

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).



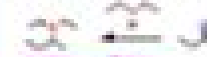
- **Covalent bonds** are formed by sharing of electrons between two atoms.



The Relative Strength of Ions



Bond and Bonding



Bonding



There are two types of bonding

Definition of ionic and covalent bonds



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 bonds** are sigma bonds.
- **Double bonds** are sigma and pi bonds.



pi bonds are stronger than sigma bonds.

Polar and Nonpolar Covalent Bonds

Depending on the difference in electronegativity

between two atoms, 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 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 not zero.



Consider the vector sum of the dipoles in the molecule.

Bond Length and Bond Strength

The length of the bond is important.

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.

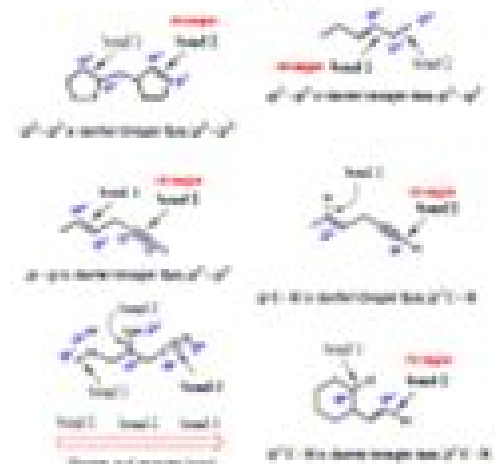


The length of the bond is important.

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	376 kJ/mol	611 kJ/mol	837 kJ/mol
Hybridization	sp^3-sp^2	sp^2-sp	$sp-sp$
Length	150 pm	143 pm	121 pm
Strength	418 kJ/mol	602 kJ/mol	837 kJ/mol

Higher s character means stronger bond

Examples



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