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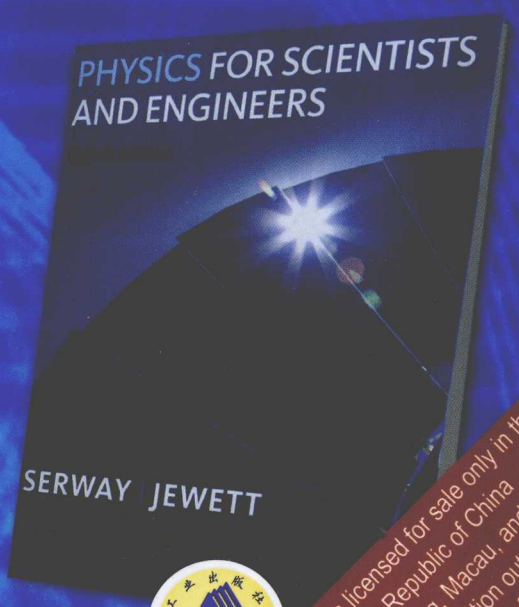
时代教育·国外高校优秀教材精选

理工科物理学

UNIVERSITY PHYSICS FOR SCIENTISTS AND ENGINEERS

(英文版·原书第8版)

(美) 朱厄特 (John W.Jewett,Jr.)
赛尔维 (Raymond A.Serway) 著



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机械工业出版社
CHINA MACHINE PRESS

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University Physics for Scientists and Engineers

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University Physics for Scientists and Engineers, 8e

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First China Reprint 2010
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图书在版编目（CIP）数据

理工科物理学：英文/（美）朱厄特（Jewett, J. W.），（美）赛尔维（Serway, R. A.）著. —影印本. —北京：机械工业出版社，2010.11
ISBN 978-7-111-32079-1

Ⅰ.①理…　Ⅱ.①朱…②赛…　Ⅲ.①物理学－英文　Ⅳ.①04

中国版本图书馆 CIP 数据核字（2010）第 191564 号

机械工业出版社（北京市百万庄大街 22 号　邮政编码 100037）
策划编辑：张金奎　责任编辑：张金奎
封面设计：鞠　杨　责任印制：鞠　杨
北京机工印刷厂印刷
2010 年 11 月第 1 版第 1 次印刷
210mm × 275mm · 78.25 印张 · 1950 千字
标准书号：ISBN 978-7-111-32079-1
定价：128.00 元

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引进国外优秀原版教材，在有条件的学校推动和开展英语授课或双语教学的同时，自然也引进了先进的教学思想和教学方法，这对提高我国自编教材的水平，加强学生的英语实际应用能力，使我国的高等教育尽快与国际接轨，必将起到积极的推动作用。

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这套教材出版后，我们将及时地将其推荐给各高校选用，并将根据各高校的双语教学计划，举办原版教材的教师培训。希望高校师生在使用教材后及时反馈意见和建议，使我们更好地为教学改革服务。

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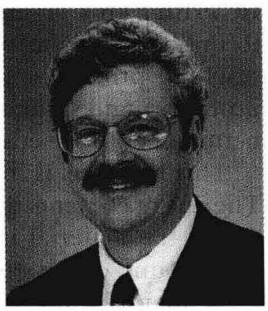
ABOUT THE AUTHORS



John W. Jewett, Jr. earned his undergraduate degree in physics at Drexel University and his doctorate at Ohio State University, specializing in optical and magnetic properties of condensed matter. Dr. Jewett began his academic career at Richard Stockton College of New Jersey, where he taught from 1974 to 1984. He is currently Emeritus Professor of Physics at California State Polytechnic University, Pomona. Through his teaching career, Dr. Jewett has been active in promoting science education. In addition to receiving four National Science Foundation grants, he helped found and direct the Southern California Area Modern Physics Institute (SCAMPI) and Science IMPACT (Institute for Modern Pedagogy and Creative Teaching), both of which work with teachers and schools to develop effective science curricula. Dr. Jewett's honors include four Meritorious Performance and Professional Promise awards, the Stockton Merit Award at Richard Stockton College in 1980, selection as Outstanding Professor at California State Polytechnic University for 1991/1992, and the Excellence in Undergraduate Physics Teaching Award from the American Association of Physics Teachers (AAPT) in 1998. He has given more than 90 presentations both domestically and abroad, including multiple presentations at national meetings of the AAPT. Dr. Jewett is the author of *The World of Physics: Mysteries, Magic, and Myth,* which provides many connections between physics and everyday experiences. In addition to his work as the coauthor for *University Physics for Scientists and Engineers* he is also the coauthor on *Principles of Physics: A Calculus-Based Text,* fourth edition, as well as *Global Issues,* a four-volume set of instruction manuals in integrated science for high school. Dr. Jewett enjoys playing keyboard with his all-physicist band, traveling, underwater photography, running, and collecting antique quack medical devices that can be used as demonstration apparatus in physics lectures. Most importantly, he relishes spending time with his wife Lisa and their children and grandchildren.

Raymond A. Serway received his doctorate at Illinois Institute of Technology and is Professor Emeritus at James Madison University. In 1990, he received the Madison Scholar Award at James Madison University, where he taught for 17 years. Dr. Serway began his teaching career at Clarkson University, where he conducted research and taught from 1967 to 1980. He was the recipient of the Distinguished Teaching Award at Clarkson University in 1977 and the Alumni Achievement Award from Utica College in 1985. As Guest Scientist at the IBM Research Laboratory in Zurich, Switzerland, he worked with K. Alex Müller, 1987 Nobel Prize recipient. Dr. Serway also was a visiting scientist at Argonne National Laboratory, where he collaborated with his mentor and friend, the late Dr. Sam Marshall. Dr. Serway is the coauthor of *College Physics,* eighth edition; *Principles of Physics: A Calculus-Based Text,* fourth edition; *Essentials of College Physics*; *Modern Physics,* third edition; and the high school textbook *Physics,* published by Holt McDougal. In addition, Dr. Serway has published more than 40 research papers in the field of condensed matter physics and has given more than 60 presentations at professional meetings. Dr. Serway and his wife Elizabeth enjoy traveling, playing golf, fishing, gardening, singing in the church choir, and especially spending quality time with their four children and nine grandchildren.

PREFACE TO CHINA EDITION

In writing this eighth edition of *University Physics for Scientists and Engineers,* we continue our ongoing efforts to improve the clarity of presentation and include new pedagogical features that help support the learning and teaching processes. Drawing on positive feedback from users of the seventh edition, data gathered from both professors and students who use Enhanced WebAssign, as well as reviewers' suggestions, we have refined the text to better meet the needs of students and teachers.

This textbook is intended for a course in introductory physics for students majoring in science or engineering. The entire contents of the book in its extended version could be covered in a three-semester course, but it is possible to use the material in shorter sequences with the omission of selected chapters and sections. The mathematical background of the student taking this course should ideally include one semester of calculus. If that is not possible, the student should be enrolled in a concurrent course in introductory calculus.

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 real-world applications. To meet these objectives, we emphasize sound physical arguments and problem-solving methodology. At the same time, we attempt to motivate the student through practical examples that demonstrate the role of physics in other disciplines, including engineering, chemistry, and medicine.

Changes in this Edition

Some of the new features are based on our experiences and on current trends in science education. Other changes were incorporated in response to comments and suggestions offered by users of the seventh edition and by reviewers of the manuscript. The features listed here represent the major changes in this Edition.

Line-by-Line Revision of the Questions and Problems Set. For the Eighth Edition, the authors reviewed each question and problem and incorporated revisions designed to improve both readability and assignability. To make problems clearer to both students and instructors, this extensive process involved editing problems for clarity, editing for length, adding figures where appropriate, and introducing better problem architecture by breaking up problems into clearly defined parts.

Data from Enhanced WebAssign Used to Improve Questions and Problems. As part of the full-scale analysis and revision of the questions and problems sets, the authors utilized extensive user data gathered by WebAssign, from both instructors who assigned and students who worked on problems from previous editions of *University Physics for Scientists and Engineers.* These data helped tremendously, indicating when the phrasing in problems could be clearer, thus providing guidance on how to revise problems so that they are more easily understandable for students and more easily assignable by instructors in Enhanced WebAssign. Finally, the data were used to ensure

that the problems most often assigned were retained for this new edition. In each chapter's problems set, the top quartile of problems assigned in Enhanced WebAssign have [redacted] problem numbers for easy identification, allowing professors to quickly and easily find the most popular problems assigned in Enhanced WebAssign.

To provide an idea of the types of improvements that were made to the problems, here are problems from the seventh edition, followed by the problem as it now appears in the eighth edition, with explanations of how the problems were improved.

Problem from the Seventh Edition . . .

38. (a) Consider an extended object whose different portions have different elevations. Assume the free-fall acceleration is uniform over the object. Prove that the gravitational potential energy of the object–Earth system is given by $U_g = Mgy_{CM}$, where M is the total mass of the object and y_{CM} is the elevation of its center of mass above the chosen reference level. (b) Calculate the gravitational potential energy associated with a ramp constructed on level ground with stone with density 3 800 kg/m^3 and everywhere 3.60 m wide. In a side view, the ramp appears as a right triangle with height 15.7 m at the top end and base 64.8 m (Fig. P9.38).

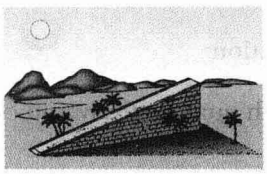


Figure P9.38

. . . As revised for the Eighth Edition:

39. Explorers in the jungle find an ancient monument in the shape of a large isosceles triangle as shown in Figure P9.39. The monument is made from tens of thousands of small stone blocks of density 3 800 kg/m^3. The monument is 15.7 m high and 64.8 m wide at its base and is everywhere 3.60 m thick from front to back. Before the monument was built many years ago, all the stone blocks lay on the ground. How much work did laborers do on the blocks to put them in position while building the entire monument? *Note:* The gravitational potential energy of an object–Earth system is given by $U_g = Mgy_{CM}$, where M is the total mass of the object and y_{CM} is the elevation of its center of mass above the chosen reference level.

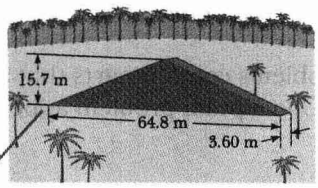


Figure P9.39

A storyline for the problem is provided.

The requested quantity is made more personal by asking for work done by humans rather than asking for the gravitational potential energy.

The expression for the gravitational potential energy is provided, whereas it was requested to be proven in the original. This allows the problem to work better in Enhanced WebAssign.

The figure has been revised and dimensions added.

Problem from the Seventh Edition . . .

67. A bicycle is turned upside down while its owner repairs a flat tire. A friend spins the other wheel, of radius 0.381 m, and observes that drops of water fly off tangentially. She measures the height reached by drops moving vertically (Fig. P10.67). A drop that breaks loose from the tire on one turn rises h = 54.0 cm above the tangent point. A drop that breaks loose on the next turn rises 51.0 cm above the tangent point. The height to which the drops rise decreases because the angular speed of the wheel decreases. From this information, determine the magnitude of the average angular acceleration of the wheel.

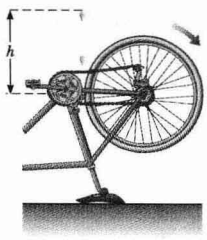


Figure P10.67 Problems 67 and 68.

. . . As revised for the Eighth Edition:

68. A bicycle is turned upside down while its owner repairs a flat tire on the rear wheel. A friend spins the front wheel, of radius 0.381 m, and observes that drops of water fly off tangentially in an upward direction when the drops are at the same level as the center of the wheel. She measures the height reached by drops moving vertically (Fig. P10.68). A drop that breaks loose from the tire on one turn rises h = 54.0 cm above the tangent point. A drop that breaks loose on the next turn rises 51.0 cm above the tangent point. The height to which the drops rise decreases because the angular speed of the wheel decreases. From this information, determine the magnitude of the average angular acceleration of the wheel.

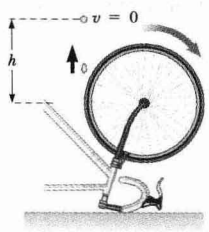


Figure P10.68 Problems 68 and 69.

Information about drops leaving the wheel is clarified.

The figure accompanying the problem has been redrawn to show the front wheel rather than the back wheel, to remove the complicating features of the pedals, chain, and derailleur gear.

Revised Questions and Problems Set Organization. We reorganized the end-of-chapter questions and problems sets for this new edition. The previous edition's Questions section is now divided into two sections: Objective Questions and Conceptual Questions.

Objective Questions are multiple-choice, true/false, ranking, or other multiple guess-type questions. Some require calculations designed to facilitate students' familiarity with the equations, the variables used, the concepts the variables represent, and the relationships between the concepts. Others are more conceptual in nature and are designed to encourage conceptual thinking. Objective Questions are also written with the personal response system user in mind, and most of the questions could easily be used in these systems.

Conceptual Questions are more traditional short-answer and essay-type questions that require students to think conceptually about a physical situation.

The first part of the *Problems* set is organized by the sections in each chapter, but within each section the problems now "platform" students to higher-order thinking by presenting all the straightforward problems in the section first, followed by the intermediate problems. The *Additional Problems* section remains in its usual place, but at the end of each chapter there is a new section, *Challenge Problems,* that gathers the most difficult problems for a given chapter in one place.

New Types of Problems. We have introduced four new problem types for this edition:

Q C *Quantitative/Conceptual* problems contain parts that ask students to think both quantitatively and conceptually. An example of a Quantitative/Conceptual problem appears here:

The problem is identified with a **Q C** icon.

53. **Q C** A horizontal spring attached to a wall has a force constant of $k = 850$ N/m. A block of mass $m = 1.00$ kg is attached to the spring and rests on a frictionless, horizontal surface as in Figure P8.53. (a) The block is pulled to a position $x_i = 6.00$ cm from equilibrium and released. Find the elastic potential energy stored in the spring when the block is 6.00 cm from equilibrium and when the block passes through equilibrium. (b) Find the speed of the block as it passes through the equilibrium point. (c) What is the speed of the block when it is at a position $x_i/2 = 3.00$ cm? (d) Why isn't the answer to part (c) half the answer to part (b)?

Parts (a)–(c) of the problem ask for quantitative calculations.

Part (d) asks a conceptual question about the situation.

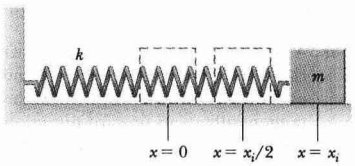


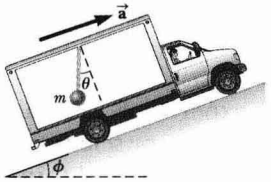
Figure P8.53

S *Symbolic* problems ask students to solve a problem using only symbolic manipulation. Reviewers of the seventh edition (as well as the majority of respondents to a large survey) asked specifically for an increase in the number of symbolic problems found in the text because it better reflects the way instructors want their students to think when solving physics problems. An example of a Symbolic problem appears here:

The problem is identified with a **S** icon.

No numbers appear in the problem statement.

51. **S** A truck is moving with constant acceleration a up a hill that makes an angle ϕ with the horizontal as in Figure P6.51. A small sphere of mass m is suspended from the ceiling of the truck by a light cord. If the pendulum makes a constant angle θ with the perpendicular to the ceiling, what is a?



The figure shows only symbolic quantities.

Figure P6.51

The answer to the problem is purely symbolic.

51. $g(\cos\phi \tan\theta - \sin\phi)$

GP *Guided Problems* help students break problems into steps. A physics problem typically asks for one physical quantity in a given context. Often, however, several concepts must be used and a number of calculations are required to obtain that final answer. Many students are not accustomed to this level of complexity and often don't know where to start. A Guided Problem breaks a standard problem into smaller steps, enabling students to grasp all the concepts and strategies required to arrive at a correct solution. Unlike standard physics problems, guidance is often built into the problem statement. Guided Problems are reminiscent of how a student might interact with a professor in an office visit. These problems (there is one in every chapter of the text) help train students to break down complex problems into a series of simpler problems, an essential problem-solving skill. An example of a Guided Problem appears here:

The problem is identified with a **GP** icon.

38. **GP** A uniform beam resting on two pivots has a length $L = 6.00$ m and mass $M = 90.0$ kg. The pivot under the left end exerts a normal force n_1 on the beam, and the second pivot located a distance $\ell = 4.00$ m from the left end exerts a normal force n_2. A woman of mass $m = 55.0$ kg steps onto the left end of the beam and begins walking to the right as in Figure P12.38. The goal is to find the woman's position when the beam begins to tip. (a) What is the appropriate analysis model for the beam before it begins to tip? (b) Sketch a force diagram for the beam, labeling the gravitational and normal forces acting on the beam and placing the woman a distance x to the right of the first pivot, which is the origin. (c) Where is the woman when the normal force n_1 is the greatest? (d) What is n_1 when the beam is about to tip? (e) Use Equation 12.1 to find the value of n_2 when the beam is about to tip. (f) Using the result of part (d) and Equation 12.2, with torques computed around the second pivot, find the woman's position x when the beam is about to tip. (g) Check the answer to part (e) by computing torques around the first pivot point.

The goal of the problem is identified.

Analysis begins by identifying the appropriate analysis model.

Students are provided with suggestions for steps to solve the problem.

The calculation associated with the goal is requested.

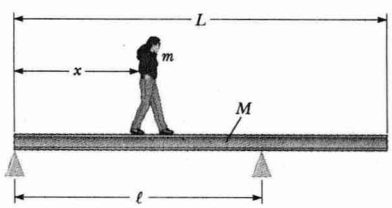
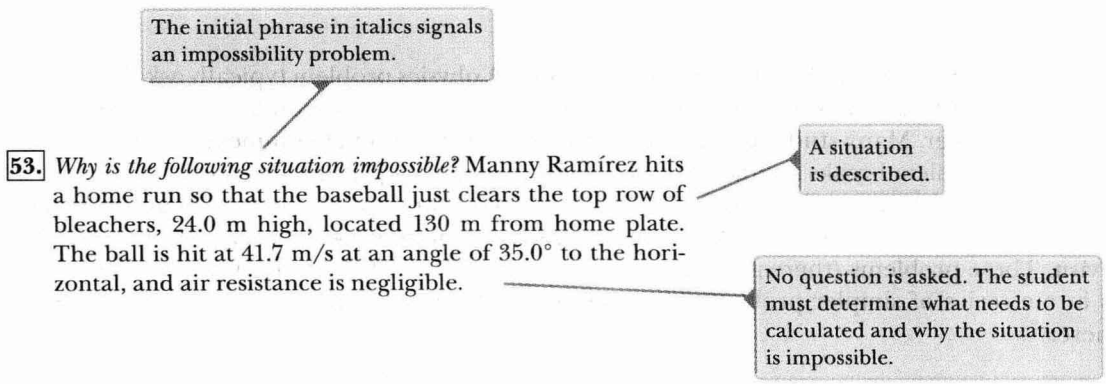


Figure P12.38

Impossibility problems. Physics education research has focused heavily on the problem-solving skills of students. Although most problems in this text are structured in the form of providing data and asking for a result of computation, two problems in each chapter, on average, are structured as impossibility problems. They begin with the phrase *Why is the following situation impossible?* That is followed by the description of a situation. The striking aspect of these problems is that no question is asked of the students, other than that in the initial italics. The student must determine what questions need to be asked and what calculations need to be performed. Based on the results of these calculations, the student must determine why the situation described is not possible. This determination may require information from personal experience, common sense, Internet or print research, measurement, mathematical skills, knowledge of human norms, or scientific thinking.

These problems can be assigned to build critical thinking skills in students. They are also fun, having the aspect of physics "mysteries" to be solved by students individually or in groups. An example of an impossibility problem appears here:



Increased Number of Paired Problems. Based on the positive feedback we received in a survey of the market, we have increased the number of paired problems in this edition. These problems are otherwise identical, one asking for a numerical solution and one asking for a symbolic derivation. There are now three pairs of these problems in most chapters, indicated by tan shading in the end-of-chapter problems set.

Integration with Enhanced WebAssign. The textbook's tight integration with Enhanced WebAssign content facilitates an online learning environment that helps students improve their problem-solving skills and gives them a variety of tools to meet their individual learning styles. New to this edition, Master It tutorials help students solve problems by having them work through a stepped-out solution. Problems with Master It tutorials are indicated in each chapter's problem set with an M icon. In addition, Watch It solution videos explain fundamental problem-solving strategies to help students step through the problem. The problems most often assigned in Enhanced WebAssign (shaded) include either a Master It tutorial or a Watch It solution video to support students. In addition, these problems also have feedback to address student misconceptions, helping students avoid common pitfalls.

Thorough Revision of Artwork. Every piece of artwork in the Eighth Edition was revised in a new and modern style that helps express the physics principles at work in a clear and precise fashion. Every piece of art was also revised to make certain that the physical situations presented correspond exactly to the text discussion at hand.

Also added for this edition is a new feature for many pieces of art: "focus pointers" that either point out important aspects of a figure or guide students through a process illustrated by the artwork or photo. This format helps those students who are more visual learners. Examples of figures with focus pointers appear below.

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