

COLLEGE CHEMISTRY

With Qualitative Analysis

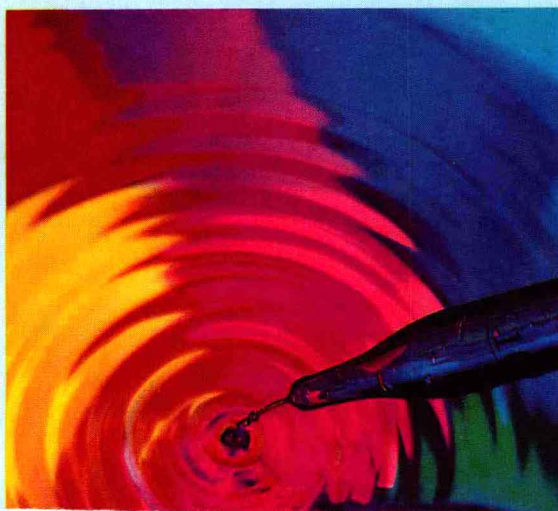
HOLTZCLAW ROBINSON

Eighth Edition

EIGHTH EDITION

College Chemistry

With Qualitative Analysis



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Preface

Chemistry is the study of the behavior of matter and of the models used to describe that behavior. Through words, photographs, diagrams, chemical equations, and mathematical equations, *College Chemistry, Eighth Edition*, introduces students to chemistry and teaches them to describe and predict chemical behavior both quantitatively and qualitatively. It offers the foundations that allow students not only to understand the chemistry presented but also to extend this understanding to new situations.

Chemistry is central to a description of the behavior of matter in many disciplines. However, we believe that it is essential that the concepts and models of the chemical behavior of the elements be presented clearly before they are applied to other systems in which additional considerations may mask the chemical principles involved. Thus we have paid careful attention to the introduction and development of chemical principles before extending them to different situations. This philosophy is also carried out in the exercises at the end of the chapters; many practice problems are provided in addition to more complicated or applied exercises.

This eighth edition of *College Chemistry* has evolved from a line of very successful general chemistry textbooks: Over one million general chemistry students have benefited from its previous editions. Two years of careful revision draw on our work with these earlier editions; our experience as teachers; the suggestions and ideas of our many users, colleagues, and collaborators; and the results of extensive market research. Throughout the revision process we have tried to make the text more interesting and readable. At the same time we have retained the clear discussion and concern for the student that has characterized the previous editions.

Important Learning Aids within the Text

This book provides several helpful tools to students and instructors.

- Over 250 examples proceed from simple, straightforward problems to those that are more complex. Many of these examples illustrate the relevance of chemistry to many other disciplines.
- Over 2100 exercises, many of which have multiple parts, are grouped by topic for easy location of problems of a particular type. Simple drill problems, with no distracting frills, help reinforce the introduction to a topic. Additional problems, including those that apply chemistry to a wide variety of other fields, will challenge the student.
- End-of-chapter material includes Summaries, which provide quick reviews of each chapter, and lists of Key Terms and Concepts. The references in Key Terms and Concepts identify the text section in which a concept is introduced.

- The glossary, a new addition to the text, enables students to review terms or look up unfamiliar terms.
- An extensive index of over 5500 entries allows the user to find topics easily. In addition, when the text introduces a new concept in terms of ideas developed earlier, there is a cross-reference to those earlier sections.

Changes in this Edition

- This edition is richly illustrated with many full color photographs and drawings selected for their pedagogical value. The art program shows chemical systems, illustrates techniques and equipment, demonstrates the behavior of chemical reactions, and elaborates on and reinforces concepts. The new photographs convincingly demonstrate that chemistry is not an isolated science.
- The text has been extensively revised. We have rewritten or replaced many chapters in order to streamline the presentation of topics and to combine similar ideas. This reorganization is particularly apparent in the chapters dealing with descriptive chemistry. We have also rewritten many sections to complement the accompanying photographs.
- The introduction to thermochemistry now appears in Chapter 4. (The more advanced concepts of thermodynamics have been left for later in the course.) With this early introduction, we can discuss energy-related topics such as ionization energy; electron affinity; lattice energy; and heats of fusion, sublimation, vaporization, and solution as specific examples of a more general concept rather than as individual, unrelated phenomena. For example, with the early coverage of thermochemistry, we can introduce bond energies as a logical component of the coverage of covalent bonding.
- The revised chapter, “Condensed Matter,” now emphasizes that many of the properties of solids and liquids can be described by similar models. For example, application of the kinetic-molecular theory explains the formation of both a liquid and solid by condensation of a gas as well as evaporation of both liquids and solids.
- The discussion of the dissolution of gases introduces the analytical form of Henry’s law.
- The separation of kinetics and the introduction to equilibrium into two chapters allows greater flexibility. We have added an expanded discussion of the solution of equilibrium problems by successive approximation and by use of the quadratic equation.
- The revised section on buffers more fully addresses the uses, selection, and function of this important class of chemical systems.
- Acid-base and solubility product chapters employ the revised value of K_2 for the ionization of H_2S .
- A clearer distinction is made between enthalpy, entropy, and free energy changes under standard state conditions and nonstandard state conditions.
- Combining the introduction to electrolysis of several solutions into a single section emphasizes the common aspects of the process.

Our Approach to Descriptive Chemistry

The descriptive chemistry of the elements has been extensively reorganized to present this material as concisely as possible without decreasing the overall descriptive chemistry content. It is presented in several segments that can be combined in a variety of ways.

- **Chapter 9 An introduction to general chemical behavior based on the Periodic Table.** This chapter introduces types of compounds (acids, bases, salts, electrolytes, and nonelectrolytes) and chemical reactions (addition, decomposition, acid-base, oxidation-reduction, etc.) as well as the general behavior of metals and nonmetals. It discusses prediction of reaction products based on the Periodic Table, oxidation numbers, and the activity series. This first chapter on descriptive chemistry reflects our philosophy that the basics of descriptive chemistry should not be strictly a matter of memorization.
- **Chapter 13 The chemistry of the active metals.** Chapter 13 describes the chemical behavior of aluminum and the active metals of Groups IA and IIA, elements that are strong reducing agents and that exhibit only one oxidation state in their (essentially ionic) compounds.
- **Chapter 16 A description and explanation of the behavior of acids and bases.** This chapter presents a qualitative description of these important classes of compounds.
- **Chapter 20 An introduction to the chemistry of the nonmetals.** Chapter 20 presents a general overview of the behavior of the nonmetals based on the similarity in their behaviors and the differences from the behavior of the active metals.
- **Chapters 22 and 23 The specifics of the behavior of the individual nonmetals.** These chapters provide the instructor with a selection of material that may be used to explore the behavior of specific nonmetals in greater detail.
- **Chapters 25, 27, and 28 The chemistry of the semi-metals, the transition metals, and the post-transition metals, respectively.** Again we discuss the general behavior common to each set of elements before examining individual elements. Thus the instructor is free to explore the behavior of these elements at varying levels. Chapter 27 includes new material on recent developments in superconductivity and its high-technology applications.
- **Chapter 29 The discussion of the atmosphere and natural waters.** The discussion of these systems has been incorporated into a single chapter that also deals with the challenges facing society.
- **Chapters 30 and 31 An introduction to organic and biochemistry.** A separate chapter is devoted to organic compounds. The biochemistry has been substantially revised and updated.

We are particularly proud of our revised qualitative analysis chapters. The qualitative analysis scheme is described in a new chapter that presents the chemistry involved in the separation and identification of the cations in the scheme and the principles upon which the scheme is based. This is followed by chapters with our well-tested qualitative analysis procedures to which we have added a useful and unique set of color photographs of the precipitates, solutions, and tests present in most steps of the scheme.

Supplements

The **Instructor's Guide** by Norman E. Griswold of Nebraska Wesleyan University provides instructors with chapter-by-chapter teaching aids for introductory chemistry course planning.

A **Study Guide**, also by Norman E. Griswold, is designed to strengthen students' knowledge of the facts and principles of chemistry. The *Study Guide* helps students to recognize important chemical concepts and understand how selected topics relate to each other. The *Study Guide* begins with a section about general study methods, including brief directions for solving problems and taking examinations. The main body of the *Guide* is divided into chapters that correspond to chapters in the text.

The supplements package also includes the **Solutions Guide** by John H. Meiser and Frederick K. Ault, both of Ball State University. This *Guide* consists of fully worked-out solutions to approximately half the problems from the text.

New to this edition is the **Complete Solutions Guide** by Norman E. Griswold, John H. Meiser, and Frederick K. Ault. This valuable supplement contains complete solutions to all text exercises, both numerical and discussion.

Basic Laboratory Studies in College Chemistry with Semimicro Qualitative Analysis by Grace R. Hered, City Colleges of Chicago, parallels the style and sequence of the material in *College Chemistry*. *Basic Laboratory Studies* can be used for a one- or two-semester course in either general chemistry and qualitative analysis or in chemistry for the health sciences. The manual emphasizes the use of descriptive chemistry and encourages students to think independently and sharpen their problem-solving skills in the lab. Bold red type is used effectively to reinforce caution and safety notes.

The **Instructor's Guide for Basic Laboratory Studies in College Chemistry**, also by Grace R. Hered, is a valuable new supplement featuring a wealth of resources for the laboratory instructor. Helpful suggestions for instructors include lists of possible chemicals and laboratory equipment, special notes for each lab exercise, answers to the prelab questions, and a list of locker supplies.

Two **Computerized Testing** programs are available to adopters in both Apple and IBM versions. *Heathtest* (licensed from ips Publishing, Inc.) is a powerful algorithmic testing program that enables instructors to produce multiple versions of chapter tests, mid-terms, and final exams quickly and easily. It has full graphics capability, enabling it to display a wide variety of structures, including Lewis structures, benzene rings, and carbon chains. *Archive* provides an extensive multiple choice program.

Printed **Test Item Files** for both *Heathtest* and *Archive* are also available. Three tests for each chapter are included in the *Heathtest Test Item File*. The entire data base is included in the *Archive Test Item File*.

By special arrangement with COMPress, Inc., a division of Wadsworth, Inc., D. C. Heath is able to offer adopters of *College Chemistry* a special discount on a variety of **software** programs.

New to this edition of the text is a collection of over 80 full-color **transparencies**, which are an excellent teaching aid. The transparencies have been taken from artwork in the text and have been carefully prepared to ensure clarity and ease of reading.

Also new to this edition are a set of **videotapes** prepared by Paul Kelter of the University of Wisconsin, Oshkosh. Fifty chemistry lecture demonstrations, chosen for their chemical significance and learning value, show real students interacting with their instructor as he performs a wide variety of interesting experiments. Designed to be both informative and motivational, the demonstrations consistently emphasize laboratory safety and depict the practical application of chemical principles.

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His research was in organometallic, organosilicon, and fluoride chemistry, and in inorganic phosphates and fluorides. He formulated the phosphate medium for Crest toothpaste that made the fluoride paste effective in dental caries control and held the patent on the toothpaste formula.

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