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国际著名物理图书 —— 影印版系列 1

Principles of Physics
(Third Edition)

物理学原理（上）
（第3版）

Serway & Jewett

清华大学出版社

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Some Fundamental Constants[a]

Quantity	Symbol	Value[b]
Atomic mass unit	u	$1.660\,540\,2(10) \times 10^{-27}$ kg 931.494 32(2 8) MeV/c^2
Avogadro's number	N_A	$6.022\,136\,7(36) \times 10^{23}$ particles/mol
Bohr magneton	$\mu_B = \frac{e\hbar}{2m_e}$	$9.274\,015\,4(31) \times 10^{-24}$ J/T
Bohr radius	$a_0 = \frac{\hbar^2}{m_e e^2 k_e}$	$5.291\,772\,49\,(24) \times 10^{-11}$ m
Boltzmann's constant	$k_B = R/N_A$	$1.380\,658\,(12) \times 10^{-23}$ J/K
Compton wavelength	$\lambda_C = \frac{h}{m_e c}$	$2.426\,310\,58(2\,2) \times 10^{-12}$ m
Coulomb constant	$k_e = \frac{1}{4\pi\epsilon_0}$	$8.987\,551\,787 \times 10^9$ N·m^2/C^2 (exact)
Deuteron mass	m_d	$3.343\,586\,0(20) \times 10^{-27}$ kg 2.013 553 214 (24) u
Electron mass	m_e	$9.109\,389\,7(54) \times 10^{-31}$ kg $5.485\,799\,03(1\,3) \times 10^{-4}$ u 0.510 999 06(1 5) MeV/c^2
Electron-volt	eV	$1.602\,177\,33(4\,9) \times 10^{-19}$ J
Elementary change	e	$1.602\,177\,33(4\,9) \times 10^{-19}$ C
Gas constant	R	8.314 510 (70) J/K·mol
Gravitational constant	G	$6.672\,59(8\,5) \times 10^{-11}$ N·m^2/kg^2
Hydrogen ground state energy	$E_1 = -\frac{e^2 k_e}{2a_0}$	−13.605 698 (40) eV
Josephson frequency–voltage ratio	$2e/h$	$4.835\,976\,7(14) \times 10^{14}$ Hz/V
Magnetic flux quantum	$\Phi_0 = \frac{h}{2e}$	$2.067\,834\,61(6\,1) \times 10^{-15}$ T·m^2
Neutron mass	m_n	$1.674\,928\,6(10) \times 10^{-27}$ kg 1.008 664 904 (14) u 939.565 63(2 8) MeV/c^2
Nuclear magneton	$\mu_n = \frac{e\hbar}{2m_p}$	$5.050\,786\,6(17) \times 10^{-27}$ J/T
Permeability of free space	μ_0	$4\pi \times 10^{-7}$ T·m/A (exact)
Permittivity of free space	$\epsilon_0 = 1/\mu_0 c^2$	$8.854\,187\,817 \times 10^{-12}$ C^2/N·m^2 (exact)
Planck's constant	h $\hbar = h/2\pi$	$6.626\,075\,(40) \times 10^{-34}$ J·s $1.054\,572\,66(6\,3) \times 10^{-34}$ J·s
Proton mass	m_p	$1.672\,623\,(10) \times 10^{-27}$ kg 1.007 276 470 (12) u 938.272 3(28) MeV/c^2
Rydberg constant	R_H	$1.097\,373\,153\,4(13) \times 10^7$ m^{-1}
Speed of light in vacuum	c	$2.997\,924\,58 \times 10^8$ m/s (exact)

[a] These constants are the values recommended in 1986 by CODATA, based on a least-squares adjustment of data from different measurements. For a more complete list, see E. R. Cohen and B. N. Taylor, *Rev. Mod. Phys.* 59:1121, 1987.

[b] The numbers in parentheses for the values above represent the uncertainties of the last two digits.

Solar System Data

Body	Mass (kg)	Mean Radius (m)	Period (s)	Distance from the Sun (m)
Mercury	3.18×10^{23}	2.43×10^{6}	7.60×10^{6}	5.79×10^{10}
Venus	4.88×10^{24}	6.06×10^{6}	1.94×10^{7}	1.08×10^{11}
Earth	5.98×10^{24}	6.37×10^{6}	3.156×10^{7}	1.496×10^{11}
Mars	6.42×10^{23}	3.37×10^{6}	5.94×10^{7}	2.28×10^{11}
Jupiter	1.90×10^{27}	6.99×10^{7}	3.74×10^{8}	7.78×10^{11}
Saturn	5.68×10^{26}	5.85×10^{7}	9.35×10^{8}	1.43×10^{12}
Uranus	8.68×10^{25}	2.33×10^{7}	2.64×10^{9}	2.87×10^{12}
Neptune	1.03×10^{26}	2.21×10^{7}	5.22×10^{9}	4.50×10^{12}
Pluto	$\approx 1.4 \times 10^{22}$	$\approx 1.5 \times 10^{6}$	7.82×10^{9}	5.91×10^{12}
Moon	7.36×10^{22}	1.74×10^{6}	—	—
Sun	1.991×10^{30}	6.96×10^{8}	—	—

Physical Data Often Used[a]

Average Earth–Moon distance	3.84×10^{8} m
Average Earth–Sun distance	1.496×10^{11} m
Average radius of the Earth	6.37×10^{6} m
Density of air (20°C and 1 atm)	1.20 kg/m^3
Density of water (20°C and 1 atm)	1.00×10^{3} kg/m^3
Free-fall acceleration	9.80 m/s^2
Mass of the Earth	5.98×10^{24} kg
Mass of the Moon	7.36×10^{22} kg
Mass of the Sun	1.99×10^{30} kg
Standard atmospheric pressure	1.013×10^{5} Pa

[a] These are the values of the constants as used in the text.

Some Prefixes for Powers of Ten

Power	Prefix	Abbreviation	Power	Prefix	Abbreviation
10^{-24}	yocto	y	10^{1}	deka	da
10^{-21}	zepto	z	10^{2}	hecto	h
10^{-18}	atto	a	10^{3}	kilo	k
10^{-15}	femto	f	10^{6}	mega	M
10^{-12}	pico	p	10^{9}	giga	G
10^{-9}	nano	n	10^{12}	tera	T
10^{-6}	micro	μ	10^{15}	peta	P
10^{-3}	milli	m	10^{18}	exa	E
10^{-2}	centi	c	10^{21}	zetta	Z
10^{-1}	deci	d	10^{24}	yotta	Y

Principles of Physics (Third Edition) A Calculus -Based Text

影 印 版 序

本书是一本在微积分基础上的大学物理教材。在选材方面，作者本着“少而精”的原则，和第2版对比，删去了交流电、光学仪器等内容，简化了刚体运动、热力学部分。对重点内容，如力学定律，特别是能量及其转化，电磁学基本定律都做了较详细的讲解。

本书比较贴近现代。最后几章系统扼要地介绍了量子物理、原子物理、核物理和粒子物理，甚至说到了核理论、M-理论，使学生接触到物理学的最前沿。除理论介绍外，还介绍了许多物理学的非常近代的应用，如空间技术、激光技术等。在讲述顺序上也做了些更动，如把氢原子的玻尔模型提前到了力学中的引力和行星运动一章，而相对论也提前到了紧接经典质点力学之后。

本书十分注意联系实际，在书中到处可见有关自然现象、科技应用（特别是现代技术）以及日常生活的实例。为了把物理原理和实际事例更自然更系统地结合起来，本书采用了美国物理学教改项目IUPP的“故事线”的设计，把全书内容组织到8个“实际背景（context）”中进行讲解。例如经典力学以“到火星去”为故事线，磁学以“磁悬浮列车”为故事线，热学以“全球变暖”为故事线，现代物理以“和宇宙联系”为故事线等。这种做法对激发学生学习兴趣并使其所获得的知识更系统化都有很大好处。

本书也注意对学生学习方法的指导。在序言之后，就写一段“致学生”，专门对学生提出如何学习物理以及如何使用本教材的建议。例题的讲解都比较详细。从特殊事例中提出一般的解题技巧。在很多例题之后还补出了“本例练习题”作为本例分析方法的应用或扩展。此外，还开辟了“想想物理”、“防止陷阱”、“快速测试”等小栏目，及时向学生提出问题以改进其学习过程，提高学习质量。

总体来讲，本书选材上注重基本，遍及现代；讲解上注意联系实际，突出应用；教学法上考虑得比较周全。全书行文通顺易读，词意准确，插图清晰美观。对我国教师和学生来说，是一本比较好的物理教学参考书，特此推荐影印出版。

张三慧
清华大学物理系
2003年8月

Dedication

IN MEMORY OF

John Vondeling

a dear friend and companion,
for his great wisdom and enthusiasm as a publisher,
and for his thoughtful guidance through the years

AND

Sally Kusch

a first-class project editor,
who worked so diligently on early versions of this
and other physics textbooks.

We shall miss them.

Preface

Principles of Physics is designed for a one-year introductory calculus-based physics course for engineering and science students and for premed students taking a rigorous physics course. This third edition contains many new pedagogical features—most notably, a contextual approach to enhance motivation, an increased emphasis on avoiding misconceptions, and a problem-solving strategy that uses a modeling approach. Based on comments from users of the second edition and reviewers' suggestions, a major effort was made to improve organization, clarity of presentation, precision of language, and accuracy throughout.

This project was conceived because of well-known problems in teaching the introductory calculus-based physics course. The course content (and hence the size of textbooks) continues to grow, while the number of contact hours with students has either dropped or remained unchanged. Furthermore, traditional one-year courses cover little if any 20th-century physics.

In preparing this textbook, we were motivated by the spreading interest in reforming this course, primarily through the efforts of the Introductory University Physics Project (IUPP) sponsored by the American Association of Physics Teachers and the American Institute of Physics. The primary goals and guidelines of this project are to

- Reduce course content following the "less may be more" theme;
- Incorporate contemporary physics naturally into the course;
- Organize the course in the context of one or more "story lines";
- Treat all students equitably.

Recognizing a need for a textbook that could meet these guidelines several years ago, we studied the various proposed IUPP models and the many reports from IUPP committees. Eventually, one of us (RAS) became actively involved in the review and planning of one specific model, initially developed at the U.S. Air Force Academy, entitled "A Particles Approach to Introductory Physics." Part of the summer of 1990 was spent at the Academy working with Colonel James Head and Lt. Col. Rolf Enger, the primary authors of the Particles model, and other members of that department. This most useful collaboration was the starting point of this project.

The coauthor (JWJ) became involved with the IUPP model called "Physics in Context," developed by John Rigden (American Institute of Physics), David Griffiths (Oregon State University), and Lawrence Coleman (University of Arkansas at Little Rock). This involvement led to the contextual overlay that is used in this book and described in detail later in the Preface.

The combined IUPP approach in this book has the following features:

- It is an evolutionary approach (rather than a revolutionary approach), which should meet the current demands of the physics community.

- It deletes many topics in classical physics (such as alternating current circuits and optical instruments) and places less emphasis on rigid body motion, optics, and thermodynamics.
- Some topics in 20th-century physics, such as special relativity, energy quantization, and the Bohr model of the hydrogen atom, are introduced early in the textbook.
- A deliberate attempt is made to show the unity of physics.
- As a motivational tool, the textbook connects physics principles to interesting social issues, natural phenomena, and technological advances.

OBJECTIVES

This introductory physics textbook has two main objectives: to provide the student with a clear and logical presentation of the basic concepts and principles of physics, and to strengthen an understanding of the concepts and principles through a broad range of interesting applications to the real world. To meet these objectives, we have emphasized sound physical arguments and problem-solving methodology. At the same time, we have attempted to motivate the student through practical examples that demonstrate the role of physics in other disciplines, including engineering, chemistry, and medicine.

CHANGES IN THE THIRD EDITION

A number of changes and improvements have been made in the third edition of this text. Many of these are in response to current trends in science education and to comments and suggestions provided by the reviewers of the manuscript and instructors using the first two editions. The following represent the major changes in the third edition:

Content While the overall content of the textbook is similar to that of the second edition, several changes were implemented. A global approach to energy and energy transfer is introduced in Chapter 6 and has been incorporated throughout the book. A discussion of molar specific heats of gases has been added to Chapter 17. Also in Chapter 17 the first law of thermodynamics is written in the form $\Delta E_{\text{int}} = Q + W$, rather than the common expression that appears in many physics textbooks, $\Delta E_{\text{int}} = Q - W$. This form follows naturally from the global approach to energy introduced in Chapter 6 and is consistent with the form of the law that most chemistry books use. The use of this form of the first law follows a recommendation made by a committee appointed by the American Physical Society. Finally, many sections have been streamlined, deleted, or combined with other sections to allow for a more balanced presentation.

Organization We have incorporated a "context overlay" scheme into the textbook, in response to the "Physics in Context" approach in the IUPP. This new feature adds interesting applications of the material covered in the third edition to real issues. We have developed this feature to be flexible, so that the instructor who does not wish to follow the contextual approach can simply ignore the additional contextual features without sacrificing complete coverage of the existing material. We feel, though, that the benefits students will gain from this approach will be many.

The context overlay organization divides the text into eight sections, or "Contexts," after Chapter 1, as follows:

Context Number	Context	Physics Topics	Chapters
1	Mission to Mars	Classical mechanics	2–11
2	Earthquakes	Vibrations and waves	12–14
3	Search for the *Titanic*	Fluids	15
4	Global Warming	Thermodynamics	16–18
5	Lightning	Electricity	19–21
6	Magnetic Levitation Vehicles	Magnetism	22–23
7	Lasers	Optics	24–27
8	The Cosmic Connection	Modern physics	28–31

Each Context begins with an introduction, leading to a "central question" that motivates study within the Context. The final section of each chapter is a "Context Connection," which discusses how the material in the chapter relates to the Context and the central question. The final chapter in each Context is followed by a "Context Conclusion." Each conclusion uses the principles learned in the context to respond fully to the central question. Each chapter, as well as the Context Conclusions, includes problems related to the context material.

Pitfall Prevention These new features are placed in the margins of the text and address common student misconceptions and situations in which students often follow unproductive paths. Over 200 Pitfall Preventions are provided to help students avoid common mistakes and misunderstandings.

Quick Quizzes Several Quick Quiz questions are included in each chapter to provide students opportunities to test their understanding of the physical concepts presented. The questions require students to make decisions on the basis of sound reasoning. Some of them help students overcome common misconceptions. Answers to all Quick Quiz questions are found at the end of each chapter.

Modeling A modeling approach, based on four types of models commonly used by physicists, is introduced to help students understand they are solving problems that approximate reality. They must then learn how to test the validity of the model. This approach also helps students see the unity in physics, as a large fraction of problems can be solved with a small number of models. A general problem-solving strategy using the modeling approach is introduced in Chapter 1.

Alternative Representations Emphasis is placed on alternative representations of the information, including mental, pictorial, graphical, tabular, and mathematical representations. Many problems are easier to solve if the information is presented in alternative ways, to reach the many different methods students use to learn.

Line-by-Line Revision The text has been carefully edited to improve clarity of presentation and precision of language. We hope that the result is a book both accurate and enjoyable to read.

Problems In an effort to improve clarity and quality, the end-of-chapter problems were substantially revised. Approximately 40% of the problems (about 575) are new to this edition, and most of these new problems are at the intermediate level (as identified by blue problem numbers). Many problems require students to make order-of-magnitude calculations. All problems have been carefully edited and reworded where necessary. Solutions to approximately 20% of the end-of-chapter problems are included in the *Student Solutions Manual and Study Guide.* Boxed numbers identify these problems. A smaller subset of solutions will be posted on the World Wide Web **(http://www.harcourtcollege.com/physics)** and will be accessible to students and instructors using *Principles of Physics.* The web icon

identifies these problems. See the next section for a complete description of other features of the problem set.

Web Notes Useful World Wide Web addresses are provided as marginal notes (indicated by a WEB icon) to encourage students to explore extensions of the material beyond what is covered in the text. In particular, the Contexts allow for rich opportunities for further explorations on the Web.

Biomedical Applications For biology and premed students, icons point the way to various practical and interesting applications of physical principles to biology and medicine.

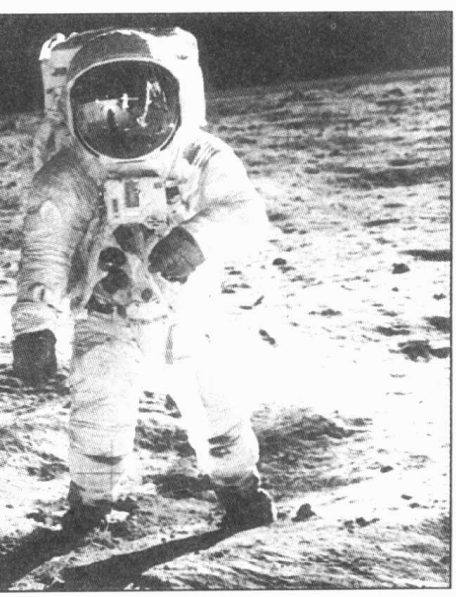
TEXT FEATURES

Most instructors would agree that the textbook selected for a course should be the student's primary guide for understanding and learning the subject matter. Furthermore, the textbook should be easily accessible as well as styled and written to facilitate instruction and learning. With these points in mind, we have included many pedagogical features that are intended to enhance the textbook's usefulness to both students and instructors. These features are as follows:

Style To facilitate rapid comprehension, we have attempted to write the book in a clear, logical, and engaging style. The somewhat informal and relaxed writing style is intended to increase reading enjoyment. New terms are carefully defined, and we have tried to avoid the use of jargon.

Previews Most chapters begin with a brief preview that includes a discussion of the particular chapter's objectives and content.

Important Statements and Equations Most important statements and definitions are set in boldface type or are highlighted with a background screen for added emphasis and ease of review. Similarly, important equations are highlighted with a tan background screen to facilitate location.



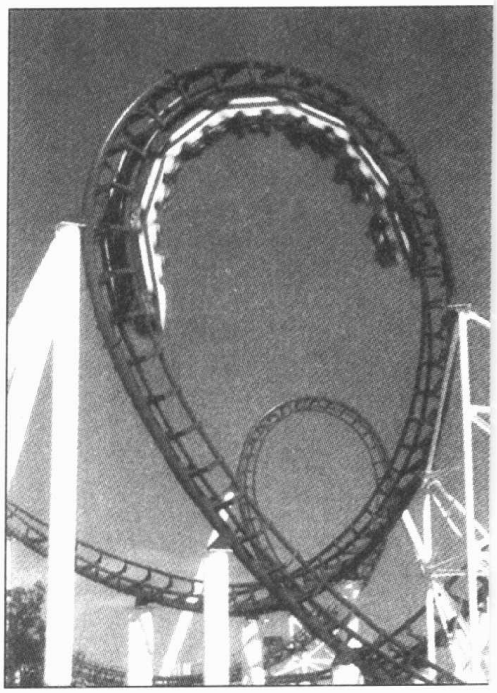
Problem-Solving Hints We have included general strategies for solving the types of problems featured both in the examples and in the end-of-chapter problems. This feature helps students identify necessary steps in solving problems and eliminate any uncertainty they might have. Problem-solving strategies are highlighted with a light blue-gray screen for emphasis and ease of location.

Marginal Notes Comments and notes appearing in the margin can be used to locate important statements, equations, and concepts in the text.

Illustrations and Tables The readability and effectiveness of the text material and worked examples are enhanced by the large number of figures, diagrams, photographs, and tables. Full color adds clarity to the artwork and makes illustrations as realistic as possible. For example, vectors are color coded, and curves in graphs are drawn in color. The three-dimensional appearance of many illustrations has been improved in this third edition. The color photographs have been carefully selected, and their accompanying captions have been written to serve as an added instructional tool.

Mathematical Level We have introduced calculus gradually, keeping in mind that students often take introductory courses in calculus and physics concurrently. Most steps are shown when basic equations are developed, and reference is often made to mathematical appendices at the end of the textbook. Vector products are discussed in detail later in the text, where they are needed in physical applications.

The dot product is introduced in Chapter 6, which addresses work and energy; the cross product is introduced in Chapter 10, which deals with rotational dynamics.



Worked Examples A large number of worked examples of varying difficulty are presented to promote students' understanding of concepts. In many cases, the examples serve as models for solving the end-of-chapter problems. Because of the increased emphasis on understanding physical concepts, many examples are conceptual in nature. The examples are set off in boxes, and the answers to examples with numerical solutions are highlighted with a tan screen.

Worked Example Exercises Many of the worked examples are followed immediately by exercises with answers. These exercises are intended to promote interactivity between the student and the textbook and to immediately reinforce the student's understanding of concepts and problem-solving techniques. The exercises represent extensions of the worked examples.

Questions Questions requiring verbal responses are provided at the end of each chapter. Over 500 questions are included in this edition. Some questions provide the student with a means of self-testing the concepts presented in the chapter. Others could serve as a basis for initiating classroom discussions. Answers to selected questions are included in the *Student Solutions Manual and Study Guide.*

Significant Figures Significant figures in both worked examples and end-of-chapter problems have been handled with care. Most numerical examples and problems are worked out to either two or three significant figures, depending on the accuracy of the data provided.

Problems The end-of-chapter problems are more numerous in this edition and more varied (in all, over 1 800 problems are given throughout the text). For the convenience of both the student and the instructor, about two thirds of the problems are keyed to specific sections of the chapter, including Context Connection sections. The remaining problems, labeled "Additional Problems," are not keyed to specific sections. An icon identifies problems dealing with applications to the life sciences and medicine. One or more problems in each chapter ask students to make an order-of-magnitude calculation based on their own estimated data. Other types of problems are described in more detail below. Answers to odd-numbered problems are provided at the end of the book.

Usually, the problems within a given section are presented so that the straightforward problems (those with black problem numbers) appear first; these straightforward problems are followed by those of increasing difficulty. For ease of identification, the numbers of intermediate-level problems are printed in blue, and those of challenging problems are printed in magenta.

Solutions to approximately 20% of the problems in each chapter are in the *Student Solutions Manual and Study Guide.* Among these, selected problems are identified with web icons and have their solutions posted on the World Wide Web at **http://www.harcourtcollege.com/physics.**

Review Problems Many chapters include review problems requiring the student to relate concepts covered in the chapter to those discussed in previous chapters. These problems could be used by students in preparing for tests and by instructors for special assignments and classroom discussions.

Paired Problems As an aid for students learning to solve problems symbolically, paired numerical and symbolic problems are included in Chapters 1 through 4 and 16 through 21. Paired problems are identified by a common tan background screen.

Computer- and Calculator-Based Problems Most chapters include one or more problems whose solution requires the use of a computer or graphing calculator. Modeling of physical phenomena enables students to obtain graphical representations of variables and to perform numerical analyses.

Units The international system of units (SI) is used throughout the text. The British engineering system of units (conventional system) is used only to a limited extent in the chapters on mechanics and thermodynamics.

Summaries Each chapter contains a summary that reviews the important concepts and equations discussed in that chapter.

Appendices and Endpapers Several appendices are provided at the end of the textbook. Most of the appendix material represents a review of mathematical concepts and techniques used in the text, including scientific notation, algebra, geometry, trigonometry, differential calculus, and integral calculus. Reference to these appendices is made throughout the text. Most mathematical review sections in the appendices include worked examples and exercises with answers. In addition to the mathematical reviews, the appendices contain tables of physical data, conversion factors, atomic masses, and the SI units of physical quantities, as well as a periodic table of the elements and a list of Nobel prize recipients. Other useful information, including fundamental constants and physical data, planetary data, a list of standard prefixes, mathematical symbols, the Greek alphabet, and standard abbreviations of units of measure, appears on the endpapers.

ANCILLARIES

The ancillary package has been updated substantially and streamlined in response to suggestions from users of the second edition. The most essential changes in the student package are a *Student Solutions Manual and Study Guide* with a tighter focus on problem-solving, the *Student Tools CD-ROM,* and the *Saunders Core Concepts in Physics CD-ROM* developed by Archipelago Productions. Instructors will find increased support for their teaching efforts with new electronic materials.

Student Ancillaries

Student Solutions Manual and Study Guide by John R. Gordon, Ralph McGrew, and Raymond A. Serway. This two-volume manual features detailed solutions to approximately 20% of the end-of-chapter problems from the textbook. Boxed numbers identify those problems in the textbook whose complete solutions are found in the manual. The manual also features a list of important equations and concepts, as well as answers to selected end-of-chapter questions.

Student Tools CD-ROM This CD-ROM contains tools designed to enhance the learning of physical concepts and train students to become better problem-solvers. It includes a textbook version of the highly acclaimed Interactive Physics™ software by MSC Working Knowledge, more than 100 Interactive Physics™ simulations keyed to appropriate worked examples and selected end-of-chapter problems (as identified by the icon), and support for working those end-of-chapter problems that require the use of computers.

Saunders Core Concepts in Physics CD-ROM This CD-ROM package developed by Archipelago Productions applies the power of multimedia to the introductory physics course, offering full-motion animation and video, engaging interactive graphics, clear and concise text, and guiding narration. *Saunders Core Concepts in Physics CD-ROM* focuses on those concepts students usually find most difficult in

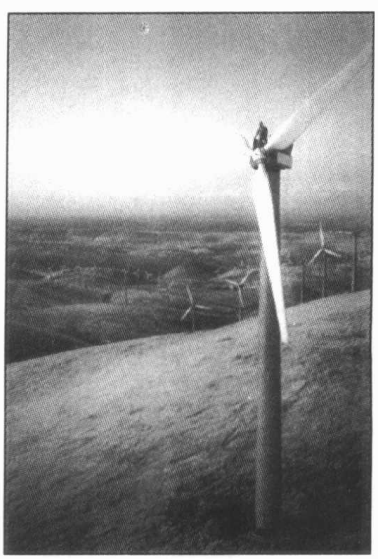
the course, drawing from topics in mechanics, thermodynamics, electric fields, magnetic fields, and optics. The animations and graphics are presented to aid the student in developing accurate conceptual models of difficult topics—topics often too complex to be explained in words or chalkboard illustrations. The CD-ROM also presents step-by-step explorations of problem-solving strategies and provides animations of problems in order to promote conceptual understanding and sharpen problem-solving skills. Textbook topics further explored on the CD-ROM are identified by marginal icons that give the appropriate module and screen number(s). Students should look to the CD-ROM for help in understanding these topics.

Student Web Site Students will have access to an abundance of material at **http://www.harcourtcollege.com/physics.** The Web Site features special topic essays by guest authors, practice problems with answers, and optional topics that accompany selected chapters of the textbook. Also included are selected solutions from the *Student Solutions Manual and Study Guide* and a glossary that includes more than 300 physics terms. Students also can take practice quizzes in our Practice Exercises and Testing area.

Physics Laboratory Manual, Second Edition by David Loyd. Updated and redesigned, this manual supplements the learning of basic physical principles while introducing laboratory procedures and equipment. Each chapter includes a prelaboratory assignment, objectives, an equipment list, the theory behind the experiment, step-by-step experimental procedures, and questions. A laboratory report form is provided for each experiment so that students can record data and make calculations. Students are encouraged to apply statistical analysis to their data so they can develop the ability to judge the validity of their results.

So You Want to Learn Physics: A Preparatory Course with Calculus by Rodney Cole. This introductory-level book is useful to those students who need additional mathematics preparation before or during a calculus-based course in physics. The friendly, straightforward style makes it easier to understand how mathematics is used in the context of physics.

Life Science Applications for Physics by Jerry Faughn. This supplement provides examples, readings, and problems from the biological sciences as they relate to physics. Topics include "Friction in Human Joints," "Physics of the Human Circulatory System," "Physics of the Nervous System," and "Ultrasound and Its Applications." This supplement is useful in those courses taken by a significant number of premed students.



Instructor's Ancillaries

Instructor's Manual with Solutions by Ralph McGrew, Jeffery Saul, and Charles Teague. This manual consists of complete, worked solutions to all the problems in the textbook. The solutions to problems new to the third edition are marked for easy identification by the instructor. New to this edition of the manual are suggestions on how to teach difficult topics and help students overcome common misconceptions. These suggestions are based on recent research in physics education.

Instructor's Web Site The instructor's area at **http://www.harcourtcollege.com/physics** includes a listing of overhead transparencies; a guide to relevant experiments in David Loyd's *Physics Laboratory Manual, Second Edition;* a correlation guide between sections in *Principles of Physics* and modules in the *Saunders Core Concepts in Physics CD-ROM;* supplemental problems with answers; optional topics to accompany selected chapters of the textbook; and a syllabus generator.

Instructor's Resource CD-ROM This CD-ROM accompanying the third edition of *Principles of Physics* has been created to provide instructors with an exciting new tool for classroom presentation. The CD-ROM contains a collection of graphics files of line art from the textbook. These files can be opened directly or can be imported into a variety of presentation packages. The labels for each piece of art have been enlarged and boldfaced to facilitate classroom viewing. The CD-ROM also contains electronic files of the *Instructor's Manual* and *Test Bank.*

Instructor Options for Online Homework

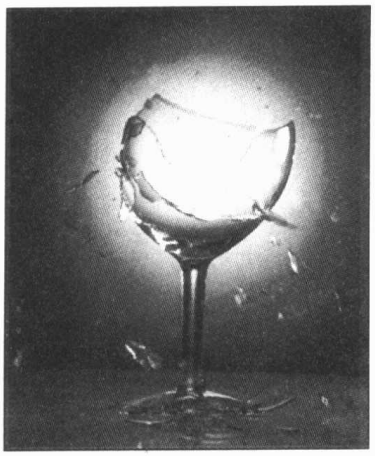
WebAssign: A Web-Based Homework System WebAssign is a Web-based homework delivery, collection, grading, and recording service developed at North Carolina State University. Instructors who sign up for WebAssign can assign frequent homework to their students, using questions and problems taken directly from *Principles of Physics.* WebAssign gives students immediate feedback on their homework and helps them to master information and skills, leading to greater competence and better grades. WebAssign can free instructors from the drudgery of grading homework and recording scores, allowing them to devote more time to meeting with students and preparing classroom presentations.

WebAssign is being used in scores of educational institutions by tens of thousands of students and hundreds of instructors. Most of the numerical problems that can be assigned have different values, so that each student has a unique problem to solve. This feature motivates independent thinking within the context of collaborative learning.

Details about and a demonstration of WebAssign are available at **http://wasnet01ws.physics.ncsu.edu/info/.** For more information about ordering this service, contact WebAssign at **webassign@ncsu.edu**

CAPA: A Computer-Assisted Personalized Approach CAPA is a network system for learning, teaching, assessment, and administration. It provides students with personalized problem sets, quizzes, and examinations consisting of qualitative conceptual problems and quantitative problems. CAPA was developed through a collaborative effort of the Physics–Astronomy, Computer Science, and Chemistry Departments at Michigan State University. Students are given instant feedback and relevant hints via the Internet and may correct errors without penalty before an assignment's due date. The system records each student's participation and performance on assignments, quizzes, and examinations; records are available online to both the individual student and his or her instructor. For more information, visit the CAPA Web site at: **http://capa4.lite.msu.edu/homepage/**

Homework Service With this service, instructors can reduce their grading workload by assigning thought-provoking homework problems using the World Wide Web. Instructors browse problem banks, select those they wish to assign to their students, and then let the Homework Service take over the delivery and grading. This system was developed and is maintained by Fred Moore at the University of Texas **(moore@physics.utexas.edu).** Students download their unique problems, submit their answers, and obtain immediate feedback; if students' answers are incorrect, they can resubmit them. This rapid grading feature facilitates effective learning. After the due date of their assignments, students can obtain the solutions to their problems. Minimal online connect time is required. The Homework Service uses algorithm-based problems: This means that each student solves sets of problems different from those given to other students. Details about and a demonstration of this service are available at **http://hw.ph.utexas.edu/hw.html**



Printed Test Bank by Edward Adelson. Contains approximately 2,000 multiple-choice questions. It is provided for the instructor who does not have access to a computer.

Computerized Test Bank Available in Windows™ and Macintosh® formats, the *Computerized Test Bank* contains more than 2,000 multiple-choice questions, representing every chapter of the text. The *Test Bank* enables the instructor to create many unique tests by allowing the editing of questions and the addition of new questions. The software program solves all problems and prints each answer on a separate grading key. All questions have been reviewed for accuracy.

Overhead Transparency Acetates This collection of transparencies consists of 200 full-color figures from the text and features large print for easy viewing in the classroom.

Instructor's Manual for Physics Laboratory Manual by David Loyd. Each chapter contains a discussion of the experiment, teaching hints, answers to selected questions, and a post-laboratory quiz with short-answer and essay questions. It also includes a list of the suppliers of scientific equipment and a summary of the equipment needed for each of the laboratory experiments in the manual.

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TEACHING OPTIONS

Although some topics found in traditional textbooks have been omitted from this textbook, instructors may find that the current text still contains more material than can be covered in a two-semester sequence. For this reason, we would like to offer the following suggestions. If you wish to place more emphasis on contemporary topics in physics, you should consider omitting parts or all of Chapters 15, 16, 17, 18, 24, 25, and 26. On the other hand, if you wish to follow a more traditional approach that places more emphasis on classical physics, you could omit Chapters 9, 11, 28, 29, 30, and 31. Either approach can be used without any loss in continuity. Other teaching options would fall somewhere between these two extremes by choosing to omit some or all of the following sections, which can be considered optional:

3.6	Relative Velocity
7.7	Energy Diagrams and Stability of Equilibrium
9.9	General Relativity
10.11	Rolling of Rigid Bodies
12.6	Damped Oscillations
12.7	Forced Oscillations
14.7	Nonsinusoidal Wave Patterns
15.8	Other Applications of Fluid Dynamics

16.6	Distribution of Molecular Speeds	20.10	Capacitors with Dielectrics
17.7	Molar Specific Heats of Ideal Gases	22.11	Magnetism in Matter
17.8	Adiabatic Processes for an Ideal Gas	26.5	Lens Aberrations
17.9	Molar Specific Heats and the Equipartition of Energy	27.9	Diffraction of X-Rays by Crystals
		28.13	Tunneling Through a Potential Energy Barrier

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