

Preface

The seventh edition of *Physics* is written for a one-year, transferable course in introductory physics. The emphasis on applications and the broad range of topics makes it suitable for students majoring in science and technology as well as for those majoring in biology, the health professions, and the environmental sciences. It may also be used for introductory courses in a variety of trade and industrial institutions, where the need is for an applied course that will not limit the future educational choices of such students. The mathematics, which has been reviewed extensively, assumes some familiarity with algebra, geometry, and trigonometry, but not calculus.

Physics began in earlier editions as an extensive project to address the need for a textbook that presents the fundamental concepts of physics in ways that can be understood and applied by students with a variety of backgrounds and preparation. The goal was to develop a textbook that is readable and easy to follow, but also one that provides a strong and rigorous preparation. The generous input from many dedicated users of the first six editions has helped to perpetuate that goal, and the work has received national recognition in the form of the prestigious McGuffey Award presented by the Text and Academic Authors Association (TAA) for excellence and longevity.

Three trends are significantly affecting modern instruction in college physics—the basic foundation for advanced study in almost any area:

1. Science and technology are growing exponentially.
2. Available jobs and career choices require more and more understanding of physics fundamentals.
3. The secondary-level preparation in math and science (for a variety of reasons) is not improving rapidly enough.

The focus of the seventh edition of *Physics* is to attack both ends of the problems caused by these trends. We provide the necessary mathematics background, and we do not compromise the educational outcomes.

Organization

The text consists of 39 chapters covering the entire spectrum of physics: *Mechanics*, *Thermal Physics*, *Wave Motion*, *Sound*, *Electricity*, *Magnetism*, *Light and Optics*, and *Atomic and Nuclear Physics*. This standard sequence can fit the requirements of a two-semester sequence or it can be used in a three-quarter program with a slight rearrangement of the topics. Shorter courses are also possible with a judicious selection of topics. Where possible, the coverage is designed so the order of topics can be changed.

There are a few areas where the coverage differs from that presented in most standard textbooks. A major distinction is the recognition that many students enter their first course in physics unable to apply basic skills in algebra and trigonometry. They have had the prerequisite courses, but for a variety of reasons seem unable to apply the concepts to solve problems. The dilemma is how to succeed with students without sacrificing standards. In *Physics*, we devote an entire chapter to a review of the mathematics and trigonometry required for solving physics problems. Other textbooks, if they provide such a review at all, usually do so in an appendix or ancillary product. Our approach enables students to recognize the *importance* of mathematics and to assess rather quickly their needs and deficiencies. It can easily be eliminated depending on the preparation of students or at the discretion of an individual instructor; however, it cannot be ignored as a critical requirement for problem solving.

Next, we address the need for meeting standards by covering statics before dynamics. Newton's first, second, and third laws are covered early to provide a qualitative understanding of force, but the full treatment of the second law is delayed until the concepts of free-body diagrams and static equilibrium are understood. This allows students to develop their understanding in a logical and continuous manner, while the skills in mathematics are slowly reinforced. In other books, the treatment of statics in later chapters often requires a review of forces and vectors. With the approach of this text, it is possible to provide more detailed examples of important applications of Newton's second law.

We also include a chapter on *Simple Machines* to give instructors the option of emphasizing many real world examples involving concepts of force, torque, work, energy, and efficiency. This chapter can easily be omitted if there are time constraints, but it has been very popular with some colleges where applications are paramount.

Modern Physics is treated as a survey course in the principles of *relativity*, *atomic physics*, and *nuclear physics*. Here the coverage is traditional and the topics have been selected in a way that helps students understand and apply the basic theories underlying many modern applications of atomic and nuclear physics.

New to the Seventh Edition

Content Changes

- **Treatment of Vectors.** The traditional component method of vector addition is emphasized, but an option that permits the use of unit vectors has been added.

- **Newton’s Second Law.** The relationship between acceleration and force is introduced earlier to provide a qualitative understanding of force, but the more detailed treatment continues after considerable practice with free-body diagrams.
- **Rotational Kinetic Energy.** A significant addition extends the treatment of rotation in conservation of energy problems by covering the problem of objects that are both translating and rotating.
- **Electromagnetic Waves.** A more extensive discussion of electromagnetic waves precedes the treatment of light and optics.
- **Examples.** New examples have been added and all have been reworked to simplify the discussion and to clarify the problem-solving process.
- The sections on electrochemistry and the chapter on electronics have been eliminated based on input from past users and reviewers.

Improved Art Program

- **Opening Chapter Photos.** An effort has been made to make physics more visual by including introductory photographs for each chapter with brief annotations. These pictures were carefully selected to demonstrate concepts and applications covered in each chapter.
- **Figures.** All of the figures have been revised and/or redrawn. In many cases, photo objects have been inserted to enhance the line art, and a more extensive use of color adds contrast for emphasis.

Planning Statements

A frequent comment from beginning students is “I just don’t know how to get started.” To address this concern we have

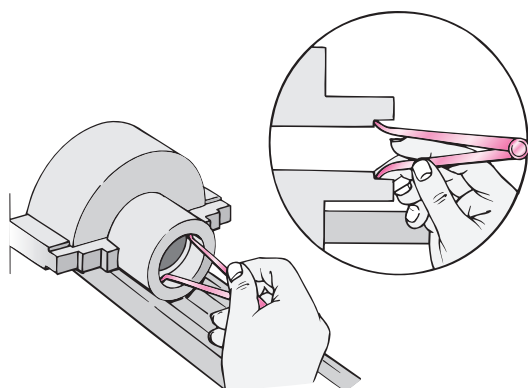


Figure 3.3 Using calipers to measure an inside diameter.

Example 7.1

Find the mass of a body whose weight on Earth is 100 N. If this mass were taken to a distant planet where $g = 2.0 \text{ m/s}^2$, what would be its weight on that planet?

► **Plan:** We first find the mass on Earth, where $g = 9.8 \text{ m/s}^2$. Since the mass is constant, we can use that same value to find the weight on the distant planet where $g = 2.0 \text{ m/s}^2$.

Solution:

$$m = \frac{W}{g} = \frac{100 \text{ N}}{9.8 \text{ m/s}^2} = 10.2 \text{ kg}$$

The weight on the planet is

$$W = mg = (10.2 \text{ kg})(2 \text{ m/s}^2); \quad W = 20.4 \text{ N}$$

included an extra step for many of the worked examples given in the text. The **Plan** statement bridges the gap between reading a problem and applying a learning strategy.

Everyday Physics Topics

Marginal notes are located throughout the text to generate interest and stimulate further study.

Online Learning Center www.mhhe.tippens.com

McGraw-Hill offers a wealth of online features and study aids that greatly enhance the physics teaching and learning experiences.

Digital Content Manager

This CD-ROM contains every illustration from the text. Instructors can use this artwork to create customized classroom presentations and other course tools.

Interactives

A total of 16 interactives are now available on the Digital Content Manager CD-ROM and online through the Online Learning Center. These interactives offer a fresh and dynamic method to teach and learn the physics basics by providing applets that are completely accurate and work with real data.

Retained Features

Several features retained from previous editions will capture and maintain the attention of students. These include:

Mathematics Preparation

Chapter 2 is devoted entirely to a review of the mathematics and trigonometry required for solving physics problems.

PHYSICS TODAY

Do you know how much time satellites have in the sunlight to charge their batteries? For low Earth orbit, they have 60 min of sunlight and 35 min of darkness. Geosynchronous Earth orbit (GEO) satellites, which are much farther out, spend less time in Earth’s shadow. They spend 22.8 hours in sunlight and 1.2 hours in darkness. The power to run the satellites must come entirely from batteries during the dark period.

Chapter Objectives

To address the problem of educational outcomes, each chapter begins with a clear statement of objectives. The student knows from the beginning which topics are important and what outcomes are expected.

Problem-Solving Strategies

Throughout the text, we have included highlighted sections detailing the step-by-step procedures for solving difficult physics problems. Students may use this as a guide until they become familiar with the reasoning processes needed to apply the fundamental concepts presented in the text. The strategies are reinforced through many examples in the text.

Informative Writing Style

A hallmark of previous editions and a continued factor in the seventh edition is the presentation of physics in a friendly and informative manner.

Use of Color

Color is used to highlight pedagogical features in the text. Examples, learning strategies, key equations are shaded, and contrast is given to the important portions of figures.

Text Examples

Throughout each chapter are numerous worked examples. These serve as models for students on how to use the

concepts covered in the text. Students learn to first visualize the situation, devise a plan for solving the problem, and then implement what they have learned to solve the problem.

End of Chapter Material

A carefully devised set of learning aids at the end of each chapter helps students review the chapter content, evaluate their grasp of key concepts, and utilize what they have learned.

- **Summaries.** A detailed summary is given for all of the essential concepts. Important equations are also highlighted in the text and summarized at the conclusion of each chapter.
- **Key Terms.** The key terms listed at the end of each chapter are highlighted in bold italic when they first appear in the text. These include all the main terms covered in the chapter so that students can verify their understanding of the concepts behind each term.
- **Review Questions.** More than 500 thought-provoking questions have been provided to stimulate thought and enhance conceptual thinking.
- **Problems and Additional Problems.** More than 1,750 carefully selected problems, ranging from simple, to moderate, to complex in difficulty are provided. In the seventh edition, considerable effort has been made to

The diagram illustrates the layout of the end-of-chapter material in a physics textbook. It shows a page with several distinct sections, each highlighted in a different color and labeled with arrows from the left and right margins:

- Summary and Review:** Located at the top of the page, highlighted in pink. A label "Summary and Review" points to it from the left.
- Summary:** A sub-section within the pink highlight, containing a brief overview of the chapter's content. A label "Summary" points to it from the left.
- Problems:** A large section containing various physics problems, highlighted in light blue. A label "Problems" points to it from the right.
- Key Terms:** A section listing important terms from the chapter, highlighted in light green. A label "Key Terms" points to it from the left.
- Review Questions:** A section of conceptual questions, highlighted in light orange. A label "Review Questions" points to it from the left.
- Additional Problems:** A section of more challenging problems, highlighted in light purple. A label "Additional Problems" points to it from the right.
- Critical Thinking Questions:** A section of questions designed to test deeper understanding, highlighted in light red. A label "Critical Thinking Questions" points to it from the right.

At the bottom of the page, there is a small section labeled "Chapter 9 Summary and Review" with a page number "192".

verify the accuracy of all problems and the answers given to the odd-numbered problems in the textbook. *Note:* Simple Problems do not have an asterisk next to them. Moderate Problems have one asterisk and complex problems have two asterisks.

- **Critical Thinking Questions.** Approximately 250 problems require moderate or greater thought than other problems in the text. They serve as learning examples that guide the students and build problem-solving skills. *Note:* Depending on the nature of the question, some answers are provided for the even-numbered questions and some for odd-numbered questions.

Supplements

Online Learning Center
www.mhhe.com/tippens

Student Online Resources include:

- **Study Questions.** True-false, multiple-choice, and completion questions are included.
- **Tutorials.** The author has prepared a comprehensive, web-based set of instructional PowerPoint modules for each chapter in the text. These tutorials are excellent for review prior to lectures, after lectures, before examinations, and before the final examination. They are also very useful to students who miss classes or who desire additional practice and discussion of physical concepts.
- **Interactives.** McGraw-Hill is proud to bring you an assortment of outstanding Interactive Applets like no other. These “Interactives” offer a fresh and dynamic method for teaching the physics basics by providing students with applets that are completely accurate

and work with real data. Interactives allow students to manipulate parameters and gain better understanding of 16 of the more difficult physics topics by watching the effect of these manipulations. Each Interactive includes an analysis tool (interactive model), a tutorial describing its function, and content describing its principle themes. Users can jump between these exercises and analysis tools with just the click of the mouse.

Instructor Online Resources include *all of the above*, plus:

- An Instructor’s Manual, which includes the solutions to all the end of chapter problems and notes for laboratory experiments.
- The Online Learning Center can be easily loaded into course management systems such as Blackboard, WebCT, eCollege, and PageOut.

Digital Content Manager

This CD-ROM contains every illustration, photograph, and table from the text, and 16 animations. The software makes customizing your multimedia presentation easy. You can organize figures in any order you want; add labels, lines, and your own artwork; integrate material from other sources; edit and annotate lecture notes; and have the option of placing your multimedia lecture into another presentation program such as PowerPoint.

Instructor’s Testing and Resource CD-ROM

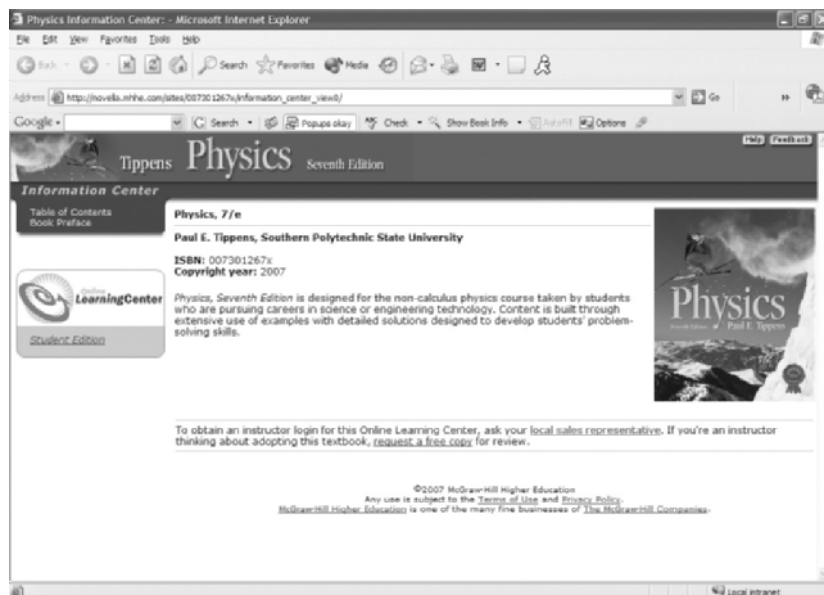
The accompanying electronic testing program is flexible and easy to use. The program allows instructors to create tests from book specific items. It accommodates a wide range of question types, and instructors may add their own questions. Multiple versions of the test can be created, and any test can be exported for use with course management systems such as WebCT, BlackBoard or PageOut. The program is available for Windows and Macintosh environments.

Instructor’s Manual

The Instructor’s Manual is found on the Tippens Online Learning Center and on the Instructor’s Testing and Resource CD, and can be accessed only by instructors.

Custom Publishing

Did you know that you can design your own text or laboratory manual using any McGraw-Hill text and your personal materials to create a custom product that correlates specifically to your syllabus and course goals? Contact your McGraw-Hill sales representative to learn more about this option.



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Reviewers of Previous Editions

The following reviewed previous editions of this book. Their comments and advice greatly improved the readability, accuracy, and currency of the book.

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