



John McMurry

Organic Chemistry

eighth edition



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Periodic Table of the Elements

Key

79	Au	Gold	196.9665
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An element

Metals
 Semimetals
 Nonmetals

Atomic number
 Symbol
 Name
 Atomic mass

Group number,
U.S. system
IUPAC system

1A
1
H
Hydrogen
1.0079

	1A 1	2A (2)	3A (13)	4A (14)	5A (15)	6A (16)	7A (17)	8A (18)
2	He Helium 4.0026							
3	Li Lithium 6.941							
4	Be Beryllium 9.0122							
5	B Boron 10.811							
6	C Carbon 12.011							
7	N Nitrogen 14.0067							
8	O Oxygen 15.9994							
9	F Fluorine 18.9984							
10	Ne Neon 20.1797							
11	Na Sodium 22.9898							
12	Mg Magnesium 24.3050							
13	Al Aluminum 26.9815							
14	Si Silicon 28.0855							
15	P Phosphorus 30.9738							
16	S Sulfur 32.066							
17	Cl Chlorine 35.4527							
18	Ar Argon 39.948							
19	K Potassium 39.0983							
20	Ca Calcium 40.078							
21	Sc Scandium 44.9559							
22	Ti Titanium 47.88							
23	V Vanadium 50.9415							
24	Cr Chromium 51.9961							
25	Mn Manganese 54.9380							
26	Fe Iron 55.847							
27	Co Cobalt 58.9332							
28	Ni Nickel 58.693							
29	Cu Copper 63.546							
30	Zn Zinc 65.39							
31	Ga Gallium 69.723							
32	Ge Germanium 72.61							
33	As Arsenic 74.9216							
34	Se Selenium 78.96							
35	Br Bromine 79.904							
36	Kr Krypton 83.80							
37	Rb Rubidium 85.4678							
38	Sr Strontium 87.62							
39	Y Yttrium 88.9059							
40	Zr Zirconium 91.224							
41	Nb Niobium 92.9064							
42	Mo Molybdenum 95.94							
43	Tc Technetium (98)							
44	Ru Ruthenium 101.07							
45	Rh Rhodium 102.9055							
46	Pd Palladium 106.42							
47	Ag Silver 107.8682							
48	Cd Cadmium 112.411							
49	In Indium 114.82							
50	Sn Tin 118.710							
51	Sb Antimony 121.757							
52	Te Tellurium 127.60							
53	I Iodine 126.9045							
54	Xe Xenon 131.29							
55	Cs Cesium 132.9054							
56	Ba Barium 137.327							
57	La Lanthanum 138.905							
58	Ce Cerium 140.115							
59	Pr Praseodymium 140.9076							
60	Nd Neodymium 144.24							
61	Pm Promethium (145)							
62	Sm Samarium 150.36							
63	Eu Europium 151.965							
64	Gd Gadolinium 157.25							
65	Tb Terbium 158.9253							
66	Dy Dysprosium 162.50							
67	Ho Holmium 164.9303							
68	Er Erbium 167.26							
69	Tm Thulium 168.9342							
70	Yb Ytterbium 173.04							
71	Lu Lutetium 174.967							
72	Hf Hafnium 178.49							
73	Ta Tantalum 180.9479							
74	W Tungsten 183.85							
75	Re Rhenium 186.207							
76	Os Osmium 190.2							
77	Ir Iridium 192.22							
78	Pt Platinum 195.08							
79	Au Gold 196.9665							
80	Hg Mercury 200.59							
81	Tl Thallium 204.3883							
82	Pb Lead 207.2							
83	Bi Bismuth 208.9804							
84	Po Polonium (209)							
85	At Astatine (210)							
86	Rn Radon (222)							
87	Fr Francium (223)							
88	Ra Radium 226.0254							
89	Ac Actinium (227)							
90	Th Thorium 232.0381							
91	Pa Protactinium 231.0369							
92	U Uranium 238.0289							
93	Np Neptunium (237)							
94	Pu Plutonium (244)							
95	Am Americium (243)							
96	Cm Curium (247)							
97	Bk Berkelium (247)							
98	Cf Californium (251)							
99	Es Einsteinium (252)							
100	Fm Fermium (257)							
101	Md Mendelevium (258)							
102	No Nobelium (259)							

6	57	La Lanthanum 138.905	58	Ce Cerium 140.115	59	Pr Praseodymium 140.9076	60	Nd Neodymium 144.24	61	Pm Promethium (145)	62	Sm Samarium 150.36	63	Eu Europium 151.965	64	Gd Gadolinium 157.25	65	Tb Terbium 158.9253	66	Dy Dysprosium 162.50	67	Ho Holmium 164.9303	68	Er Erbium 167.26	69	Tm Thulium 168.9342	70	Yb Ytterbium 173.04
7	89	Ac Actinium (227)	90	Th Thorium 232.0381	91	Pa Protactinium 231.0369	92	U Uranium 238.0289	93	Np Neptunium (237)	94	Pu Plutonium (244)	95	Am Americium (243)	96	Cm Curium (247)	97	Bk Berkelium (247)	98	Cf Californium (251)	99	Es Einsteinium (252)	100	Fm Fermium (257)	101	Md Mendelevium (258)	102	No Nobelium (259)

Lanthanides

Actinides

Numbers in parentheses
are mass numbers of
radioactive isotopes.

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The screenshot shows the OWL interface for a chemistry question. At the top, it says "OWL Question" and "Welcome Sample Student! Support Sign Out". The status bar shows "Status: 1 ? 2 ? 3 ?" and "12:44 PM". The question text reads: "You must answer 2 of 3 questions correctly in the SAME attempt at this Unit to receive credit for it. After answering the questions in this Unit, press **Unit Menu** to go to other Units in this Assignment or to redo this Unit." Below the text are tabs for "Chemical Formulas", "Scientific Notation", "Periodic Table", and "Tables". The question asks to "Examine the geometry of the molecule in the Jmol window. Use the geometry to determine the bond types." A 3D ball-and-stick model of a molecule is shown in a Jmol window. To the right of the model are instructions:

- Click gray Hewhite Oared
- Click and drag to rotate the molecule
- Double-click on an atom (look for +) and then move cursor over another one to get a distance (click off of the molecule to end)
- Double-click on an atom, click on a second and move cursor over a third to get the angle about the second atom (click off of the molecule to end)

 Below the model is a dropdown menu with the text: "Is the molecule shown a primary alcohol, a secondary alcohol, a tertiary alcohol, or not an alcohol." A "CHECK ANSWER" button is at the bottom. At the very bottom, it says "Learning Resources for Question: 22.4d SIM - Alcohols: Nomenclature (Assignment)".

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Organic Chemistry



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Organic Chemistry

John McMurry
Cornell University



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Preface

I love writing, and I love explaining organic chemistry. This book is now in its eighth edition, but I'm still going over every word and every explanation, updating a thousand small details and trying to improve everything. My aim is always to refine the features that made earlier editions so successful, while adding new ones.

- End-of-chapter problems are now grouped by topic so that students can focus on specific subjects.
- Figure references and cross-references are identified by color to better tie the text to nearby illustrations and to previous material.
- Many new problems at the ends of chapters have been added, with a particular emphasis on biologically related topics.
- Coverage of stereochemistry at tetrahedral centers has been moved forward to Chapter 5.

CHANGES AND ADDITIONS FOR THIS EIGHTH EDITION

Specific changes within individual chapters include:

- *Chapter 2—Polar Covalent Bonds; Acids and Bases.* A new end-of-chapter *A Deeper Look* dealing with dental anesthetics derived from cocaine has been added.
- *Chapter 5—Stereochemistry at Tetrahedral Centers.* This crucial topic, so important for understanding biological chemistry, has been moved forward from its previous position in Chapter 9 to give it more prominence.
- *Chapter 6—An Overview of Organic Reactions.* All bond-dissociation data have been updated, and the discussion of energy changes in multistep reactions has been enhanced.
- *Chapter 7—Alkenes: Structure and Reactivity.* A new end-of-chapter *A Deeper Look* dealing with bioprospecting and the hunt for biologically active natural products has been added.
- *Chapter 8—Alkenes: Reactions and Synthesis.* New Sections 8.12 and 8.13 dealing with the stereochemistry of addition reactions to chiral and achiral alkenes have been added.
- *Chapter 10—Organohalides.* A discussion of synthesizing alkyl fluorides from alcohols has been added to Section 10.5 to reflect the increasing importance of fluorinated compounds in pharmaceutical chemistry. Coverage of the palladium-catalyzed Suzuki–Miyaura coupling reaction has been added to Section 10.7.
- *Chapter 12—Structure Determination: Mass Spectrometry and Infrared Spectroscopy.* A new end-of-chapter *A Deeper Look* dealing with X-ray crystallography has been added.
- *Chapter 13—Structure Determination: Nuclear Magnetic Resonance Spectroscopy.* Integration of NMR spectra is presented in a digital format rather than in the outdated stair-step format.

- *Chapter 16—Chemistry of Benzene: Electrophilic Aromatic Substitution.* Coverage of aromatic fluorination has been added to Section 16.2 to reflect the increasing importance of fluorinated compounds in pharmaceutical chemistry.
- *Chapter 17—Alcohols and Phenols.* The standard method for oxidizing alcohols has been changed to using the Dess–Martin periodinane to reflect current laboratory practice.
- *Chapter 18—Ethers and Epoxides; Thiols and Sulfides.* Coverage of the Claisen rearrangement has been expanded, and a biological example of the reaction has been added in Section 18.4. Epoxide opening by amine nucleophiles has been added to Section 18.6.
- *Chapter 19—Aldehydes and Ketones: Nucleophilic Addition Reactions.* The Tollens' oxidation has been deleted, and the mechanism of the Wittig reaction has been updated.
- *Chapter 22—Carbonyl Alpha-Substitution Reactions.* A new end-of-chapter *A Deeper Look* dealing with barbiturates has been added.
- *Chapter 25—Biomolecules: Carbohydrates.* Section 25.11 on cell-surface carbohydrates has been changed to focus on influenza viruses such as avian flu and swine flu.
- *Chapter 28—Biomolecules: Nucleic Acids.* The chapter material has been extensively updated.
- *Chapter 29—The Organic Chemistry of Metabolic Pathways.* A new end-of-chapter *A Deeper Look* dealing with statin drugs has been added.
- *Chapter 31—Synthetic Polymers.* A new Section 31.5 on olefin metathesis polymerization has been added.

FEATURES



- The “Why This Chapter?” section is a short paragraph that appears at the end of the introduction to every chapter and tells students why the material about to be covered is important.
- Key Ideas are highlighted. These include topics pivotal to students' development in organic chemistry, such as Proposing a Mechanism for a Reaction and the Rules of Resonance. These Key Ideas are further reinforced in end-of-chapter problems marked with a ▲ icon.
- The Exercises are assignable in OWL for Organic Chemistry, an online homework assessment tool in which students can practice and test their knowledge.
- Each Worked Example includes a Strategy and a detailed Solution and is followed by problems for students to try on their own. This book has more than 1800 in-text and end-of-chapter problems.
- An overview chapter, *A Preview of Carbonyl Chemistry*, follows Chapter 18 and highlights the idea that studying organic chemistry requires both summarizing and looking ahead.
- The Visualizing Chemistry Problems that begin the exercises at the end of each chapter offer students an opportunity to see chemistry in a different way by visualizing molecules rather than by simply interpreting structural formulas.

- Applied essays called *A Deeper Look* complement the text and highlight applications to the chemistry. They include, “Where Do Drugs Come From?” in Chapter 6 and “Molecular Mechanics” in Chapter 4.
- Summaries and Key Word lists help students by outlining the key concepts of the chapter.
- Summaries of Reactions at the ends of appropriate chapters bring together the key reactions from the chapter in one complete list.

Ancillaries for Students and Instructors

Study Guide and Solutions Manual by Susan McMurry, provides answers and clear, step-by-step explanations to all in-text and end-of-chapter exercises. ISBN: 0-8400-5445-9

Companion Website has study tools, including a glossary and flashcards. Accessible from www.cengagebrain.com.

OWL for Organic Chemistry

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By Steve Hixson and Peter Lillya of the University of Massachusetts, Amherst, and William Vining of the State University of New York at Oneonta. End-of-chapter questions by David W. Brown, Florida Gulf Coast University. OWL Online Web Learning offers more assignable, gradable content (including end-of-chapter questions specific to this textbook) and more reliability and flexibility than any other system. OWL’s powerful course management tools allow instructors to control due dates, number of attempts, and whether students see answers or receive feedback on how to solve problems. OWL includes the **Cengage YouBook**, a Flash-based eBook that is interactive and customizable. It features a text edit tool that allows instructors to modify the textbook narrative as needed. With the Cengage YouBook, instructors can quickly re-order entire sections and chapters or hide any content they don’t teach to create an eBook that perfectly matches their syllabus. Instructors can further customize the Cengage YouBook by publishing web links. It also includes animated figures, video clips, highlighting, notes, and more.

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Understanding the Principles of Organic Chemistry: A Laboratory Course, by Pedersen and Myers. Class-tested by thousands of students and using simple equipment and green chemistry ideas, this laboratory manual includes 36 experiments that introduce traditional as well as recently developed synthetic methods. Offering up-to-date and novel experiments not found in other lab manuals, this innovative book focuses on safety, gives students practice in the basic techniques used in the organic lab, and includes microscale experiments, many drawn from the recent literature. ISBN: 1-111-42816-6

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