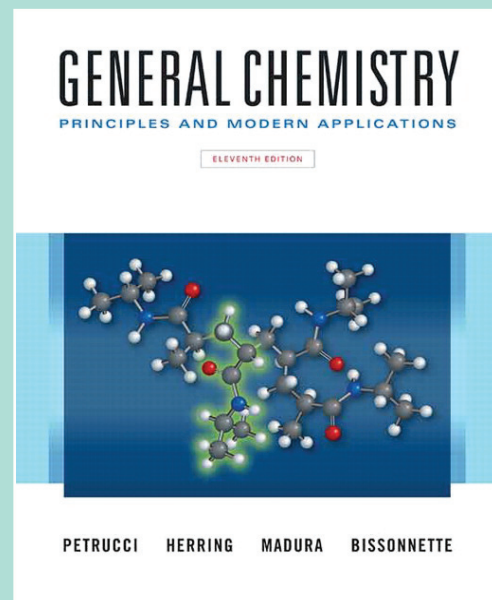




General Chemistry: Principles and Modern Applications, 11e

Ralph H. Petrucci, California State University, San Bernardino
F. Geoffrey Herring, University of British Columbia
Jeffrey D. Madura, Duquesne University
Carey Bissonnette, University of Waterloo



February 2016
©2017

Paper Bound
ISBN: 9780321971371

with MasteringChemistry
ISBN: 9780134097329

ModifiedMastering SACC
ISBN: 9780134193601

Loose Leaf Version
ISBN: 9780133897319

Petrucci General Chemistry: Principles and Modern Applications is written for the student that has already studied some chemistry. Students with no prior background and those who could use a refresher will find that the early chapters develop fundamental concepts from the most elementary ideas. Students who do plan to become professional chemists will also find opportunities in the text to pursue their own special interests.

Petrucci General Chemistry: Principles and Modern Applications, is recognized for its superior problems, lucid writing, precision of argument, and precise and detailed treatment of the subject. The 11th edition offers enhanced hallmark features, new innovations and revised discussions that that respond to key market needs for detailed and modern treatment of organic chemistry, embracing the power of visual learning and conquering the challenges of effective problem solving and assessment. In every explanation, illustration, and media resource for General Chemistry: Principles and Modern Applications, 11e students and instructors benefit from the care and craftsmanship of an extraordinarily talented and collaborative authorial team of active researchers who also share a wealth of experience from regularly teaching the General Chemistry course for majors as well as non-majors.

Personalize learning with MasteringChemistry

MasteringChemistry is an online homework, tutorial, and assessment program designed to work with this text to engage students and improve results. Interactive, self-paced tutorials provide individualized coaching to help students stay on track. With a wide range of activities available, students can actively learn, understand, and retain even the most difficult concepts. The pedagogical apparatus and overall approach in this edition continue to reflect contemporary thoughts on how best to teach general chemistry. We have retained the following key features of the text:

■ **Logical approach to solving problems.** All worked examples are presented consistently throughout the text by using a tripartite structure of Analyze-Solve-Assess. This presentation not only encourages students to use a logical approach in solving problems but also provides them with a way to start when they are trying to solve a problem that may seem, at first, impossibly difficult. The approach is used implicitly by those who have had plenty of practice solving problems; but for those who are just starting out, the Analyze-Solve-Assess structure will serve to remind students to (1) analyze the information and plan a strategy, (2) implement the strategy, and (3) check or assess their answer to ensure that it is a reasonable one.

■ **Integrative Practice Examples and End of Chapter Exercises.** Users of previous editions have given us very positive feedback about the quality of the integrative examples at the end of each chapter and the variety of the end-of-chapter exercises. We have added two practice examples (Practice Example A and Practice Example B) to every Integrative Example in the text. Rather than replace end-of-chapter exercises with new exercises, we have opted in most chapters to increase the number of exercises. In most chapters, at least 10 new exercises have been added; and in many chapters, 20 or more exercises have been added.

■ **Use of IUPAC recommendations.** Because communication among scientists in general, and chemists in particular, is made easier when we agree to use the same terms and notations, we have decided to follow—with relatively few exceptions—recommendations made by the International Union of Pure and Applied Chemistry (IUPAC). In particular, the version of the periodic table that now appears throughout the text is based on the one currently endorsed by IUPAC. The IUPAC-endorsed version places the elements lanthanum (La) and actinium (Ac) in the lanthanides and actinides series, respectively, rather than in group 3. Interestingly, almost every other chemistry book still uses the old version of the periodic table, even though the proper placement of La and Ac has been known for more than 20 years! An important change is the use of IUPAC-recommended symbols and units for thermodynamic quantities. For example, in this edition, standard enthalpies of reaction are represented by the symbol ΔH° (not ΔH) and are expressed in kJ mol^{-1} (not kJ).

Pedagogy

Exercises are organized by topic subheads and are presented in pairs. Answers to selected questions (i.e., those numbered in red) are given on the MasteringChemistry™ site (www.masteringchemistry.com).

■ **Integrative and Advanced Exercises** are more advanced than the preceding Exercises. They are not grouped by topic or type. They integrate material from sections of the chapter and sometimes from multiple chapters. In some instances, they introduce new ideas or pursue specific ideas further than is done in the chapter. Answers to selected questions (i.e., those numbered in red) are given on the MasteringChemistry™ site (www.masteringchemistry.com).

■ **Feature Problems** require the highest level of skill to solve. Some deal with classic experiments; some require students to interpret data or graphs; some suggest alternative techniques for problem solving; some are comprehensive in their scope; and some introduce new material. These problems are a resource that can be used in several ways: for discussion in class, for individually assigned homework, or for collaborative group work. Answers to selected questions (i.e., those numbered in red) are given on the MasteringChemistry™ site (www.masteringchemistry.com).

■ **Self-Assessment Exercises** are designed to help students review and prepare for some of the types of questions that often appear on quizzes and exams. Students can use these questions to decide whether they are ready to move on to the next chapter or first spend more time working with the concepts in the current chapter. Answers with explanations to selected questions (i.e., those numbered in red) are given on the MasteringChemistry™ site (www.masteringchemistry.com).

NEW!

■ **Content Reorganization to improve flow.** In this edition we retain the core organization of the previous edition with two notable exceptions. First, we have moved the chapter entitled Spontaneous Change: Entropy and Gibbs Energy forward in the text. It is now Chapter 13. By moving the introduction of entropy and Gibbs energy forward in the text, we are able to use these concepts in subsequent chapters. Second, we have moved the chapter on chemical kinetics to Chapter 20. Consequently, the discussion of chemical kinetics now appears after the chapters that rely on equilibrium and thermodynamic concepts.

■ **Adaptive Follow-Up.** Adaptive Follow-Up Assignments in MasteringChemistry are based on each student's past performance on their course work to date, including homework, tests, and quizzes. These provide additional coaching and targeted practice as needed, so students can master the material.

■ **Dynamic Study Module Topics** include key math skills, general chemistry skills such as nuclear chemistry, phases of matter, redox reactions, acids and bases, and organic and biochemistry skills.

■ **Learning Catalytics™** generates class discussion, guides your lecture, and promotes peer-to-peer learning with real-time analytics. MasteringChemistry with eText now provides Learning Catalytics—an interactive student response tool that uses students' smartphones, tablets, or laptops to engage them in more sophisticated tasks and thinking.

■ **End-of-Chapter questions.** 450 new End-of-Chapter questions will be added to the Mastering item library (approximately 50% of these will be algorithmic).

Table of Contents

1. Matter: Its Properties and Measurement
2. Atoms and the Atomic Theory
3. Chemical Compounds
4. Chemical Reactions
5. Introduction to Reactions in Aqueous Solutions
6. Gases
7. Thermochemistry
8. Electrons in Atoms
9. The Periodic Table and Some Atomic Properties
10. Chemical Bonding I: Basic Concepts
11. Chemical Bonding II: Valence Bond and Molecular Orbital Theories
12. Intermolecular Forces: Liquids and Solids
13. Spontaneous Change: Entropy and Gibbs Energy
14. Solutions and Their Physical Properties
15. Principles of Chemical Equilibrium
16. Acids and Bases
17. Additional Aspects of Acid–Base Equilibria
18. Solubility and Complex-Ion Equilibria
19. Electrochemistry
20. Chemical Kinetics
21. Chemistry of the Main-Group Elements I: Groups 1, 2, 13, and 14
22. Chemistry of the Main-Group Elements II: Groups 18, 17, 16, 15, and Hydrogen
23. The Transition Elements
24. Complex Ions and Coordination Compounds
25. Nuclear Chemistry
26. Structure of Organic Compounds
27. Reactions of Organic Compounds
- (Online) 28. Chemistry of the Living State

APPENDICES

- A Mathematical Operations
- B Some Basic Physical Concepts
- C SI Units
- D Data Tables
- E Concept Maps
- F Glossary
- G Answers to Practice Examples and Selected Exercises
- H Answers to Concept Assessment Questions