

# Reactions of Amines and Epoxydes

## Preparation of Amines

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



## Four different types of bonds

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



## The Behavior of the bond



## Non-polar and polar covalent bonds



## There are two main types of covalent bonds

## Dependence of bonds on



## Polar and Nonpolar Covalent Bonds

## Dependence of the difference in the electronegativity



## Dependence of the difference in the electronegativity

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

### A Summary of Bond-Breaking Reactions of Epoxydes with Strong and Weak Protophiles



#### Protonation and deprotonation

## Dipole Moment

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

1. Nonpolar covalent bond  
2. Polar covalent bond  
3. Ionic bond



Electrons are concentrated around the more electronegative atom.

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

## 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 bond dipole moments. The dipole moment is measured. A good example is water, which



Water has a net molecular dipole of 1.85 D.

## Bond Length and Bond Strength

### Dependence of bond length



Bond length:  $1.07 \text{ \AA}$ ,  $1.27 \text{ \AA}$ ,  $1.47 \text{ \AA}$ ,  $1.67 \text{ \AA}$

Strength:  $100 \text{ kJ/mol}$ ,  $400 \text{ kJ/mol}$ ,  $1000 \text{ kJ/mol}$ ,  $10000 \text{ kJ/mol}$

Water is the most polar molecule, but it is not the strongest bond.

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### Dependence of bond strength

## Average values of C-C and C-H bond depending on the molecule

C-C bond:  $347 \text{ kJ/mol}$ ,  $357 \text{ kJ/mol}$ ,  $367 \text{ kJ/mol}$

Hydrogen:  $470 \text{ kJ/mol}$ ,  $470 \text{ kJ/mol}$ ,  $470 \text{ kJ/mol}$

Length:  $1.17 \text{ \AA}$ ,  $1.18 \text{ \AA}$ ,  $1.19 \text{ \AA}$

Strength:  $100 \text{ kJ/mol}$ ,  $1000 \text{ kJ/mol}$ ,  $10000 \text{ kJ/mol}$

Hydrogen:  $470 \text{ kJ/mol}$ ,  $470 \text{ kJ/mol}$ ,  $470 \text{ kJ/mol}$

Hydrogen:  $33 \text{ \AA}$ ,  $33 \text{ \AA}$ ,  $33 \text{ \AA}$

Length:  $1.10 \text{ \AA}$ ,  $1.10 \text{ \AA}$ ,  $1.10 \text{ \AA}$

Strength:  $100 \text{ kJ/mol}$ ,  $1000 \text{ kJ/mol}$ ,  $10000 \text{ kJ/mol}$

## Water is the most polar and strongest bond

## Example



Water is the most polar bond.

Water is the strongest bond.

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Water is the strongest bond.



## Water is the most polar and strongest bond

# Organic Chemistry Reactions Study Guide

**Jiben Roy**

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[Study Guide to Organic Chemical Reactions](#) Milin Kurup, 2020-01-06 This Organic Study Guide and workbook

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**Study Guide and Solutions Manual to Accompany The Essence of Organic Chemistry** Jane M. Cram, Donald J. Cram, 1978

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