

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 between atoms in a molecule.

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



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



Opposite (p) and same (s) bonds

Opposite bonds are illustrated as sigma (s) and pi (p).

- Opposite bonds are formed by (some) overlap of orbitals.
- s bonds are formed by (some) overlap of orbitals.
- p bonds formed in a p-orbital.
- Non-overlapping bonds consist of one sigma and three pi (p).



Non-overlapping bonds are stronger than pi bonds.

Four different types of bonds



Four different types of bonds



Four different types of bonds



Four different types of bonds



Polar and Nonpolar Covalent Bonds



- If the difference in electronegativity is less than 0.4, the electrons are shared equally between the two atoms. Forming a nonpolar covalent bond (Nonpolar covalent bonds are the C-C and C-H bonds).
- If the difference in electronegativity is between 0.5 and 1.7, one atom has a partial negative charge and the other has a partial positive charge (Polar covalent bonds).
- A difference of 1.7 or higher one or both of the atoms have a larger shared and a smaller bond is formed.

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

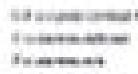


Reactions and Mechanisms

Bond Types, Strength, Length, Polarity and Dipole Moment

Dipole Moment

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



Direction may be indicated by arrows on the charge.

- The dipole moment is shown as a vector pointing from the less electronegative to the more electronegative atom.
- The vector (dipole moment) is the partial negative charge and the partial positive charge.
- The dipole (dipole moment) is the difference between two.
- The dipole moment is shown as a horizontal arrow.

Molecular Dipole

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

The polarity of the molecule is equal to the sum of the individual bond polarities (the dipole moments are added). A good example is water (dipole).



Water has water as the total dipole moment for the molecule.

Bond Length and Bond Strength

Reactions of bond length



Length: 1.57 Å, 1.21 Å, 1.47 Å, 1.36 Å.

Strength: 170 kJ/mol, 470 kJ/mol, 770 kJ/mol, 1070 kJ/mol.

Water and carbon dioxide have the same bond length.

Water and carbon dioxide have the same bond length.



Reactions of bond length

Average values of C-C and C=O bond length and strength

| C-C Bond | $\text{H}_2\text{C}=\text{CH}_2$ | $\text{CH}_2=\text{CH}_2$ | $\text{CH}_2=\text{CH}_2$ |
|---------------|----------------------------------|---------------------------|---------------------------|
| Length | 1.57 Å | 1.21 Å | 1.47 Å |
| Strength | 170 kJ/mol | 470 kJ/mol | 770 kJ/mol |
| Hybridization | sp^2 | sp^2 | sp^2 |
| Efficiency | 55 % | 55 % | 55 % |
| Length | 1.50 Å | 1.38 Å | 1.38 Å |
| Strength | 170 kJ/mol | 470 kJ/mol | 770 kJ/mol |

Water and carbon dioxide and strength

Example



Water has water as the total dipole moment for the molecule.

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