalysis

Introduction to Organic Laboratory Techniques Donald L. Pavia, 1995 Subject Guide to Books in Print, 1991 **Scientific and Technical Books and Serials in Print**, 1989 Subject Guide to Children's Books in Print 1997 Bowker Editorial Staff, R R Bowker Publishing, 1996-09

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