


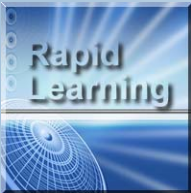
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Teach Yourself
Organic Chemistry in 24 Hours




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 **Introduction to Organic Chemistry**

Organic Chemistry Rapid Learning Series

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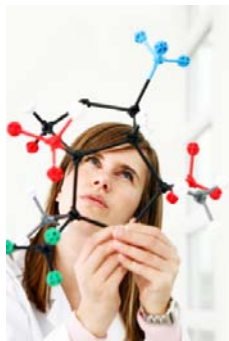
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Learning Objectives

By completing this tutorial, you will learn about:



- The Chemistry of Carbon and the Language of Organic Chemistry.
- Functional Groups.
- Acids and Bases.
- Electrons and Mechanisms.
- Resonance and Delocalization.

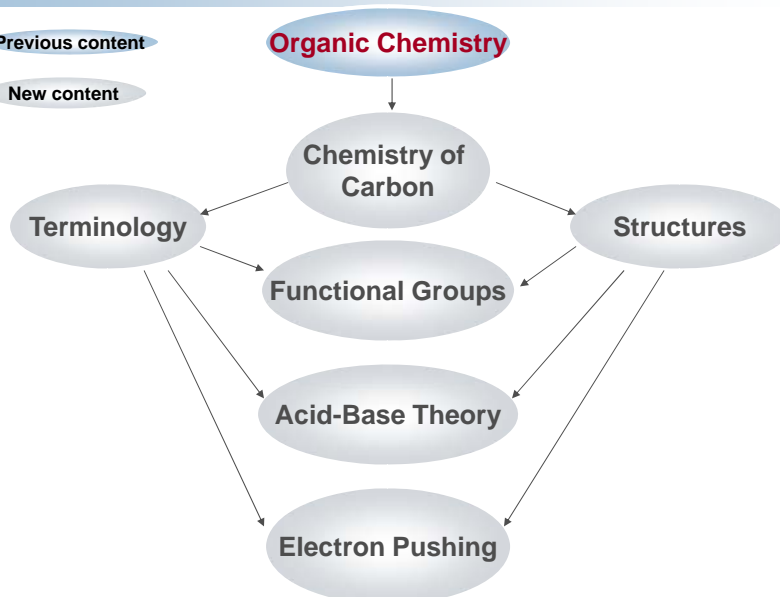
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Concept Map

Previous content

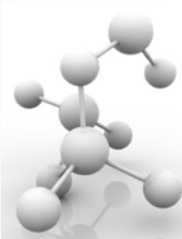
New content



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Organic Chemistry



1. The Chemistry of Carbon
2. Language of Organic Chemistry


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Chemistry of Carbon

The Importance of Organic Chemistry

- Carbon is the basis for all living things.
- Organic chemistry is the chemistry of carbon compounds.
- Organic compounds are used for food, medicine, fuel, plastics, and clothing.
- Organic chemists synthesize medicines, medical implants, plastics, paints, fibers, and many other items.
- The study of organic chemistry allows a student to understand these chemical processes with the goal of improving them and developing new products.



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Language of Organic Chemistry

Terminology

- Learn the proper vocabulary.
- Know the proper abbreviations.

Proper Structures

- Learn how to draw structures correctly.
- Know the number of bonds per atom (C has 4 bonds, N and P have 3 bonds, O and S have 2 bonds, and H, F, Cl, Br, and I have 1 bond).



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Organic Chemistry Summary

Carbon is the basis for all living things.

Organic chemistry is the chemistry of carbon compounds.


Organic compounds are used for food, medicine, fuel, plastics, and clothing.

Learn the proper vocabulary and abbreviations.


Learn how to draw structures correctly.

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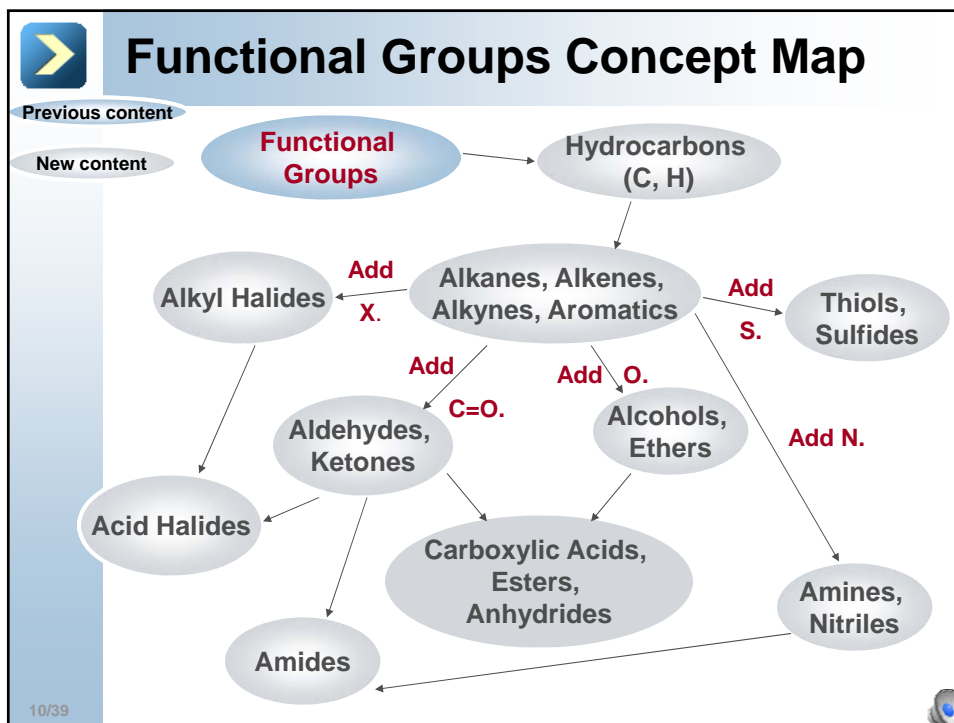


Functional Groups



1. Alkane, Alkene, Alkyne, Aromatic
2. Alkyl Halide, Alcohol, Ether, Thiol, Sulfide
3. Aldehyde, Ketone, Acid Halide
4. Carboxylic Acid, Ester, Anhydride
5. Amine, Amide, Nitrile

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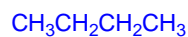
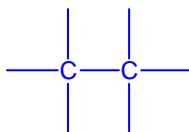




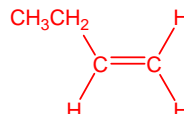
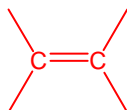
Functional Groups - 1

Hydrocarbons

Alkane



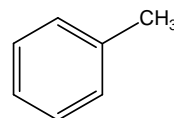
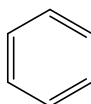
Alkene



Alkyne



Aromatic



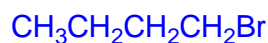
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Functional Groups - 2

R = Alkyl group; X = F, Cl, Br, or I.

Alkyl Halide



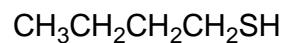
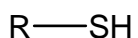
Alcohol



Ether



Thiol



Sulfide



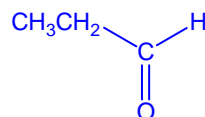
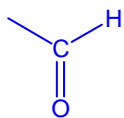
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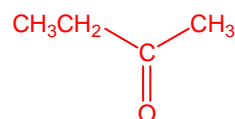
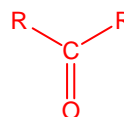
Functional Groups - 3

Compounds with C=O

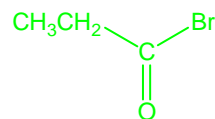
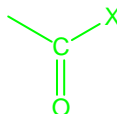
Aldehyde



Ketone



Acid halide



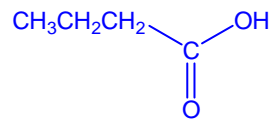
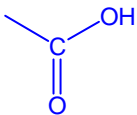
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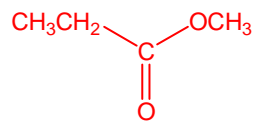
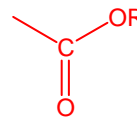
Functional Groups - 4

Compounds with O=C-O

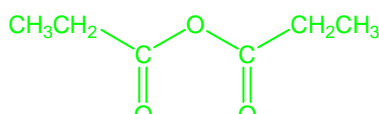
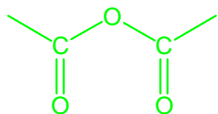
Carboxylic acid



Ester



Anhydride

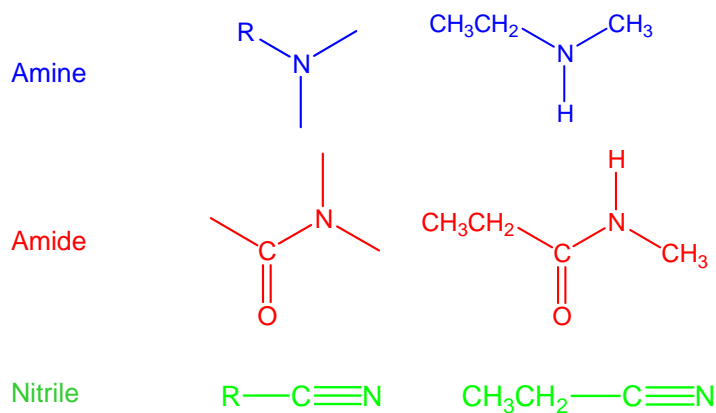


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Functional Groups - 5

Compounds with N

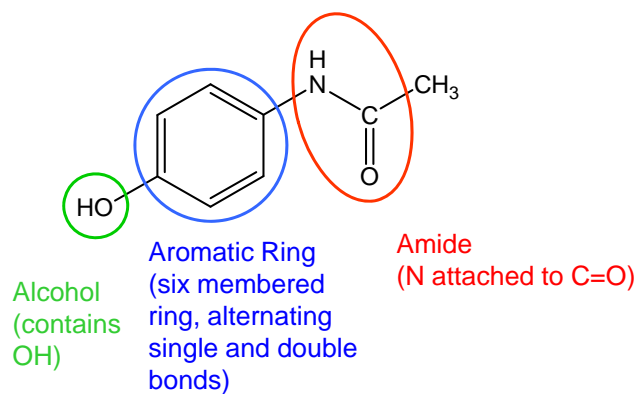


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Functional Group Problem - 1

Circle the functional groups and name them.



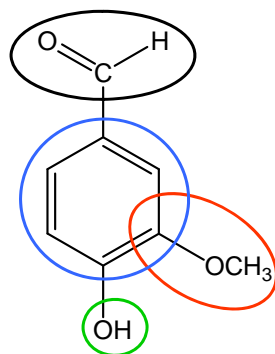
Acetaminophen (Active Ingredient in Tylenol™)

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Functional Group Problem - 2

Circle the functional groups and name them.



Aldehyde
(contains H next to C=O)

Aromatic Ring
(six membered ring,
alternating single and
double bonds)

Ether
(ROR)

Alcohol
(ROH)

Vanillin

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Functional Groups Summary - 1

Definitions:

An **alkane** contains carbon-carbon single bonds.

An **alkene** contains a carbon-carbon double bond.

An **alkyne** contains a carbon-carbon triple bond.

An **aromatic** compound contains a six membered ring with alternating double and single bonds.

R is an abbreviation for an alkyl group.

X is an abbreviation for the halogens: fluorine, chlorine, bromine, and iodine.

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Functional Groups Summary - 2

Definitions:

An **alkyl halide** (haloalkane, RX) contains an alkyl group (R) and a halogen (X).

An **alcohol** consists of a R and an OH (ROH).

An **ether** contains an O, with an R on both sides (ROR).

A **thiol** contains a S, with a R on one side and a H on the other side of the S (RSH).

A **sulfide** has a S with a R group on both sides (RSR).

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Functional Groups Summary - 3

Definitions:

An **aldehyde** contains a H attached to the C of a C=O $[-(C=O)H]$. H or R is on the other side.

A **ketone** contains two R groups attached to the C of the C=O $[R(C=O)R]$.

An **acid halide** contains a X attached to the C of a C=O $[R(C=O)X]$. A H or R is attached on the other side.

A **carboxylic acid** contains a C=O with a H or R on one side and an OH attached to the C of the C=O $[-(C=O)OH]$.

An **ester** has a H or R on one side and an OR attached to the C of the C=O $[-(C=O)OR]$.

An **anhydride** contains two C=O groups separated by an O $[-(C=O)O(C=O)-]$. R or H is attached to the C of the C=O.

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Functional Groups Summary - 4

Definitions:

Amines contain a N bonded to three other R or H (NH_3 , NRH_2 , NR_2H , or NR_3).

Amides have a N attached to a C of the $\text{C}=\text{O}$ [$-(\text{C}=\text{O})\text{NH}-$, $-(\text{C}=\text{O})\text{NR}-$]. The other positions are H or R.

A **nitrile** has an R attached to a C which is triple bonded to a N (RCN).

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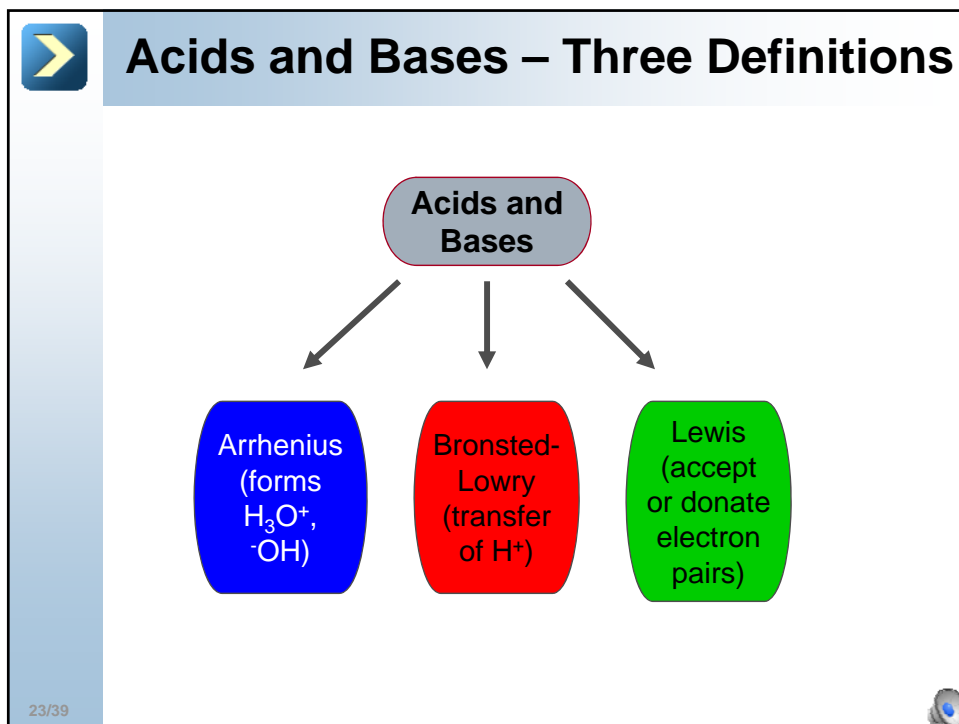
Acids and Bases



1. Arrhenius
2. Bronsted-Lowry
3. Lewis

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Arrhenius Acids and Bases

Arrhenius Acid

- Substance that dissociates to give H_3O^+ (hydronium ion).

Arrhenius Base

- Substance that dissociates to give OH^- (hydroxide ion).

$$\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{O}^{\oplus} + \text{HSO}_4^{\ominus}$$

Arrhenius Acid

$$\text{NaOH} + \text{H}_2\text{O} \longrightarrow \text{Na}^{\oplus} + \text{OH}^{\ominus}$$

Arrhenius base

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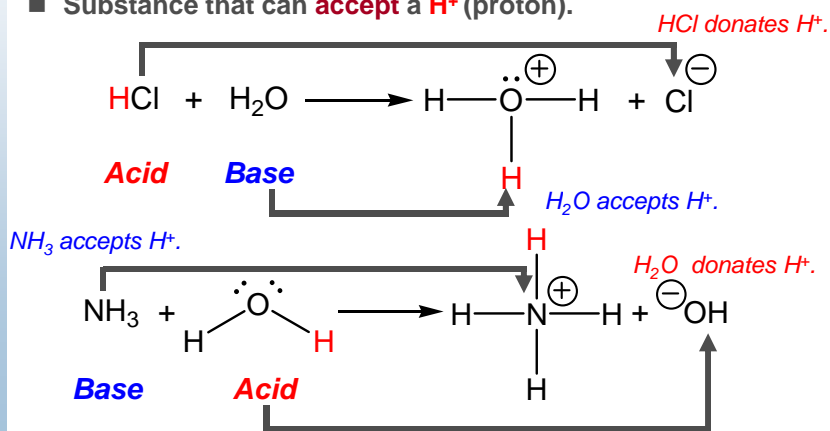
Bronsted-Lowry Acids and Bases

Bronsted-Lowry Acid

- Substance that can **donate** a H^+ (proton).

Bronsted-Lowry Base

- Substance that can **accept** a H^+ (proton).



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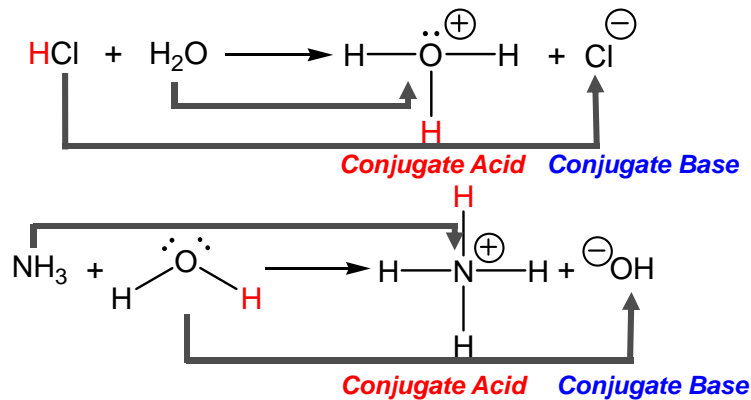
Bronsted-Lowry Conjugate Acids & Bases

Conjugate Acid

- The acid that results from the Bronsted-Lowry base gaining a H^+ .

Conjugate Base

- The base that results from the Bronsted-Lowry acid losing a H^+ .



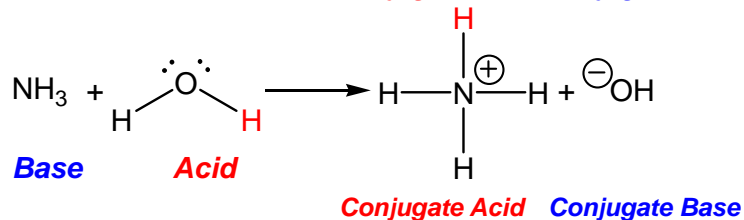
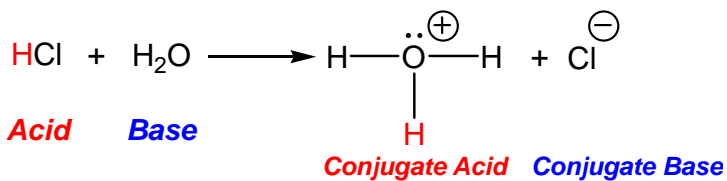
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Amphoteric Compounds

Amphoteric Compound

- A compound that can react as an acid or a base.
- Water is reacting as an acid or base in the following examples.



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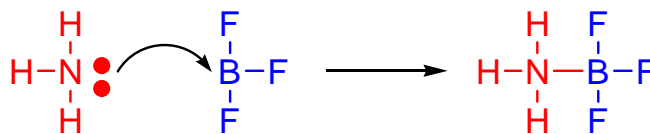
Lewis Acids and Bases

Lewis Acid

- Substance that can accept electron pairs to form new bonds.

Lewis Base

- Substance that can donate electron pairs to form new bonds.



Lewis Base Lewis Acid

NH₃ donates an electron pair to BF₃.

BF₃ accepts an electron pair from NH₃.

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Acids and Bases Summary - 1

Definitions:

An **Arrhenius acid** is a substance that dissociates to give H_3O^+ .

An **Arrhenius base** is a substance that dissociates to give OH^- .

A **Bronsted-Lowry acid** is a substance that can donate a H^+ .

A **Bronsted-Lowry base** is a substance that can accept a H^+ .

A **conjugate acid** is the acid that results from the Bronsted-Lowry base gaining a H^+ .

A **conjugate base** is the base that results from the Bronsted-Lowry acid losing a H^+ .

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Acids and Bases Summary - 2

Definitions:


An **amphoteric** compound is a compound that reacts as an acid or a base.

A **Lewis acid** is a substance that can accept electron pairs to form new bonds.


A **Lewis base** is a substance that can donate electron pairs to form new bonds.

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Electron Pushing



1. Electrons and Mechanisms
2. Resonance and Delocalization

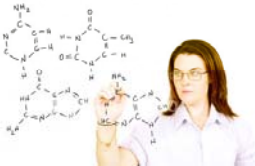
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Electrons and Mechanisms - 1

Basic Rules for Drawing Mechanisms

- Identify the **most electronegative** atom and the **least electronegative** atom in a bond.
- Locate the **electrons** on the **more electronegative** atom.
- A **mechanism** is a **step-by-step explanation** of what happens in a chemical reaction.
- The **flow of electrons** in a mechanism is **from the most electronegative atom to the least electronegative** atom.



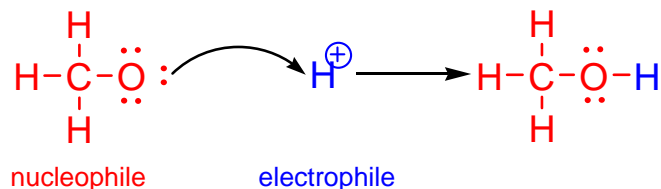
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Electrons and Mechanisms - 2

Basic Rules for Drawing Mechanisms

- The **nucleophile** donates the electrons in a mechanism.
- The **electrophile** accepts the electrons in a mechanism.



- The **O** is the most electronegative.
- The **H⁺** is the least electronegative.
- CH₃O⁻ is the **nucleophile**.
- H⁺ is the **electrophile**.

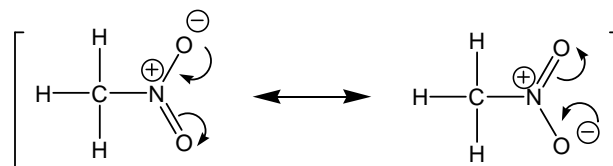
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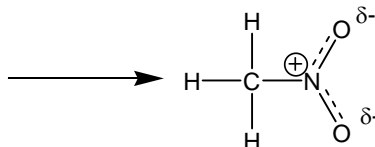
Resonance and Delocalization

Important Definitions from Resonance Theory:

- **Resonance structures** are two or more equivalent structures for the same arrangements of atoms, the only difference is the location of the electrons.
- **Delocalization** is electrons that are distributed among more than two atoms that are bonded together.



resonance structures



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Electron Pushing Summary - 1

Definitions:

Locate the **electrons** on the more electronegative atoms.

Identify the most **electronegative** atom and the least electronegative atom in a bond.

A **mechanism** is a step-by-step explanation of what happens in a chemical reaction.

The flow of electrons in a mechanism is from the most electronegative atom to the least electronegative atom.

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Electron Pushing Summary - 2

Definitions:

The **nucleophile** donates the electrons in a mechanism.

The **electrophile** accepts the electrons in a mechanism.

Resonance structures are equivalent structures for the same arrangements of atoms, the only difference is the electrons.

Delocalization are electrons that are distributed among more than two atoms that are bonded together.

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Learning Summary

Amphoteric compounds can react as acids or bases.

Organic chemistry is the chemistry of **carbon** compounds.

The flow of **electrons** in a mechanism is from the most electronegative atom to the least electronegative atom.

Resonance structures are two or more equivalent structures for the same arrangements of atoms, the only difference is the location of the electrons.

There are three types of **acid-base theory**: Arrhenius, Bronsted-Lowry, and Lewis.

A **mechanism** is a step-by-step explanation of what happens in a chemical reaction.

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Congratulations!

You have successfully completed the tutorial

Introduction to Organic Chemistry

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What's Next ...

Step 1: Concepts – Core Tutorial (Just Completed)
→ Step 2: Practice – Interactive Problem Drill
Step 3: Recap – Super Review Cheat Sheet

Go for it!



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