NINTH EDITION

ORGANIC CHEMISTRY

A SHORT COURSE

HART CRAINE HART

Organic Chemistry
A Short Course

NINTH EDITION

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Preface

Purpose

Several decades have passed since the first edition of this text was published. Although the content continues to change, our purpose in writing it remains much the same—to present as clearly as possible a brief introduction to modern organic chemistry.

This book was written for students who, for the most part, will not major in chemistry, but whose main interest—agriculture, biology, human or veterinary medicine, pharmacy, nursing, medical technology, health sciences, engineering, home economics, forestry, or whatever—requires some knowledge of organic chemistry. To maintain the interest of these students, we have made a special effort to illustrate the practical applications of organic chemistry to everyday life and to biological processes. The success of this approach is demonstrated by the widespread use of this text by hundreds of thousands of students here in the U.S. and worldwide, via numerous translations.

The text is designed for a one-semester introductory course, but it is easily adapted to other formats. It is often used in either a one- or two-quarter course. In some countries (France and Japan, for example) it is an introductory text for chemistry majors, followed by a longer and more detailed full-year text. And in a number of high schools, it is used as the text for a second-year course, following the usual introductory general chemistry.

Organization

The organization is fairly classical, with some exceptions. After an introductory chapter on bonding, isomerism, and an overview of the subject (Chapter 1), the next three chapters treat in sequence saturated, unsaturated, and aromatic hydrocarbons. The concept of reaction mechanism is presented early, and examples are included in virtually all subsequent chapters. Stereoisomerism is also introduced early, briefly in Chapters 2 and 3, and then given separate attention in a full chapter (Chapter 5). Halogen compounds are used in Chapter 6 as a vehicle for introducing aliphatic substitution and elimination mechanisms and dynamic stereochemistry.

Chapters 7 through 10 take up oxygen functionality in order of increasing oxidation state of carbon (alcohols and phenols, ethers, aldehydes and ketones, acids and their derivatives). Brief mention of sulfur analogs is made in these chapters. Chapter 11 deals with amines.

Chapters 2 through 11 treat all of the main functional groups and constitute the heart of the course. Chapter 12 then takes up spectroscopy, with an emphasis on NMR and applications to structure determination. It handles the student's question—how do you know that those molecules really have the structures you say they have?

Next come two chapters on topics not always treated in introductory texts but especially important in practical organic chemistry—Chapter 13 on heterocyclic compounds and Chapter 14 on polymers. The book ends with four chapters on biologically important substances—lipids, carbohydrates, amino acids and proteins, and nucleic acids.

"A Word About" Essays

Although relevant applications of organic chemistry are stressed throughout the text, short sections under the general rubric *A Word About* emphasize applications to other branches of science and to human life. These sections, which have been a popular feature, appear at appropriate places within the text rather than as isolated essays. Numbered and printed in special type, they stand out from the text so that instructors can easily require these sections or not, as desired. There are thirty-five of these essays, three new in this edition.

Examples and Problems

Problem solving is essential to learning organic chemistry. **Examples** (worked-out problems) appear at appropriate places within each chapter to help students develop these skills. These examples and their solutions are clearly marked. Unsolved **problems** that provide immediate learning reinforcement are included within each chapter and are supplemented with an abundance of end-of-chapter problems. The combined number of examples and problems is 925, or an average of more than 51 per chapter.

New in the Ninth Edition

The entire text was carefully revised to sharpen the writing and clarify difficult sections. In addition to many small changes, users of the previous edition will notice the following more substantial changes: (1) The footnote on arrow formalism in Chapter 1 has been upgraded to a section. (2) In response to reviewers' interest, two sections introducing the thermodynamics and kinetics of organic reactions have been added to Chapter 3. Reaction energy diagrams are introduced here and are used again in Chapter 6. (3) In Chapter 5 and throughout subsequent chapters, the terms "chiral center" and "asymmetric carbon atom" have been replaced with the currently accepted "stereogenic center" and "stereogenic carbon atom." (4) A *Reaction Summary* section, located before the end-of-chapter problems, is included in each chapter where new reactions are introduced. After each reaction type, a reference to the appropriate section of the text is provided. This summary collects new reactions in one easy-to-find location and will help students organize their study of new materials effectively.

Three new *A Word About* sections have been added in this edition, and three former sections of this type have been deleted. We hope that students and teachers alike will enjoy the following timely topics: C_{60}, an Aromatic Sphere: The Fullerenes; Degradable Polymers; and Bacterial Cell Walls, Enzyme Inhibitors, and Antibiotics. Please write to us with your comments.

We are very conscious of the need to keep the book to a manageable size for the one-semester course. Wherever possible, some old material has been deleted to make room for the new material that has been added. Users will find that this edition is nearly identical in length to the previous one.

Ancillaries

Two accompanying books are available to help the student in this course learn organic chemistry.

The **Study Guide and Solutions Book** contains answers to all text problems, a guide on how to reason out the answers, a summary of each chapter, a summary of the new reactions in each chapter, a list of learning objectives for each chapter, a summary of important reaction mechanisms, and sample test questions.

The **Laboratory Manual** contains experiments that have been time-tested with thousands of students. A substantial number of the preparative experiments contain procedures on both the **macro-** and the **microscale**, thus adding considerable flexibility for the instructor and the opportunity for both types of laboratory experience for the student. We have been careful to avoid hazardous chemicals on the OSHA list and to minimize contact with solvents, and so forth. The student and instructor are clearly warned whenever caution or special care is required, and thorough waste disposal instructions are consistently specified. The manual has tear-out, perforated report sheets convenient for student and instructor. It is also a convenient size for the nonmajor lab. Most experiments can be completed in the relatively short two- or three-hour lab period for nonmajors. The manual contains appendices giving atomic weights, other properties of common reagents, instructions for the teacher on how to make or obtain special reagents, and a list of chemicals and equipment required for each experiment that will simplify ordering and stocking the labs. Experiments are a good mix of techniques, preparations, tests, and applications.

An **Instructor's Resource Manual** and a set of transparencies and black line transparency masters are also available.

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One pleasure of authorship is receiving letters from students who have benefited from the book, and from their teachers. We thank here all who have written to us, from all parts of the world, since the last edition; we have incorporated many of their suggestions in this revision. We will be happy to hear from users and nonusers, faculty and students, with suggestions for further improvements.

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