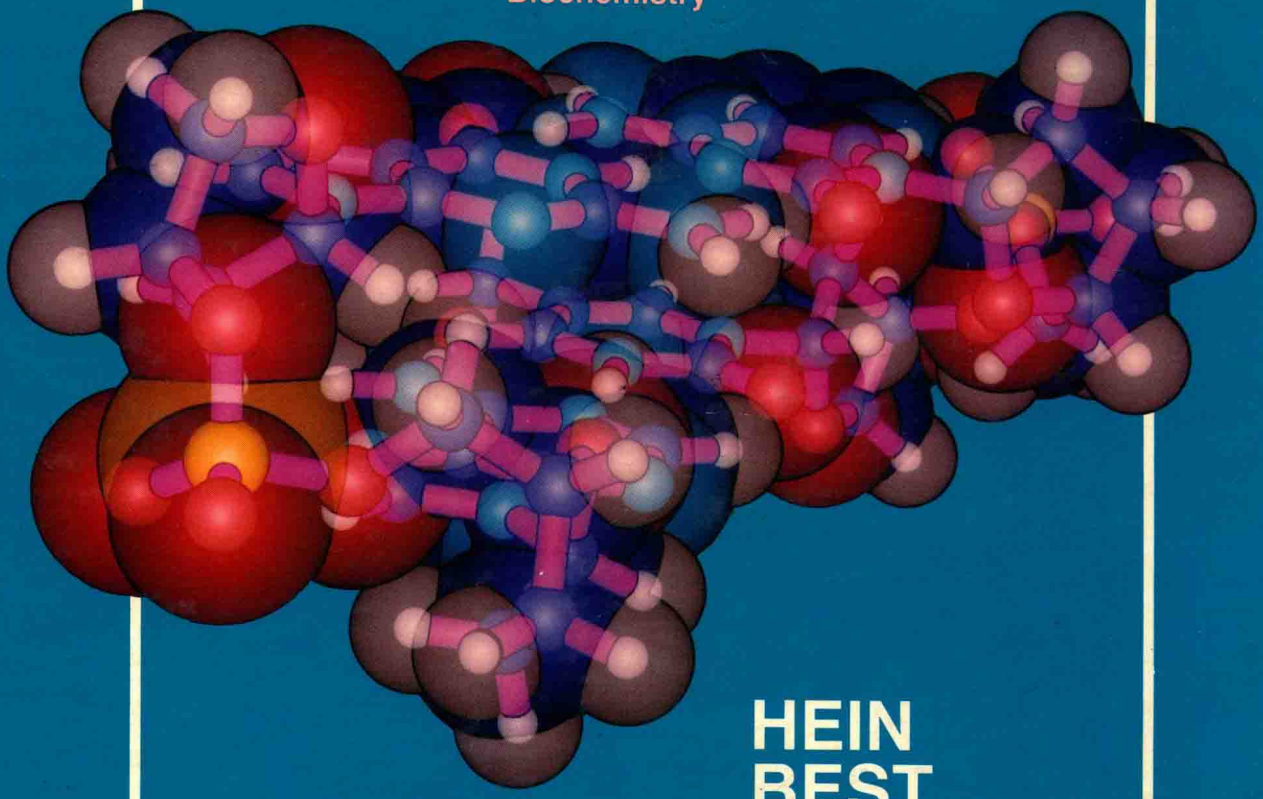
COLLEGE CHEMISTRY

An Introduction to General, Organic, and Biochemistry

FOURTH EDITION



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An Introduction to General, Organic, and Biochemistry

Fourth Edition

Morris Hein
Leo R. Best
Scott Pattison

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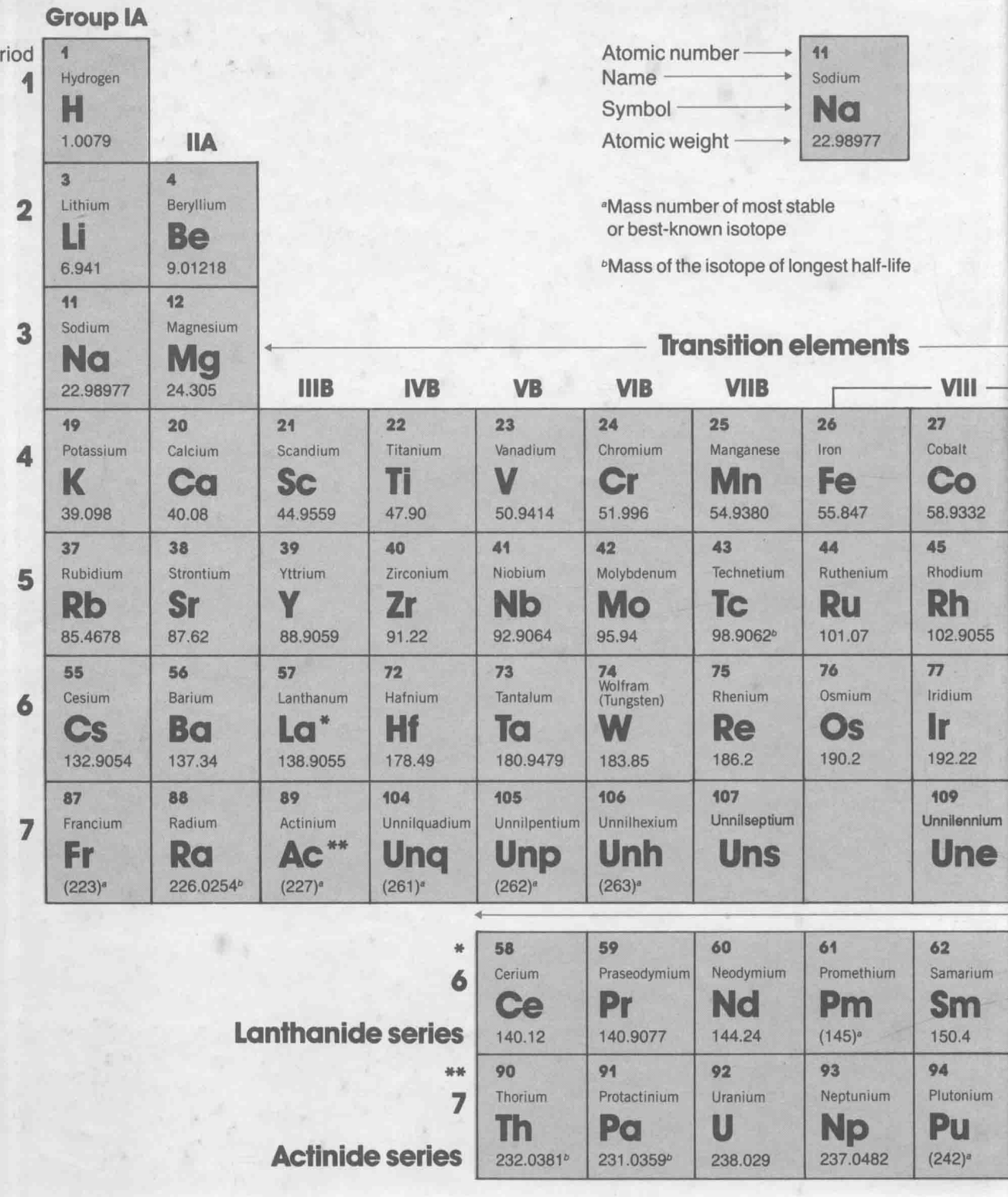
About the cover: The photo is a computer-generated image of two base pairs of DNA. One pair is represented by a ball-and-stick model; the other is a space-filling model. A CDC 7600 was used to calculate which spheres, balls, and sticks would be visible. A Sperry-UNIVAC V75 was used to color the visible regions. The images were superimposed by double exposing them in a Dicomed film recorder. Courtesy of Nelson Max, Lawrence Livermore National Laboratory.

Periodic Table of the Elements



Atomic weights are based on carbon-12. Atomic weights in parentheses indicate the most stable or best-known isotope. Slight disagreement exists as to the exact electronic configuration of several of the high-atomic-number elements.

Noble gases

			IIIA	IVA	VA	VIA	VIIA	2 Helium He 4.00260
			5 Boron B 10.81	6 Carbon C 12.011	7 Nitrogen N 14.0067	8 Oxygen O 15.9994	9 Fluorine F 18.99840	10 Neon Ne 20.179
			13 Aluminum Al 26.98154	14 Silicon Si 28.086	15 Phosphorus P 30.97376	16 Sulfur S 32.06	17 Chlorine Cl 35.453	18 Argon Ar 39.948
IB		IIB						
28 Nickel Ni 58.71	29 Copper Cu 63.546	30 Zinc Zn 65.38	31 Gallium Ga 69.72	32 Germanium Ge 72.59	33 Arsenic As 74.9216	34 Selenium Se 78.96	35 Bromine Br 79.904	36 Krypton Kr 83.80
46 Palladium Pd 106.4	47 Silver Ag 107.868	48 Cadmium Cd 112.40	49 Indium In 114.82	50 Tin Sn 118.69	51 Antimony Sb 121.75	52 Tellurium Te 127.60	53 Iodine I 126.9045	54 Xenon Xe 131.30
78 Platinum Pt 195.09	79 Gold Au 196.9665	80 Mercury Hg 200.59	81 Thallium Tl 204.37	82 Lead Pb 207.2	83 Bismuth Bi 208.9804	84 Polonium Po (210)[a]	85 Astatine At (210)[a]	86 Radon Rn (222)[a]

Inner transition elements

63 Europium Eu 151.96	64 Gadolinium Gd 157.25	65 Terbium Tb 158.9254	66 Dysprosium Dy 162.50	67 Holmium Ho 164.9304	68 Erbium Er 167.26	69 Thulium Tm 168.9342	70 Ytterbium Yb 173.04	71 Lutetium Lu 174.97
95 Americium Am (243)[a]	96 Curium Cm (247)[a]	97 Berkelium Bk (249)[a]	98 Californium Cf (251)[a]	99 Einsteinium Es (254)[a]	100 Fermium Fm (253)[a]	101 Mendelevium Md (256)[a]	102 Nobelium No (254)[a]	103 Lawrencium Lr (257)[a]

College Chemistry

An Introduction to General, Organic, and Biochemistry

Fourth Edition

To Edna, Louise, and Joan

Preface

As in the previous editions, the primary purpose of this edition of *College Chemistry* is to instruct students in the basic concepts of chemistry. This book is intended for students who, although not majoring in chemistry, require a basic course in the subject that includes an introduction to organic chemistry and biochemistry. The text is written with the assumption that the students have not taken a previous chemistry course.

Many students are somewhat apprehensive about beginning the study of chemistry. Accordingly, one of our major goals has been to present the subject in a well-organized and readily understandable fashion. Each chapter was written with this thought in mind: Is our language clear—will the student be able to understand this material?

A fair amount of quantitative reasoning is essential to the study of chemistry. Therefore, another major goal has been to provide careful, step-by-step explanations of the topics that require quantitative reasoning. These explanations are then illustrated by one or more problems. These example problems are generally set up and worked by the conversion-factor dimensional analysis approach. This approach has proven to be an effective tool and requires no mathematics beyond arithmetic and elementary algebra. From experience, however, we know that to develop sufficient skill in quantitative reasoning, most students need considerable practice in working numerical problems. Consequently, we have provided

many end-of-chapter problems. To save student time, an inexpensive electronic calculator is recommended for the calculations needed in these problems.

In preparation for this revision, a number of instructors who are actual or potential users of the text submitted detailed reviews and comments on the text. These colleagues provided many suggestions for changes both in content and arrangement; a number of changes in the present text were based on these helpful suggestions.

Learning Aids

The following features are intended to serve as learning aids and to make the text convenient to use—a book that students can read, understand, and study by themselves.

- A list of achievement goals is given at the beginning of each chapter as a guide to students.
- Important new terms are set in boldface type where they are defined in the text, and they are also printed in color in the margin.
- A detailed discussion of significant figures, rounding off numbers, scientific notation of numbers, and the use of dimensional analysis in calculations is given in Chapter 2. Appendix I contains a concise review of the mathematics pertinent to *College Chemistry.*
- Numerous questions and problems are given in separate groups at the end of each chapter. These questions are generally arranged in the order in which the topics are discussed. A few of the more challenging problems are marked with asterisks. Answers to all mathematical problems are given in Appendix V.
- All chapters have at least one self-evaluation question that contains a fairly large number of "correct" or "not correct" statements. Answers to these questions are given in Appendix V.
- The mole is used as a unifying chemical concept wherever possible.
- Material on inorganic nomenclature appears in several chapters, but for convenient reference the basic rules for naming inorganic compounds are brought together in Chapter 8.
- Examples relating to health topics are used extensively.

Supplementary Materials

Supplementary materials that accompany *College Chemistry* are a student study guide, a laboratory manual, and a solutions manual.

Major Changes and Additions

- The concepts of the mole and Avogadro's number have been moved from Chapter 5 to Chapter 9 where they complement the material on quantitative composition of compounds.
- The sections on oxidation numbers and oxidation number tables have been moved from the end of Chapter 7 (Chemical Bonds) to the beginning of Chapter 8 (Nomenclature).

- The biochemistry section, especially Chapters 30 through 34, has been revised extensively.
- A chapter, Chapter 19, on the chemistry of some selected metals and nonmetals has been added.
- Most of the end-of-chapter problems have been modified or are new.
- Both the joule and calorie are used as energy units, with emphasis on the joule.
- A more extensive discussion of enzymes has been added to Chapter 29.
- New material on viruses and genetic engineering has been introduced.
- The significance of processed foods, food additives, and dieting in relation to good nutrition is treated in more detail.
- A section on hydrolysis has been added to Chapter 16.
- Several pressure units are introduced in discussing the properties of gases, but emphasis is given to atmospheres and torrs in problems.
- A different method of balancing oxidation–reduction equations in alkaline solutions is given.
- Ionic bond is used in place of electrochemical bond.
- Much of the material on cell structure and function, formerly found in Chapter 30, has been integrated into Chapter 32, Bioenergetics.
- The use of K, L, M, . . . for atomic orbitals has been deleted.
- The periodic table most recently recommended by the American Chemical Society is shown in Appendix VI.

Acknowledgments

It is impossible to thank by name each of the many people who have been involved and helpful in making this revision of *College Chemistry*. We are grateful for the friendship and many helpful comments and suggestions from our colleagues and students who, over the years, have made this book possible. We appreciate the many helpful comments and suggestions made by the following reviewers of this manuscript: Robert Bruce Banks, *University of North Carolina, Greensboro;* Robert K. Boggess, *Radford University;* Edward J. Cowles, *University of Minnesota, Duluth;* David A. Darnall, *Shelby State Community College;* Karen E. Eichstadt, *Ohio University;* Edwin J. Gollier, *Virginia Military Institute;* John Pearsley, *Grossmont College;* and John K. Ruff, *University of Georgia.*

No textbook can be completed without the untiring effort of many professionals in publishing. Special thanks are due to Sue Ewing, Kath Minerva, Trisha Cain, Lisa Torri, and Flora Pomeroy of Brooks/Cole Publishing. All have contributed to making this edition.

Last, but certainly not least, we are grateful to our wives, Edna, Louise, and Joan, for their patience and understanding during this revision.

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