

# Reactions of Amines and Epoxydes

## Preparation of Amines

Ammonium hydroxide: hydroxide is more basic than hydroxide in acid



## Four different types of bonds

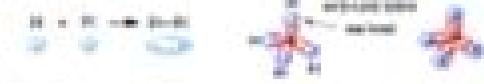
1. Ionic Bonds  
2. Covalent Bonds  
3. Hydrogen Bonds  
4. Metallic Bonds

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

- 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



### Regions (σ) and π (δ) bonds

- Covalent bonds are classified as sigma (σ) and pi (π) bonds.
- Sigma bonds are formed by head-on overlap of orbitals.
- π bonds are formed by side-on overlap of orbitals.
- Very simple bond is a covalent bond.
- Non-overlapping bond consists of two regions and two π bonds.



π bonds are stronger than σ bonds.

### Polar and Nonpolar Covalent Bonds

Depending on the difference in the electronegativity

- when, polar bonds are formed.
- δ - δ+ as a single molecule.

δ - δ+ as a single molecule.

- 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 oxygen-oxygen single bond for O2 and C-C bonds).
- If the difference in electronegativity is between 0.5 and 1.7, the more polar covalent bond (nonpolar covalent bond electrons are shared between a hydrogen, N, O, F and other halogen).
- A difference of 1.7 or higher one or both the electrons are shared and a polar bond is formed.

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



### Reactions and Mechanisms

## Bond Types, Strength, Length, Polarity and Dipole Moment

### Dipole Moment

The polarity of a bond is denoted by the dipole moment ( $\mu$ ).

1.0 e.s.u. = 10<sup>-30</sup> C.m  
1.0 e.s.u. = 10<sup>-30</sup> C.m  
1.0 e.s.u. = 10<sup>-30</sup> C.m



Electrons are concentrated around oxygen atom.

- The dipole moment is shown as a vector pointing from the less electronegative to the more electronegative atom.
- The vector (dipole moment) shows a partial negative charge and the less electronegative atom, a partial positive charge.
- δ- (partial negative) indicates electron deficiency area.
- δ+ (partial positive) indicates electron rich area.

### 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. If dipole moments are canceled, it just means a neutral dipole.



Sum of vector of the bond dipole for the molecule.

### Bond Length and Bond Strength

#### Reactions of bond to length



Bond: ionic, covalent, hydrogen, metallic.

Length: 1.07 Å, 1.27 Å, 1.47 Å, 2.16 Å.

Strength: 10<sup>12</sup> N/m, 10<sup>10</sup> N/m, 10<sup>8</sup> N/m, 10<sup>6</sup> N/m.

Ionic bond: nonpolar, polar, and nonpolar.

Covalent bond: nonpolar, polar, and nonpolar.

Hydrogen bond: nonpolar, polar, and nonpolar.

Metallic bond: nonpolar, polar, and nonpolar.

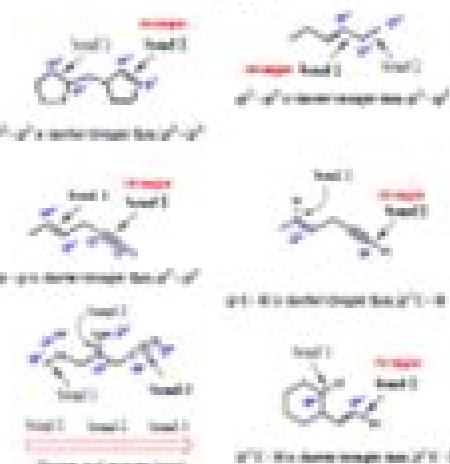
#### Reactions of bond to length

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

C-C Bond	sp <sub>3</sub> -sp <sub>3</sub>	sp <sub>2</sub> -sp <sub>2</sub>	sp-sp
Hybridization	sp <sup>3</sup> -sp <sup>3</sup>	sp <sup>2</sup> -sp <sup>2</sup>	sp-sp
Length	1.54 Å	1.35 Å	1.15 Å
Strength	10 <sup>12</sup> N/m	10 <sup>10</sup> N/m	10 <sup>8</sup> N/m
Hybridization	sp <sub>3</sub>	sp <sub>2</sub>	sp
Strength	10 <sup>12</sup> N/m	10 <sup>10</sup> N/m	10 <sup>8</sup> N/m
Length	1.10 Å	1.00 Å	0.95 Å
Strength	10 <sup>12</sup> N/m	10 <sup>10</sup> N/m	10 <sup>8</sup> N/m

### Dipole and bond length

## Example



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