College PHYSICS

SECOND EDITION

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David L. Tauck

Sample Chapter Inside:
Chapter 6: Work and Energy

MOVE LEARNING FORWARD...

Bridge conceptual understanding and problem solving with resources to support active teaching and learning.

This new integrated learning system brings together a ground-breaking media program with an innovative text presentation of algebra-based Physics. An experienced author team provides a unique set of expertise and perspectives to help students master concepts and succeed in developing problem-solving skills necessary for College Physics. Now available for the first time with SaplingPlus—an online learning platform that combines the heavily research-based FlipItPhysics Prelectures (derived from smartPhysics) with the robust Sapling homework system, in which every problem has targeted feedback, hints, and a fully worked and explained solution. This HTML5 platform gives students the ability to actively read with a fully interactive eBook, watch Prelecture videos and work or review problems with a mobile-accessible learning experience. Integration is available with Learning Management Systems to provide single sign-on and grade-sync capabilities and compatible with the iClicker 2 and other classroom response systems to provide a seamless full course experience for you and your students.

To request your review copy, contact your local Macmillan Learning representative, or visit **macmillanlearning.com/requestfreedman2e**.

Second Edition | Cloth Text | 1360 pages | ISBN: 978-1-4641-9639-3

Build a conceptual foundation...before class

We place a high value on learning Physics concepts prior to class time instruction and have created resources to make this as effective as possible for student learning and easy to implement for instructors. Groundbreaking Prelecture videos introduce students to Physics topics and concepts as well as reinforce understanding with embedded questions ahead of class. In tandem, *College Physics*, Second Edition provides an exceptional narrative and purposeful pedagogical tools focused on moving both conceptual learning and quantitative skill acquisition prior to class. A unique visual program and seamless blend of biological applications are interwoven throughout the book to provide relevance and interest for students taking algebra-based Physics. By providing Prelectures with reading assignments, our goal is to jump start student learning and allow for more productive class time.

Make classroom engagement meaningful

Instructor-student engagement can become more meaningful in class when students are aware of misconceptions and instructors have better insight into what students know before coming to class. Bridge questions (developed from research-based smartPhysics) provide a vehicle for students to demonstrate and communicate how well they understand the material that they learned before class. This invaluable instructor insight provides you with a way of identifying gaps in understanding and student misconceptions as you develop lectures to make the most efficient and meaningful use of class time. To further support an engaged classroom, Roger Freedman has refined an active classroom approach and shares in-class activities he has written to apply conceptual knowledge and engage students in the process of problem solving in class.

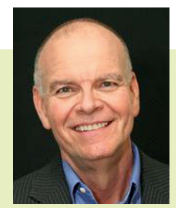
Develop problem-solving skills

Every effort in developing the print and digital materials for *College Physics*, Second Edition has been made to encourage students to develop a deep understanding of Physics concepts and foster the reasoning and analytical skills necessary to apply to solve problems. This goal motivated the student-centered pedagogy demonstrated in the worked examples and consistent Set Up—Solve It—Reflect problem solving strategy found in *College Physics*, as well as the design and development of the Prelecture videos. Text problems incorporate conceptual questions, basic concepts, synthesis of multiple concepts and life science applications. Paired with the Sapling homework platform, students are provided a tutorial experience with every problem in the system. Sapling adheres to the philosophy that every problem counts—therefore requiring ALL problems have hints, targeted feedback and a detailed solution—ensuring that students learn how to approach a problem, not just whether they answered correctly or incorrectly.

Roger Freedman This ground-breaking text boasts an exceptionally strong writing team that is uniquely qualified to write a college Physics textbook. The *College College Physics* author team is led by Roger Freedman, an accomplished textbook author of such bestselling titles as Universe (W. H. Freeman), *Investigating Astronomy* (W. H. Freeman), and *University Physics* (Pearson). Dr. Freedman is a lecturer in Physics at the University of California, Santa Barbara. He was an undergraduate at the University of California campuses in San Diego and Los Angeles, and did his doctoral research in theoretical nuclear Physics at Stanford University. He came to UCSB in 1981 after three years of teaching and doing research at the University of Washington. At UCSB, Dr. Freedman has taught in both the Department of Physics and the College of Creative Studies, a branch of the university intended for highly gifted and motivated undergraduates. In recent years, he has helped to develop computer-based tools for learning Introductory Physics and Astronomy and has been a pioneer in the use of classroom response systems and the "flipped" classroom model at UCSB. Roger holds a commercial pilot's license and was an early organizer of the San Diego Comic-Con, now the world's largest popular culture convention.

Todd Ruskell As a Teaching Professor of Physics at the Colorado School of Mines, Todd Ruskell focuses on teaching at the introductory level, and continually develops more effective ways to help students learn. One method used in large enrollment introductory courses is Studio Physics. This collaborative, hands-on environment helps students develop better intuition about, and conceptual models of, physical phenomena through an active learning approach. Dr. Ruskell brings his experience in improving students' conceptual understanding to the text, as well as a strong liberal arts perspective. Dr. Ruskell's love of Physics began with a B.A. in physics from Lawrence University in Appleton, Wisconsin. He went on to receive an M.S. and Ph.D. in optical sciences from the University of Arizona. He has received awards for teaching excellence, including Colorado School of Mines' Alumni Teaching Award. Dr. Ruskell currently serves on the Physics panel and advisory board for the NANSLO (North American Network of Science Labs Online) project.

Phillip R. Kesten Associate Professor of Physics and Associate Provost for Residential Learning Communities at Santa Clara University, holds a B.S. in physics from the Massachusetts Institute of Technology and received his Ph.D. in High-Energy Particle Physics from the University of Michigan. Since joining the Santa Clara faculty in 1990, Dr. Kesten has also served as Chair of Physics, Faculty Director of the ATOM and da Vinci Residential Learning Communities, and Director of the Ricard Memorial Observatory. He has received awards for teaching excellence and curriculum innovation, was Santa Clara's Faculty Development Professor for 2004-2005, and was named California Professor of the Year in 2005 by the Carnegie Foundation for the Advancement of Education. Dr. Kesten is co-founder of Docutek (A SirsiDynix Company), an Internet software company, and has served as the Senior Editor for *Modern Dad*, a newsstand magazine.



David L. Tauck Unlike any other physics text on the market, this project includes a physiologist as primary author. David Tauck, Associate Professor of Biology, holds both a B.A. in biology and an M.A. in Spanish from Middlebury College. He earned his Ph.D. in physiology at Duke University and completed postdoctoral fellowships at Stanford University and Harvard University in Anesthesia and Neuroscience, respectively. Since joining the Santa Clara University faculty in 1987, he has served as Chair of the Biology Department, the College Committee on Rank and Tenure, and the Institutional Animal Care and Use Committee; he has also served as president of the local chapter of Phi Beta Kappa. Dr. Tauck currently serves as the Faculty Director in Residence of the da Vinci Residential Learning Community.

BUILDING A CONCEPTUAL FOUNDATION... BEFORE CLASS

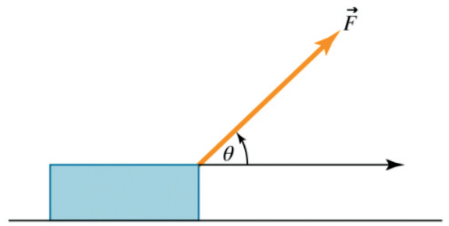
Purposeful pedagogy helps students gain an accurate conceptual understanding of the most important Physics concepts and avoid misconceptions.

Embedded questions reinforce student understanding along the way.

A box is pulled a distance d across the floor by a force F that makes an angle θ with the horizontal, as shown in the figure.

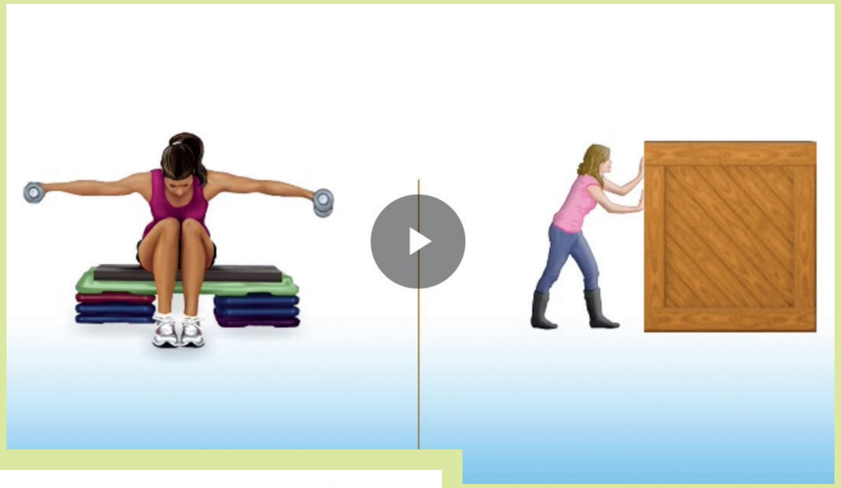
If the magnitude of the force was kept constant but the angle θ was increased toward 90°, the work done by the force in dragging the box would

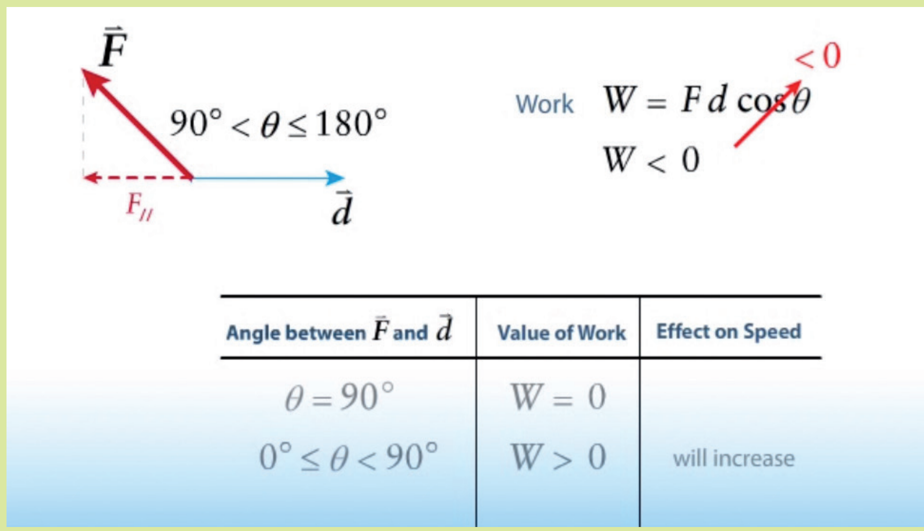
- ◯ either increase or decrease, depending on what the initial angle θ was.
- ◯ increase.
- ◯ decrease.
- ◯ remain the same.
- ◯ either increase or decrease, depending on the magnitude of the force F.



Prelecture videos.

Animated, narrated videos introduce core Physics topics, laying the groundwork for conceptual understanding before students ever set foot in class. Each video is about 1-3 minutes long interspersed with conceptual questions. Each series can either be assigned in its entirety or divided into smaller, more tightly focused assignments. The full Prelecture activity is about 15 minutes long.

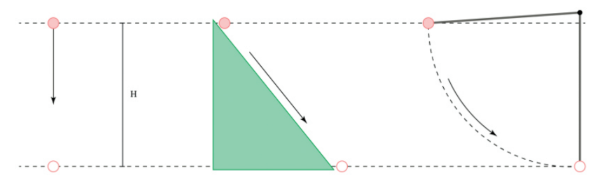




Bridge questions.

Multiple-choice and free-response questions review the content covered in the Prelectures and serve as a unique way for students to both demonstrate what they have learned and communicate misunderstandings or questions to an instructor prior to lecture.

Three objects of the same mass begin their motion at the same height. One object falls straight down, one slides down a low-friction inclined plane, and one swings in a circular arc on the end of a string. All three objects end at the same height.



On which object does gravity do the most work?

- ◯ Gravity does equal work on all three objects.
- ◯ the object traversing the circular arc
- ◯ the object sliding down the low-friction incline
- ◯ the object in free fall

Briefly explain your choice.

A box sits on the horizontal bed of a truck that is accelerating to the left, as shown in the diagram. Static friction between the box and the truck keeps the box from sliding around as the truck accelerates.

The work done on the box by the static friction force as the accelerating truck moves a distance D to the left is

- ◯ positive.
- ◯ negative.
- ◯ zero.
- ◯ dependent upon the speed of the truck.

Briefly explain your answer choice.

BUILDING A CONCEPTUAL FOUNDATION… BEFORE CLASS

Purposeful pedagogy helps students gain an accurate conceptual understanding of the most important Physics concepts and avoid misconceptions.

Art and equations designed to teach.

Visual narrative with word balloons.

Average velocity of an object in linear motion

Displacement (change in position) of the object over a certain time interval: The object moves from x_1 to x_2, so $\Delta x = x_2 - x_1$.

$$v_{\text{average},x} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

For both the displacement and the elapsed time, subtract the earlier value (x_1 or t_1) from the later value (x_2 or t_2).

Elapsed time for the time interval: The object is at x_1 at time t_1 and x_2 at time t_2, so the elapsed time is $\Delta t = t_2 - t_1$.

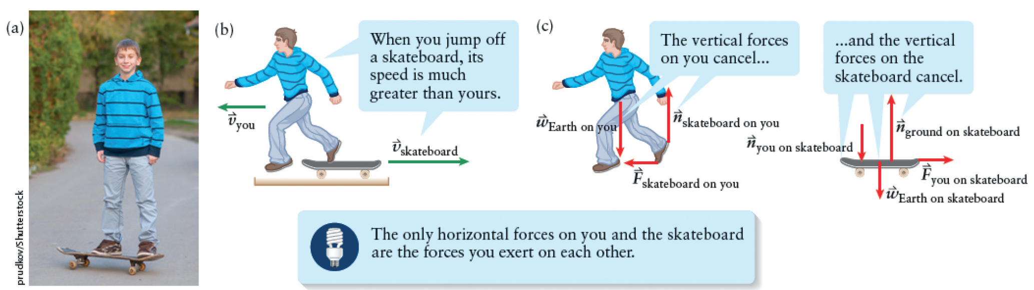


Figure 7-2 **Jumping off a skateboard** You are (a) initially at rest atop a skateboard then (b) jump off horizontally. (c) Free-body diagrams for you and the skateboard during the push-off.

GOT THE CONCEPT? 6-2 Slap Shot

A hockey player does work on a hockey puck in order to propel it from rest across the ice. When a constant force is applied over a certain distance, the puck leaves his stick at speed v. If instead he wants the puck to leave at speed $2v$, by what factor must he increase the distance over which he applies the same force? (a) $\sqrt{2}$; (b) 2; (c) $2\sqrt{2}$; (d) 4; (e) 8.

Pedagogy emphasizes conceptual understanding.

GOT THE CONCEPT? boxes help students think through the implications or connections of a physics concept.

WATCH OUT! The normal force exerted on an object is not always equal to the object's weight.

Since the maximum force of static friction is related to the normal force, it's important to remember that the normal force for an object on a surface is *not* always equal to the object's weight. (We cautioned you about this in Section 4-3). The situation shown in Figure 5-5 is an example of this caveat. Equation 5-4b shows that the normal force on this object is the object's weight multiplied by the cosine of the angle of the incline. Resist the temptation to always set the normal force equal to the weight!

WATCH OUT! boxes draw attention to common student misconceptions and correct them immediately to promote a deeper understanding of Physics.

TAKE-HOME MESSAGE FOR Section 6-3

- ✔ The net work done on an object (the sum of the work done on it by all forces) as it undergoes a displacement is equal to the change in the object's kinetic energy during that displacement.
- ✔ The formula for the kinetic energy of an object of mass m and speed v is $K = \frac{1}{2}mv^2$.
- ✔ The kinetic energy of an object is equal to the amount of work that was done to accelerate the object from rest to its present speed.
- ✔ The kinetic energy of an object is also equal to the amount of work the object can do in the process of coming to a halt from its present speed.

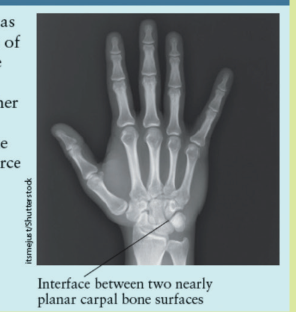
TAKE-HOME MESSAGE. Every chapter section ends with a take-home message that is tied to outcome-based learning objectives listed at the beginning of each chapter and summarizes the main physics principles each student can take away.

Deep integration of medical and biological examples provide real-world relevance for life science majors.

BIO-Medical icons point out biological applications.

BIO-Medical EXAMPLE 5-1 Friction in Joints

The wrist is made up of eight small bones called *carpals* that glide back and forth as you wave your hand from side to side. A thin layer of cartilage covers the surfaces of the carpals, making them smooth and slippery. In addition, the spaces between the bones contain synovial fluid, which provides lubrication. During a laboratory experiment, a physiologist applies a compression force to squeeze the bones together along their nearly planar bone surfaces. She then measures the force that must be applied parallel to the surface of contact to make them move. (Figure 5-7 shows the contact region between these two carpal bone surfaces.) When the compression force is 11.2 N, the minimum force required to move the bones is 0.135 N. What is the coefficient of static friction in the joint?



X-ray image shows the carpal bones of the wrist.

GOT THE CONCEPT? 8-9 BIO-Medical Insects versus Birds

The maneuverability of a flying insect or a bird depends in large part on the contributions their wings make to the moments of inertia around their roll, pitch, and yaw axes (Figure 8-24). As much as 15% of the total body mass of a bird can be in its wings, while the wings of a typical insect are a considerably smaller fraction of its total mass. Which would you expect to be able to maneuver more quickly in flight: (a) a flying insect or (b) a bird?

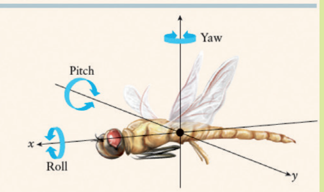


Figure 8-24 **Rotation axes of an insect** An insect can rotate in three ways: It can roll around its longitudinal x axis, pitch around its lateral y axis, or yaw around its z axis.

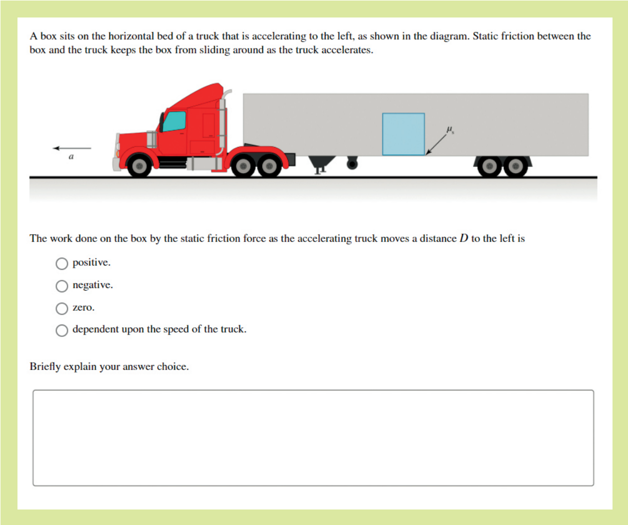
Electronic biological applications index appendix. The index at the front of the book tells you where all of the BIO-Medical icons are in each chapter (by section) and relate to life science applications.

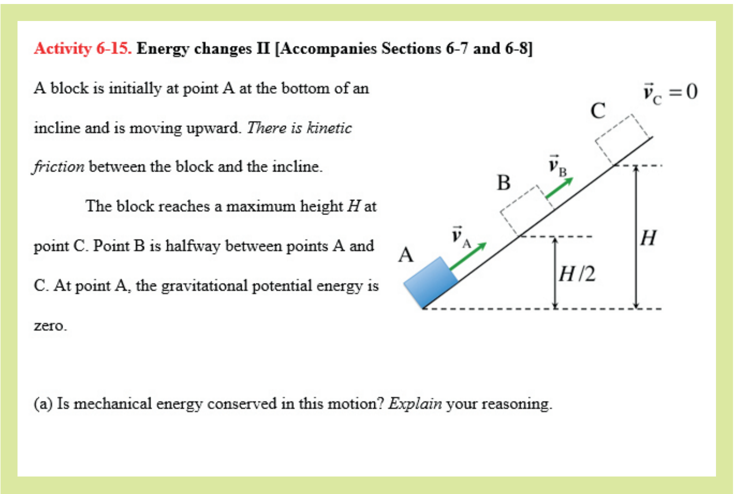
Life science examples are infused into problems throughout the text.

MAKE CLASSROOM ENGAGEMENT MEANINGFUL

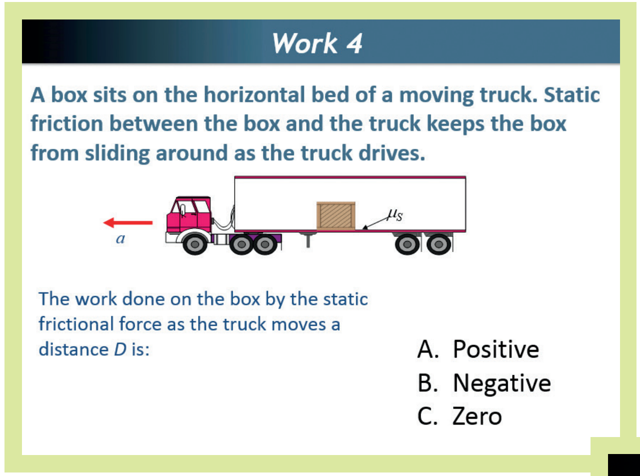
Refine conceptual understanding in class with meaningful instructor-student engagement.

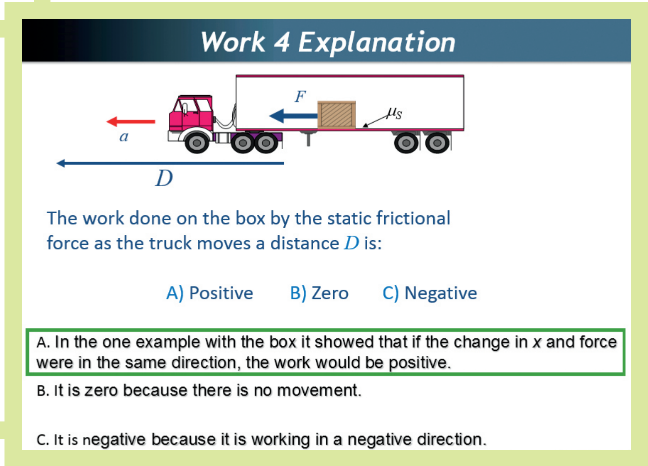
Bridge questions connect the Prelecture activity to the classroom experience, providing instructors with valuable insight into student understanding. With a better-prepared student audience, instructors can devote time to topics needing further explanation, or they can build on the knowledge students acquire before coming to class.





In-class activities from Roger Freedman provide tough problems to tackle in class with annotations for instructors on learning objectives and student misconceptions. The activities can be used with iClicker Reef.





Integrated with iClicker
iClicker active learning simplified.

In-class activities with iClicker
iClicker offers simple, flexible tools to help you give students a voice and facilitate active learning in the classroom. Students can participate with the devices they already bring to class using our iClicker Reef mobile app (which works with smart phones, tablets, or laptops) or iClicker remotes. We've now integrated iClicker with Macmillan's Sapling and Roger Freedman has authored in-class activities to be used with iClicker Reef. With Freedman, *College Physics*, Second Edition and iClicker, it's easier than ever to promote engagement and synchronize student grades both in the classroom and at home.

iClicker Reef access cards can also be packaged with Sapling or your Macmillan textbook at a significant savings for your students. To learn more, visit **iclicker.com** or talk to your Macmillan Learning representative.

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DEVELOP
PROBLEM-SOLVING SKILLS

Encourage students to develop a deep understanding of Physics concepts and foster the reasoning and analytical skills necessary to apply a consistent problem-solving strategy and a student-centered pedagogical framework.

Set Up. The first step in each problem is to determine an overall approach and to gather the necessary pieces of information needed to solve it. These might include sketches, equations related to the physics, and concepts.

Solve. Rather than simply summarizing the mathematical manipulations, required to move from first principles to the final answer, the authors show many intermediate steps in working out solutions to the sample problems, highlighting a crucial part of the problem-solving process.

Reflect. An important part of the process of solving a problem is to reflect on the meaning, implications, and validity of the answer. Is it physically reasonable? Do the units make sense? Is there a deeper or wider understanding that can be drawn from the result? The authors address these and related questions when appropriate.

Encourage strategic thinking.

Set Up—Solve—Reflect problem-solving strategy.
Worked examples mirror the approach scientists take to solve problems by developing reasoning and analysis skills.

BIO-Medical EXAMPLE 5-7 Terminal Speed

When diving straight down toward its prey, a peregrine falcon is acted on by two forces: a downward gravitational force, and a drag force of magnitude F_{drag} given by Equation 5-9 directed vertically upward (opposite to the direction of the falcon's motion through the air). As the falcon falls and its speed v increases, the value of F_{drag} also increases. When the drag force becomes equal in magnitude to the gravitational force, the net force on the falcon is zero and the falcon ceases to accelerate. It has reached its *terminal speed*, so it no longer speeds up nor does it slow down. Find the terminal speed of a female peregrine falcon of mass 1.2 kg, for which the value of c is $1.6 \times 10^{-3}\ \text{N}\cdot\text{s}^2/\text{m}^2$.

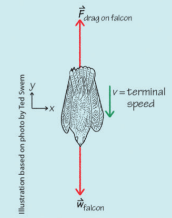
Set Up

The free-body diagram shows the two forces acting on the falcon. We use Equation 5-9 to find the value of the speed v at which the sum of these forces is zero, so that the acceleration is zero and the downward velocity is constant.

$$\sum \vec{F}_{\text{ext on falcon}} = \vec{F}_{\text{drag on falcon}} + \vec{w}_{\text{falcon}} = m\vec{a}_{\text{falcon}} = 0$$

Drag force for larger objects at faster speeds:

$$F_{drag} = cv^2 \qquad (5\text{-}9)$$



Solve

Write Newton's second law in component form and solve for the terminal speed v_{term}.

Newton's second law in component form applied to the falcon:

$$y:\ F_{\text{drag on falcon}} + (-w_{\text{falcon}}) = 0$$

At the terminal speed v_{term},

$$F_{\text{drag on falcon}} = cv_{term}^2 \text{ so}$$
$$cv_{term}^2 - w_{falcon} = 0$$
$$cv_{term}^2 = w_{falcon} = mg$$
$$v_{term}^2 = \frac{mg}{c}$$
$$v_{term} = \sqrt{\frac{mg}{c}}$$

Substitute the numerical values of m and c for the falcon.

Using $m = 1.2$ kg and $c = 1.6 \times 10^{-3}\ \text{N}\cdot\text{s}^2/\text{m}^2$,

$$v_{term} = \sqrt{\frac{(1.2\ \text{kg})(9.80\ \text{m/s}^2)}{1.6 \times 10^{-3}\ \text{N}\cdot\text{s}^2/\text{m}^2}} = 86\ \text{m/s} = 310\ \text{km/h} = 190\ \text{mi/h}$$

Reflect

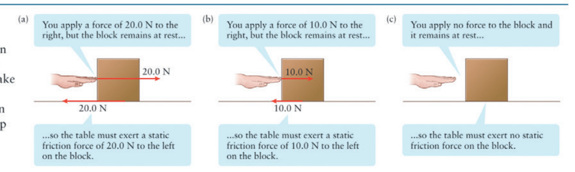
The high diving speeds attained by a peregrine falcon make it the fastest member of the animal kingdom.

The relationship $v_{term} = \sqrt{\frac{mg}{c}}$ explains the common notion that "heavier objects fall faster." A baseball and an iron ball of the same radius falling side by side in air have the same value of c (because they have the same shape and size), but the iron ball will have a greater terminal speed because its mass m is greater. So a heavier object *does* fall faster if we take the drag force into account. If the baseball and iron ball were dropped side by side in a vacuum, however, they would have the same acceleration of magnitude g and so would always have the same speed.

Key Terms

centripetal force
coefficient of kinetic friction
coefficient of rolling friction
coefficient of static friction
drag force
fluid resistance
friction
kinetic friction
rolling friction
static friction

Chapter Summary

Topic	Equation or Figure
Static friction: If an object is at rest on a surface, a static friction force $\vec{f}_s$ arises if other forces are trying to make the object move. The static friction force can have any magnitude up to a maximum value.	 (Figure 5-2)

① The magnitude of the force of static friction on an object... ② ...is less than or equal to a certain maximum value.

$$f_s \le f_{s,max} \qquad (5\text{-}1a)$$

③ The maximum force of static friction depends on...

$$f_{s,max} = \mu_s n \qquad (5\text{-}1b)$$

④ ...the coefficient of static friction (which depends on the properties of the two surfaces in contact)... ⑤ ...and the normal force pressing the object against a surface.

Student-centered framework.

Key terms/visual summary
Help students synthesize ideas after reading or class time.

End of chapter questions tagged with related worked examples. Students can go back and review worked examples while working problems.

47. •• An object of mass $3M$, moving in the $+x$ direction at speed v_0, breaks into two pieces of mass M and $2M$ as shown in **Figure 7-26**. If $\theta_1 = 45°$ and $\theta_2 = 30°$, determine the final velocities of the resulting pieces in terms of v_0. SSM Example 7-4

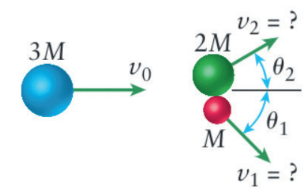


Figure 7-26 Problem 47

EXAMPLE 7-4 A Tricky Billiards Shot

On a billiards table the 7-ball and the 8-ball are initially at rest and touching each other. You hit the cue ball in such a way that it acquires a speed of 1.7 m/s before hitting the 7-ball and 8-ball simultaneously. After the collision the cue ball is at rest, and the other two balls are each moving at 45° from the direction that the cue ball was moving. What are the speeds of the 7-ball and 8-ball immediately after the collision? Each billiard ball has a mass of 0.16 kg.

Set Up

This is a more complicated collision than in the previous two examples, but the fundamental principle is the same: Total momentum is conserved.

Initially all of the momentum is in the cue ball and points along the direction of its motion. After the collision the 7-ball and 8-ball must travel on opposite sides of the cue ball's initial path as shown. (If they were on the same side, there would be a nonzero total momentum perpendicular to the cue ball's initial path, and momentum would not be conserved.)

As in Example 7-2 we know the directions of motion of the balls before and after the collision. We know the initial speed $v_{cue,i} = 1.7$ m/s and final speed $v_{cue,f} = 0$ of the cue ball, and we want to find the final speeds v_{7f} and v_{8f} of the 7-ball and 8-ball.

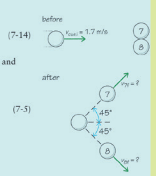
Momentum conservation:

$$\vec{P} = \vec{p}_{cue} + \vec{p}_7 + \vec{p}_8 \qquad (7\text{-}14)$$

(cue ball, 7-ball, and 8-ball) has the same value just before and just after the collision

Linear momentum:

$$\vec{p} = m\vec{v} \qquad (7\text{-}5)$$



Solve

Write in component form the momentum conservation equation, which says that the total momentum before the collision (subscript i) equals the total momentum after the collision (subscript f). Take the positive x axis to be in the direction that the cue ball was moving before the collision. Note that all three balls have the same mass $m = 0.16$ kg.

Momentum conservation:

$$\vec{p}_{cue,f} + \vec{p}_{7f} + \vec{p}_{8f} = \vec{p}_{cue,i} + \vec{p}_{7i} + \vec{p}_{8i}$$

The 7-ball and 8-ball are not moving before the collision, so $\vec{p}_{7i} = \vec{p}_{8i} = 0$, and the cue ball is not moving after the collision, so $\vec{p}_{cue,f} = 0$. So the momentum conservation equation becomes

$$\vec{p}_{7f} + \vec{p}_{8f} = \vec{p}_{cue,i}$$
$$m\vec{v}_{7f} + m\vec{v}_{8f} = m\vec{v}_{cue,i}$$

Categorized end of chapter problems

- Conceptual questions
- Multiple-choice questions
- Estimation/numerical analysis
- Problems (organized by section)
- General problems

WITH SAPLINGPLUS...
EVERY PROBLEM COUNTS

This comprehensive and robust online platform combines innovative, high-quality teaching and learning features with Sapling Learning's acclaimed online Physics homework.

SaplingPlus for Freedman,
***College Physics* Second Edition features:**

Prelecture videos/embedded questions/bridge questions
Developed based on research and principles that defined smartPhysics. Animated, narrated Prelecture videos give students both a conceptual and quantitative understanding of core physics topics. Followed up by *bridge questions* that bridge student learning to in class engagement by giving students a means of communicating what they know and don't know and instructors access to valuable insight to tailor class time.

Interactive eBook
New! For the first time, the eBook is also available through an app which allows students to read offline, have the book read aloud to them, in addition to the highlighting, note taking and keyword search that you have come to expect.

Sapling learning problems
Where every problem counts—with hints, targeted feedback and detailed solutions.

Balloon art concept checks
Designed to guide students through the process of identifying important Physics concepts in key figures and equations. Mirroring the visual narrative in the form of word balloons, these interactive questions reinforce key ideas from the text by highlighting important physics principles in each chapter.

PhET simulations
New HTML5 PhET Simulations from the University of Colorado at Boulder's renowned research-based Physics simulations help students gain a visual understanding of concepts and illustrate cause-and-effect relationships. Tutorial questions further encourage this quantitative exploration, while addressing specific problem-solving needs.

P'Casts
250 total whiteboard mobile ready videos. Carefully selected by Physics students and instructors throughout North America to help simulate the experience of watching an instructor walk through the steps and explanation of Physics concepts while solving a problem.

Pocket worked examples
All worked examples from *College Physics* are available as a downloadable item for mobile devices.

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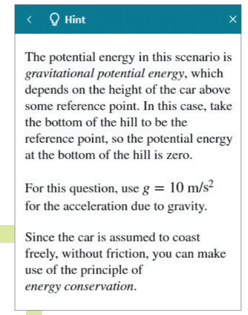
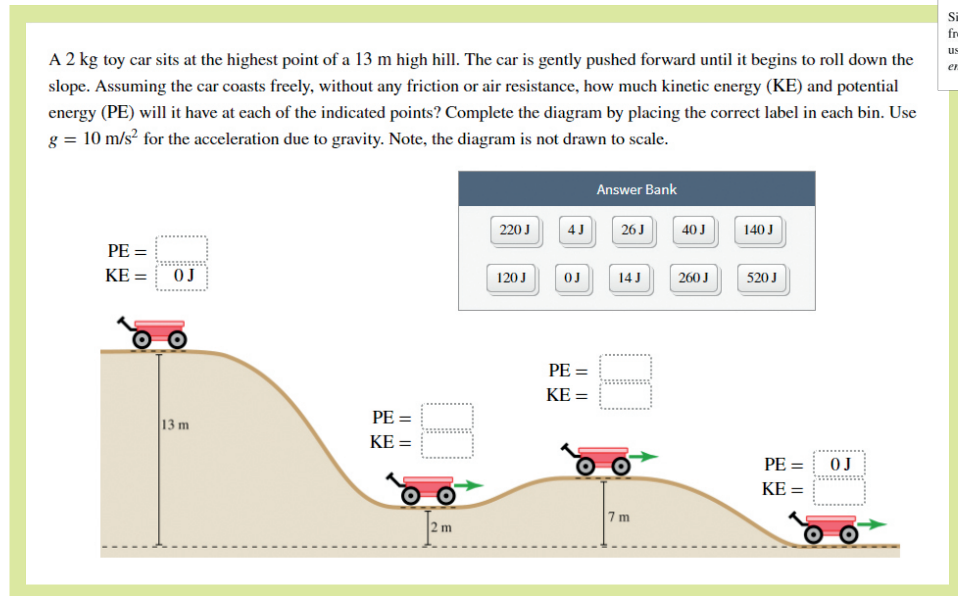
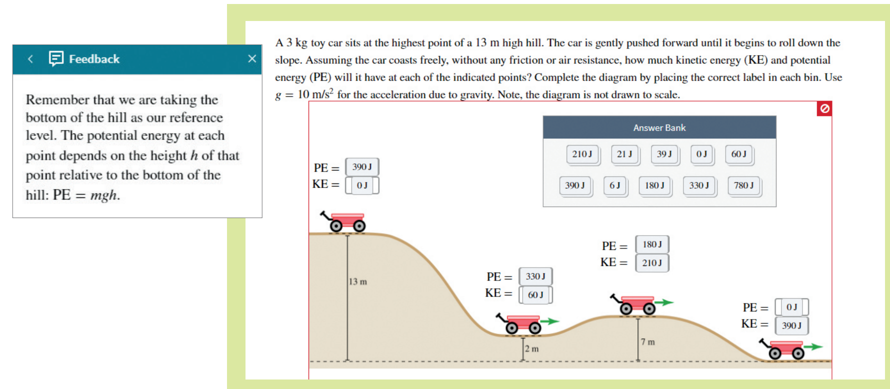
Hints: clues attached to every problem encourage critical thinking by providing suggestions for completing the problem, without giving away the answer.

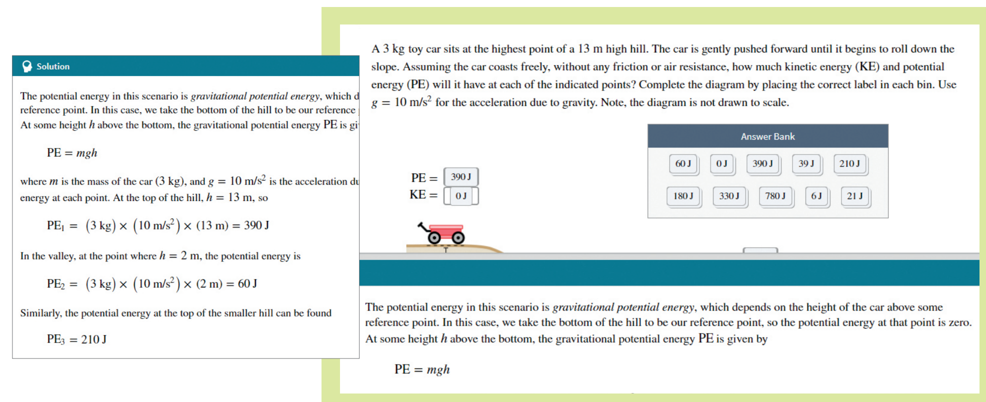




Targeted feedback: each question includes wrong-answer specific feedback targeted to students' misconceptions.



Detailed solutions: fully-worked solutions reinforce concepts and provide an in-product study guide for every problem in the Sapling Learning system.



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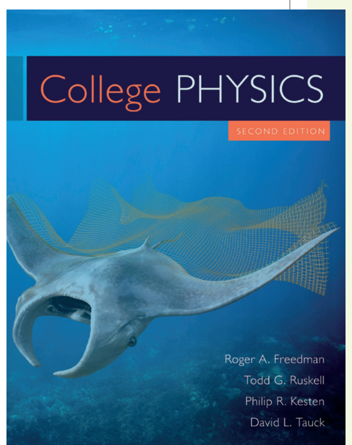

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BRIEF
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The exposition of concepts of the book are great for developing physical intuition… The book also has great example problems and would be great for self study. This book is great for teaching Physics the right way.”

— Avishek Kumar, Arizona State University

This is an excellent physics textbook. I particularly like the easy-to-understand bubble text to clarify equations and figures, which many students typically spend quite some time to understand. The clearly written example problems and solution steps are also essential for this book, which I expect the students to like them a lot… The presentation of this book is outstanding. It will be a good choice for students with wide ranging Math and Physics backgrounds.”

— Fengyuan Yang, The Ohio State University

It is obvious that the author is a master teacher. The text reads like the author is sitting across the desk from and talking to the student—this is a real skill. The choice of example problems are excellent—lot of attention to detail.”

— Marllin Simon, Auburn University

College Physics is more student-centered than any textbooks I have seen so far, for the following reasons. 1) it makes minimal use of jargon, and qualitatively explains each concept in very clear terms before giving formal definitions; 2) it has good conceptual examples based on situations that the average student can easily relate to; 3) cautions the reader about common misconceptions—in a very direct way; 4) it provides diverse opportunities for deliberate practice, including for example several estimation problems at the end each chapter.”

— Matteo Broccio, University of Pittsburgh

About the Cover

A manta ray propels itself through the water by flapping its pectoral fins. Researchers have documented mantas swimming at a range of speeds, studied the turbulent wake they leave behind, and compared their movements to detailed computer models. Through this study, researchers have found that mantas—the largest marine animals to use this form of locomotion—are highly efficient at moving through the water. This research is just one example of how the physics of turbulent fluids (Chapter 11) can give us insight into biological systems.