Chem 342

Organic Chemistry II
Spring 2004

cook.chem.ndsu.nodak.edu/chem342

Please pick up a syllabus near the entrance
Office Hours

Mon, Wed - 9:00-10:00 am or give me a call

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Grading

500 point scale

three 100 point midterm exams

a 200 point comprehensive final

Quizzes

Six 21 point quizzes

Top 5 quizzes will be added for total of 105 potential points

If higher, this will automatically replace your lowest midterm exam score
Grading

A  85-100%
B  75-84%
C  60-74%
D  45-59%
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Course Outline

- NMR Spectroscopy
- Conjugated Dienes
- Aromaticity - Chemistry of Benzene
- Alcohols and Phenols
- Ethers and Epoxides
- Carbonyl Chemistry
- Amines
- Biomolecules
Functional group chemistry

General Properties

Reactions

Why is this important?
My Philosophy Toward Organic Chemistry

- Like a foreign language
- Vocabulary
  - Terms
  - Structures
  - Functional Groups
- Grammar
  - Electronic properties
- Reactivity
Tips For Learning Organic Chemistry

- Read ahead before coming to class
- COME TO CLASS
- Rewrite your notes
- Do the suggested problems - do them again
- Flash cards can help

SUBSTRATES ➔ REAGENTS ➔ PRODUCTS
Tips For Learning Organic Chemistry

- Study with a friend or form a study group
- A set of molecular models can help
- DON’T Fall Behind
- DON’T Fall Behind
- DON’T Fall Behind
- Organic Chemistry is an integral part of Biology and Biochemistry. Life exists because of Organic Chemistry.
Chapter 13 - NMR Spectroscopy

- **Basis of NMR**
- How functional groups affect NMR
- How protons affect nearby protons
- How to interpret NMR and assign structure
How to determine the structures of molecules?

- Probe physical properties
- Elemental Analysis
  - atomic composition (relative ratios)
  - empirical formula
- Mass Spectrometry
  - molecular formula
  - element identification (isotopes)
- connectivity
How to determine the structure of molecules?

- Vibrational (Infrared) Spectroscopy
- functional groups
- Electronic (UV-VIS) Spectroscopy
- conjugation
- X-Ray Crystallography
- 3D positions of atoms
NMR Spectroscopy

- Atom Connectivity
- Functional Group Identification
- Stereochemistry
- Higher Order Structure
Identification of a Natural Product

High Res. Mass Spectrometry

- 210.0764 4.4% \( \text{C}_{11}\text{H}_{13}\text{N}_{2}\text{Cl} \)
- 208.0769 15.5% \( \text{C}_{11}\text{H}_{13}\text{N}_{2} \text{Cl} \)

UV Spectroscopy

- 217 nm and 250-280 nm indicates pyridine ring

IR Spectroscopy

- 1428 and 1112 cm\(^{-1}\) suggests a pyridine ring

Epibatidine


Isolated from the Ecuadorian tree frog - *Epibatis Tricolor*

Analgesic activity 500 times greater than morphine.
Epibatidine
Epibatidine
Nuclear Magnetic Resonance

A spinning charged particle generates a magnetic field.

A nucleus with a spin angular momentum will generate a magnetic moment ($\mu$).

If these tiny magnets are placed in an applied magnetic field ($B_0$), they will adopt two different states - one aligned with the field and one aligned against the field. The energy difference between these two states is what we are observing with NMR.
Nuclear Spin States

When EM waves at this energy are directed at the nuclei - it will absorb. Spins will flip from lower energy to higher energy. At that energy, nuclei are “In Resonance”.

Energy difference between the states at a particular magnet strength. In the $R_f$ range of the EM Spectrum.
Many nuclei are “NMR Active”

Spin Quantum Number \( I \neq 0 \)

\( ^1H \) -- \( I = \frac{1}{2} \); \( ^{13}C \) -- \( I = \frac{1}{2} \)

\( ^{12}C, \; ^{16}O \) -- \( I = 0 \) -- Can’t be observed

Other nuclei that are NMR active

\( ^2H \) (D), \( ^{14}N \), \( ^{19}F \), \( ^{31}P \)
Magnetic Resonance Imaging

NMR is the basis for MRI