

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 gain enthalpy).



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



The Relative Strength of Ions



Bond and Bonding



Bonding



There are two types of bonding

Definition of ionic bond



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 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 indicates that 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 vector dipole moment is a product of the charge and the distance between the charges.
- $\mu = q \times r$ (where q is the charge and r is the distance between the charges).

Molecular Dipole

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

The polarity of the molecule is determined by the vector sum of the dipole moments of the bonds.



Calculate the vector sum of the dipole moments to determine the molecular polarity.

Bond Length and Bond Strength

The length of the bond is related to the strength of the bond.

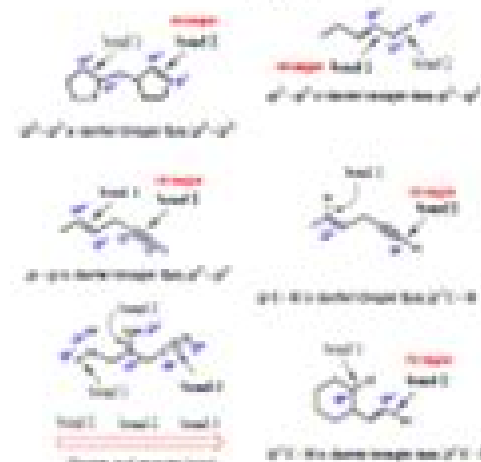


The length of the bond is related to the strength of the bond.

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	1.03 Å
Strength	99 kcal/mol	112 kcal/mol	120 kcal/mol

Higher s character = stronger and shorter bond

Examples



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