

Reactions of Amines and Epoxydes

Preparation of Amines

Ammonium chlorides: $\text{NH}_4^+ + \text{H}_3\text{N}^- \rightarrow \text{NH}_3 + \text{NH}_4^+$



Four different types of bonds

1. Ionic bond
2. Covalent bond
3. Hydrogen bond
4. Metallic bond

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).



The covalent bonding of two atoms

$\text{O}=\text{C}=\text{O}$

Shared and transferred electrons

H_2

Hydrogen bonding

H_2O

Electrostatic interactions

Na^+

Metals

Na^+

Hydrogen bonding

H_2O

Hydrogen bonding

H_2O

Hydrogen bonding

H_2O

Hydrogen bonding

H_2O

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



Protagonists and Protagonists

Bond Types, Strength, Length, Polarity and Dipole Moment

Dipole Moment

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

1. 100% covalent bond
2. 50% covalent bond
3. 0% covalent bond



Electrostatic map of the surface of the molecule.

- The dipole moment is shown as a vector pointing from the less electronegative bond to the more electronegative atom.
- The vector is longer if there is a partial negative charge and the less electronegative atom is a partial positive charge atom.
- The dipole plot indicates the charge difference.
- The electrostatic difference is shown with arrows.

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 the bond dipole moments. If the dipole moments are equal, it is just simple addition.



Sum of the bond dipole moment of the molecule.

Long bonds are stronger than short bonds.

Polar and Nonpolar Covalent Bonds

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



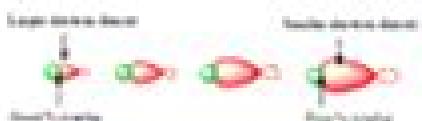
- If the difference in electronegativity is less than 0.4, the electrons are almost equally shared between the two atoms. This is a nonpolar covalent bond. (For example: H_2 and C_2 bonds).
- If the difference in electronegativity is between 0.5 and 1.7, the more polar covalent bond. (Nonpolar covalent bonds are often the carbon-hydrogen bonds, C_6H_6 , C_2H_4 and other halogen).
- If a difference of 1.7 or higher one of the atoms has an electron pair, longer shared and a polar bond is formed.

Bond Length and Bond Strength

→ Bond length vs. bond strength

Bond	H_2	H_2O	H_2S	H_2Se
Length	1.07 Å	1.21 Å	1.47 Å	1.66 Å
Strength	100% bond	50% bond	10% bond	5% bond

Longer bonds have shorter bond length and stronger bond.



→ Bond length vs. bond strength

Average values of C-C and C-H bond depending on the heteroatoms			
C-C bond	$\text{H}_2\text{C}-\text{CH}_3$	$\text{H}_2\text{C}-\text{CH}_2\text{O}$	$\text{H}_2\text{C}-\text{CH}_2\text{S}$
Hybridization	sp ³ hybrid	sp ² hybrid	sp hybrid
Length	1.07 Å	1.16 Å	1.23 Å
Strength	100% bond	50% bond	10% bond
Hybridization	sp ³	sp ²	sp
Hybridization	sp ³	sp ²	sp
Length	1.07 Å	1.16 Å	1.23 Å
Strength	100% bond	50% bond	10% bond

→ Dipole moment and stronger bond

Example



→ Dipole moment of H_2O



→ Dipole moment of H_2O



→ Dipole moment of H_2O



→ Dipole moment of H_2O

→ Dipole moment of H_2O

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Saul Wischnitzer, Edith Wischnitzer

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