

Reactions of Amines and Epoxydes

Preparation of Amines

Ammonium hydroxide: $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$



Four different types of bonds



There are four types of bonding: ionic bonding and covalent bonding.

- Ionic bonds are formed by the transfer of electron from one atom to another (anions and cations) (opposite charges).



Covalent ionic and polar covalent bonds

- Covalent bonds are classified as ionic (polar) and non-polar.
- Ionic bonds are formed by the transfer of electrons.
- Covalent bonds are formed by sharing of electrons between two atoms.
- Non-polar covalent bonds consist of two equal and identical atoms.



Non-polar covalent bonds are stronger than ionic.

Four types of bonds

Dependence of bond length



Polar and Nonpolar Covalent Bonds

Depending on the difference in the electronegativity between two atoms, polar bonds can be polar and nonpolar.

- If the difference in electronegativity is less than 0.4, the electrons are shared equally between the two atoms. Forming a nonpolar covalent bond (like a covalent bond between chlorine atoms for the Cl-Cl bond).
- If the difference in electronegativity is between 0.5 and 1.7, the more polar covalent bond (nonpolar covalent bond electrons are shared between hydrogen, N, O, F and other halogens).
- A difference of 1.7 or higher one of the atoms can have more than one bond and as a result bond is ionic.

A Summary of Ring-Opening Reactions of Epoxydes with Strong and Weak Protagonists

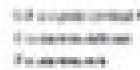


Protagonists and Reactions

Bond Types, Strength, Length, Polarity and Dipole Moment

Dipole Moment

The polarity of a bond is denoted by the dipole moment (μ).



Directional dipole moment represents the polarity of the bond.

- The dipole moment is shown as a vector pointing from the less electronegative atom towards the more electronegative atom.
- The vector is proportional to the partial negative charge and the distance between a partial positive charge and a partial negative charge.
- The dipole plot indicates the charge difference.
- The dipole moment is shown as a distance and angle.

Molecular Dipole

To measure the molecular polarity, the sum of the dipole is used.

The polarity of the molecule is equal to the sum of individual bond polarities. The dipole moment is measured. A good example is water, dipole.



Water has a net molecular dipole of 1.85 D.

Bond Length and Bond Strength

Dependence of bond length

Bond	Cl-Cl	Cl-O	Cl-F	Cl-H
Length	1.77 Å	1.71 Å	1.67 Å	1.36 Å
Strength	170 kJ/mol	177 kJ/mol	180 kJ/mol	197 kJ/mol

Water exhibits more bond length than the chlorine and hydrogen bond.



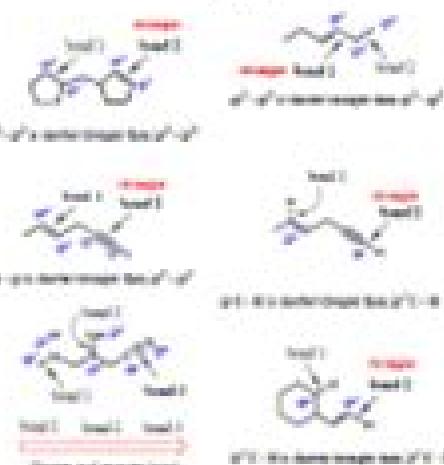
Dependence of bond strength

Average values of C-C and C-H bond depending on hybridization

C-C Bond	sp^2-sp^2	sp^3-sp^3	sp^3-sp^2
Hybridization	sp^2-sp^2	sp^3-sp^3	sp^3-sp^2
Length	1.37 Å	1.54 Å	1.65 Å
Strength	170 kJ/mol	177 kJ/mol	180 kJ/mol
Hybridization	sp^2	sp^3	sp^3-sp^2
Efficiency	25.7%	33.7%	33.7%
Length	1.39 Å	1.56 Å	1.67 Å
Strength	170 kJ/mol	177 kJ/mol	180 kJ/mol

Dependence of bond length and strength

Example



Organic Chemistry I Study Guide

Susan McMurry

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