OPTIMIZING THE TEXT

The modern chemistry student's learning experience is changing dramatically. To address the changes that students face, a modern text partnered with a suite of robust electronic tools must continue to evolve. With each edition, students and instructors alike have been involved in refining this text. From one-on-one interviews, focus groups, and symposia, as well as extensive chapter reviews and class tests of the previous edition, we learned that everyone praises the pioneering molecular art, the stepwise problem-solving approach, the abundant mix of qualitative, quantitative, and applied end-of-chapter problems, and the rigorous *and* student-friendly coverage of mainstream topics.

Global Changes to Every Chapter

Our revision for this edition has gone further than ever to optimize the text. We completed the distillation of the text and the annotation of the illustrations so appreciated in the previous edition, and created an inviting, easy-to-follow page design. But, when professors *and* students were asked what they wanted most in a new edition, the answer inevitably cited more good problems, so that became a major focus. We are delighted to introduce the seventh edition of *Chemistry: The Molecular Nature of Matter and Change,* which takes several major steps closer to perfecting its content and approach.

Learning ideas through focused writing and content presentation. Once again, every discussion has been revised to optimize clarity, readability, and the conciseness and directness of the presentation. The use of additional subheads, numbered (and titled) paragraphs, and bulleted (and titled) lists that was introduced in the sixth edition has been completed in the seventh.

Applying ideas with an enhanced problem-solving approach. The much admired—and copied—four-part problem-solving format (plan, solution, check, follow-up) is still used throughout, in both data-based *and* molecular-scene *Sample Problems*. But, many changes make the seventh edition a problem-solving "powerhouse." Each sample problem now includes ***two*** *Follow-up Problems:* as professors requested, the first closely matches the worked-out problem, so the student gains confidence, while the second varies a bit to test comprehension. As always, a thoroughly worked-out *Brief Solution* for each follow-up problem appears at the end of the chapter (rather than providing just a numerical answer in a distant end-of-book appendix, as is typical). As students requested, for more practice, each sample problem now lists *Some Similar Problems* within the end-of-chapter problem set. Moreover, some remaining pedagogic gaps have been filled with 22 *new* sample problems: thus, the seventh edition has over 250 sample problems and over 500 follow-up problems.

Re-learning ideas with annotated illustrations. The innovative three-level figures and other art that raised the bar for molecular visualization in chemistry textbooks is still present. Many existing figures have been revised and several new ones added to create an even better teaching tool. And, continuing the innovation of last edition, wherever appropriate, figure legends have been turned into simple captions and their content into clarifying annotations within the figures themselves.

Easier studying with attractive and functional page design and layout. A more open layout with three-dimensional accents engages students by focusing attention on section heads, sample problems, tables, and other important features, while maintaining clean margins. The orderly presentation fosters easier viewing and studying and allows the intimate placement of figures and tables in relation to the discussion.

Mastering the content with abundant end-of-chapter problem sets. With the more open design for improved readability, traditional and molecular-scene problems updated and revised, and many new problems added, these problem sets are more extensive than in most other texts. They provide students and teachers with abundant choices in a wide range of difficulty and real-life scenarios.

Content Changes to Individual Chapters

The major revision that created this seventh edition of *Chemistry* included key improvements to nearly every chapter:

- **Chapter 1** has been rearranged so that units are now discussed *before* the problem-solving approach and unit conversions are introduced. The chapter includes a *new sample problem* on converting units raised to a power.
- **Chapter 2** now clarifies the meaning of mass fraction and introduces IUPAC's new recommendations on atomic-mass ranges. It presents the periodic table updated with the latest atomic masses and includes a *new sample problem* on identifying an element from its Z value.
- **Chapter 3** includes more information in its road maps, and road maps in later chapters also have these enhancements. Sample problems on calculating mass percent of an element and the mass of an element have been carefully revised. The section on calculations for reactions in solution has been moved to Chapter 4.
- **Chapter 4** introduces many types of reactions in solution, so it was thoroughly revised to, more logically, include the

material on molarity and solution stoichiometry previously in Chapter 3. The table on solubility rules was revised, and a new table focuses on the reactions of strong versus weak acids in strong base. *Two new sample problems* show how to determine the amount of ions in solution and the amounts of reactants and products in a precipitation reaction. And two sample problems from the last edition were combined to show the logical relation of their material. Balancing redox reactions by the oxidation-number method was deleted, but balancing them by the half-reaction method is covered in the electrochemistry chapter (Chapter 21).

- **Chapter 5** includes *two new sample problems* that apply various combinations of the individual gas laws, and it provides a derivation of Graham's law.
- **Chapter 6** includes *a new sample problem* on calculating *PV* work.
- **Chapter 7** incorporates carefully revised atomic and continuous spectra throughout.
- **Chapter 8** contains a new table on changes in Z_{eff} within the sublevels of an atom.
- **Chapter 9** includes *a new sample problem* on predicting relative lattice energy and a revised figure on the properties of the covalent bond.
- **Chapter 10** has pedagogic improvements to several figures and expanded coverage in two sample problems.
- **Chapter 12** includes *two new sample problems,* one on the use of phase diagrams to predict phase changes and the other on determining the number of particles in a unit cell and the coordination number.
- **Chapter 13** presents *a new sample problem* on calculating an aqueous ionic heat of solution.
- **Chapter 14** incorporates in its unique Family Portraits all the updated atomic masses and newly synthesized elements that fill out the periodic table.
- **Chapter 16** includes revisions to two important figures and *two new sample problems,* one on rate laws and the molecularity of elementary steps and the other on intermediates and the correlation of rate laws and mechanism.
- **Chapter 17** contains *a new sample problem* on writing a reaction quotient from the balanced equation, and two important figures have been revised.
- **Chapter 18** has undergone major improvements. It has *two new sample problems,* one on calculating hydronium and hydroxide ion concentrations in strong acids and bases and the other on finding the percent dissociation of a weak acid. Several summarizing tables were revised to display reactions, and a key figure was revised. Also, the discussion was rearranged to present the material on acids in a clearer sequence.
- **Chapter 19** incorporates improvements to several key figures, as well as a new figure that summarizes the effects of added acid or base to buffer-component concentration and pH.
- **Chapter 20** has clearer discussions of measuring the change in entropy and of free energy and work, as well as *a new sample problem* on the relationship between ΔG° and K.
- **Chapter 21** includes *a new sample problem* on using $E^\circ_{\text{half-cell}}$ to find E°_{cell}, as well as much clearer discussions of the activity series of the metals, the electrolysis of aqueous salts, and the stoichiometry of electrolysis.
- **Chapter 23** has improvements to many figures as well as *a new sample problem* on finding the coordination number and ion charge in a coordination compound.
- **Chapter 24** provides *a new sample problem* on calculating the specific activity and decay constant of a radionuclide.

Innovative Topic and Chapter Presentation

While the topic sequence coincides with that used in most mainstream courses, built-in flexibility allows a wide range of differing course structures:

For courses that follow their own topic sequence, the general presentation, with its many section and subsection breaks and bulleted lists, allows topics to be rearranged, or even deleted, with minimal loss of continuity.

For courses that present several chapters, or topics within chapters, in different orders:

- Redox balancing by the oxidation-number method (formerly covered in Chapter 4) has been removed from the text, and the half-reaction method is covered with electrochemistry in Chapter 21, but it can easily be taught with Chapter 4.
- Gases (Chapter 5) can be covered in sequence to explore the mathematical modeling of physical behavior or, with no loss of continuity, just before liquids and solids (Chapter 12) to show the effects of intermolecular forces on the three states of matter.

For courses that want an atoms-first approach for some of the material, Chapters 7 through 13 move smoothly from quantum theory (7) through electron configuration (8), bonding models (9), molecular shape (10), VB and MO bonding theories (11), intermolecular forces in liquids and solids (12), and solutions (13). Immediate applications of these concepts appear in the discussions of periodic patterns in main-group chemistry (Chapter 14) and in the survey of organic chemistry (Chapter 15). Some instructors have also brought forward the coverage of transition elements and coordination compounds (23) as further applications of bonding concepts. (Of course, Chapters 14, 15, and 23 can just as easily remain in their more traditional placement later in the course.)

For courses that want biological/medical applications, many chapters highlight these topics, including the role of intermolecular forces in biomolecular structure (12), the

chemistry of polysaccharides, proteins, and nucleic acids (including protein synthesis, DNA replication, and DNA sequencing) (15), as well as introductions to enzyme catalysis (16), biochemical pathways (17), and trace elements in protein function (23).

For courses that want engineering applications of physical chemistry topics, Chapters 16 through 21 cover kinetics (16), equilibrium in gases (17), acids and bases (18), and aqueous ionic systems (19) and entropy and free energy (20) as they apply to electrochemical systems (21), all in preparation for coverage of the elements in geochemical cycles, metallurgy, and industry in Chapter 22.

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