

# ORGANIC CHEMISTRY II (CHEM 232) – SPRING 2005

This syllabus subject to change pending notification verbally in class or via the email list.

*MWF 9:10-10:00 am, Hayes 109*

*Prof. Yutan Getzler*

*Office:* Tomsich Hall 308

*Office hours:* Mon & Wed, 10 am – 12 pm, Mon 1 pm – 2 pm, or by appointment.

*PBX:* 5091

*email:* getzlery <http://chem.kenyon.edu/faculty/getzler/05S-CHEM232.html>

**Text:** Vollhardt, K. Peter C.; Schore, Neil E. “Organic Chemistry: Structure and Function,” 4<sup>th</sup> edition

**Optional:** Schore, Neil E. “Study Guide and Solutions Manual for Organic Chemistry,” 3<sup>rd</sup> edition

**Material:** Molecular Visions Molecular Model Kit; PokeScope • 3D Viewer.

## Point Distribution:

3 Midterm Exams @ 170 points each	510
Final Exam	340
In-class problem presentation	100
<u>Class participation</u>	<u>50</u>
Total	1000

## Exam Schedule:

<u>Exam</u>	<u>Primary Content</u>	<u>Date &amp; Time</u>
Midterm I	Chs. 17, 18	Th, Feb 10 <sup>th</sup> , 7:00 pm
Midterm II	Chs. 19, 20	Th, Mar 3 <sup>rd</sup> , 7:00 pm
Midterm III	Chs. 26, 24	Th, Apr 20 <sup>th</sup> , 7:00 pm
Final	ACS; Chs. 14 – 16	Fri, May 13 <sup>th</sup> , 8:30 am

*All exams in Hayes 109. Midterms ~1 hr; final ~3 hrs. If you have a conflict at the scheduled time, you may take the exam earlier.*

## Rules for the Course:

*Goals:* Chemistry 232 provides a foundation of knowledge for other science courses at Kenyon, such as Advanced Organic Chemistry (Chemistry 453), Biochemistry (Chemistry 356), Advanced Biochemistry (Chemistry 460), and Molecular Genetics (Biology 363). In addition, by the end of the semester you should be able to read and understand a large amount of the current published original research in organic chemistry.

*Attendance:* As you already know by now from your experience in Chemistry 231, it is quite easy to get behind if you miss a particular topic. Therefore class attendance is mandatory. Also see in-class problem presentation below.

*Prerequisite:* Organic chemistry is a science that continually builds upon itself, and this course is acutely dependent upon your working knowledge of Chemistry 231 (first semester) material.

**WARNING:** The final exam of this course will contain topics from Chemistry 231.

*Rules for the Course, continued:*

*Studying:* You should devote 9 hours minimum per week to studying for this course outside of our normal meeting time. There are many potentially effective strategies for success in this course. Read the sections of the text to be covered in class before coming to class. Work through the appropriate exercises and end-of-chapter problems. Recopy your notes after each lecture.

I will be available on the Wednesdays evenings of exam weeks (including Wednesday, May 11<sup>th</sup>) for a purely voluntary question/answer review session at 7:30 pm in Tomsich 207.

*Exams:* To allow for ample time on exams, they are scheduled for Thursday evenings.

*In-class problem presentations:* At the beginning of each class one or two students will randomly be assigned to come to the board and solve one of the suggested problems from last lecture. The presentation can not last beyond 9:15 am (9:20 am if there are two presentations). If you are not present, you will receive no credit for this assignment. These presentations will be graded in the following manner: preparation/accuracy – 60%, presentation – 20%, time – 20%. I will cut you off at the end of the time period which may also cut into the accuracy of your presentation.

*Class participation:* I will call on you in class to answer relevant questions; evaluation is on a 0, ✓-, ✓, ✓+ basis.

*Academic Honesty:* You are expected to follow the college policy for academic honesty as outlined in the “Kenyon College Course of Study 2002-2003,” pp 26-29. All materials submitted for credit must be your own work.

*Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990:* If you have a disability and need accommodation in order to fully participate in this class, please identify yourself to Erin Salva, Coordinator of Disability Services (PBX 5145, [salvae@kenyon.edu](mailto:salvae@kenyon.edu)). All information and documentation of disability is confidential. No accommodations of any kind will be given in this course without notification from the Coordinator of Disability Services.

## Tentative Schedule &amp; Reading Assignments:

Date	Topic	Section in V & S
<b>ALDEHYDES &amp; KETONES</b>		
M 1/17	Structure, Nomenclature, & Ppn of Aldehydes & Ketones	17-1, 17-2, 17-4
W 1/19	Addition Rxns of Aldehydes & Ketones / Acetals	17-5 to 17-7
F 1/21	Acetals as Protecting Groups / Desulfurization	17-8
M 1/24	Imines & Enamines	17-9
W 1/26	Wolff-Kishner Reduction / Cyanohydrins	17-10, 17-11
F 1/28	The Wittig Rxn / The Baeyer-Villiger Oxidation	17-12, 17-13
M 1/31	Keto-Enol Equilibria / Deuterium Exchange / Stereoisomerization	18-2
W 2/2	Halogenation & Alkylation of Aldehydes & Ketones	18-3, 18-1, 18-4
F 2/4	The Aldol Addition Rxn & Condensation / Crossed Aldol Condensation	18-5, 18-6
M 2/7	Intramolecular Aldol Condensation / Conjugate Addition	18-7, 18-9, 18-10
W 2/9	The Michael Addition / The Robinson Annulation	18-11
Th 2/10	<i>Exam I – 7 pm, RBH 109 – covering material until 2/9 – NO CLASS 2/11</i>	
M 2/14	Claisen & Dieckmann Condensations, The Acetoacetic & Malonic Ester Syntheses	23-1, 23-2
<b>CARBOXYLIC ACIDS &amp; THEIR DERIVATIVES</b>		
W 2/16	Nomenclature & Physical Properties of Carboxylic Acids	19-1, 19-2
F 2/18	Acid-Base Properties & Ppn of Carboxylic Acids	19-4, 19-6
M 2/21	Ppn of Acyl Halides, Anhydrides, & Esters / The Fischer Esterification	19-8, 19-9
W 2/23	Ppn of Amides, Alcohols, $\alpha$ -Bromocarboxylic Acids / Hell-Volhard-Zelinsky Rxn	19-10 to 19-12
F 2/25	The Addition-Elimination Mechanism / Rxns of Acyl Halides	19-7, 20-1, 20-2
M 2/28	Rxns of Anhydrides & Esters	20-3, 20-4
W 3/2	More Rxns of Esters	20-4
Th 3/3	<i>Exam II – 7 pm, RBH 109 – covering material until 3/2 – NO CLASS 3/4 – spring break</i>	
M 3/21	Rxns of Amides & Nitriles / The Hofmann Rearrangement	20-6 to 20-8
<b>BIOLOGICAL &amp; SYNTHETIC POLYMERS</b>		
W 3/23	Nomenclature, Structure, & Acid-Base Properties of Amino Acids	26-1
F 3/25	Isoelectric Point & Separation of Amino Acids	26-1, 26-5
M 3/28	Syntheses & Resolution of Amino Acids	26-2, 26-3
W 3/30	Primary Structure & Sequencing of Polypeptides/Proteins	26-4, 26-5
F 4/1	Peptide & DNA Synthesis	26-6, 26-7, 26-11
M 4/4	Nomenclature, Structure, & Conformation of Monosaccharides	24-1, 24-2
W 4/6	Rxns of the “Cyclic Form” of Monosaccharides / Di- & Polysaccharides	24-8, 24-11, 24-12
F 4/8	Alkene polymerization & polymer nomenclature	12-14, 12-15
M 4/11	Addition, condensation & ring-opening polymerizations	
W 4/13	Polymer architectures & properties – linear, branched, dendritic, cross-linked, etc	14-10
Th 4/14	<i>Exam III – 7 pm, RBH 109 – covering material until 4/13 – NO CLASS 4/15</i>	
<b>DIENES, AROMATICS, &amp; ALKYNES</b>		
M 4/18	Stability of Dienes / The Diels-Alder Rxn	14-5, 14-8
W 4/20	Structure, Resonance Energy, & Nomenclature of Benzenes	15-1, 15-2, 15-5
F 4/22	Aromaticity	15-7, 15-8
M 4/25	Electrophilic Aromatic Substitution: Halogenation, Nitration, & Sulfonation	15-9 to 15-11
W 4/27	Electrophilic Aromatic Substitution: The Friedel-Crafts Rxns	15-12 to 15-14
F 4/29	Electrophilic Attack on Substituted Benzenes: Control of Regioselectivity	16-1 to 16-3
M 5/2	Electrophilic Attack on Disubstituted Benzenes / Dissolving-Metal Reductions	16-4, 16-5
W 5/4	Synthetic Strategies / Electrophilic Attack on Naphthalene & its Derivatives	16-5, 16-6

Reactions will often occur at the most acidic/basic site on a molecule. Therefore it is important to be able to identify the relative acidities of molecules. The following table, taken from V & S, should help you with this task.

**TABLE 2-2** Relative Strengths of Common Acids (25 °C)

Acid	$K_a$	$pK_a$
Hydrogen iodide, HI (strongest acid)	$1.6 \times 10^5$	-5.2
Sulfuric acid, $H_2SO_4$	$1.0 \times 10^5$	-5.0 <sup>a</sup>
Hydrogen bromide, HBr	$5.0 \times 10^4$	-4.7
Hydrogen chloride, HCl	160	-2.2
Hydronium ion, $H_3O^+$	50	-1.7
Nitric acid, $HNO_3$	25	-1.4
Methanesulfonic acid, $CH_3SO_3H$	16	-1.2
Hydrogen fluoride, HF	$6.3 \times 10^{-4}$	3.2
Acetic acid, $CH_3COOH$	$2.0 \times 10^{-5}$	4.7
Hydrogen cyanide, HCN	$6.3 \times 10^{-10}$	9.2
Ammonium ion, $NH_4^+$	$5.7 \times 10^{-10}$	9.3
Methanethiol, $CH_3SH$	$1.0 \times 10^{-10}$	10.0
Methanol, $CH_3OH$	$3.2 \times 10^{-16}$	15.5
Water, $H_2O$	$2.0 \times 10^{-16}$	15.7
Ammonia, $NH_3$	$1.0 \times 10^{-35}$	35
Methane, $CH_4$ (weakest acid)	$\sim 1.0 \times 10^{-50}$	$\sim 50$

Note:  $K_a = [H_3O^+][A^-]/[HA]$  mol L<sup>-1</sup>.  
<sup>a</sup>First dissociation equilibrium.

The point on transforming  $K_a$  to  $pK_a$  is to make it more like pH. In fact since  $K = \text{products/reactants}$ , in this case  $[H_3O^+][A^-]/[HA]$ , under certain conditions ( $[A^-] = [HA]$ ),  $pH = pK_a$ ! **Therefore if you can remember that lower pH is more acidic, you can remember that a lower  $pK_a$  indicates a stronger acid.**