

# Physics study guide 13 answer key File PDF

## Physics Study Guide 13 Answer Key: Your Comprehensive Resource for Success

When it comes to mastering complex physics concepts, having the right study tools can make all the difference. If you're currently working through Physics Study Guide 13, you're likely seeking an answer key to help verify your understanding and guide your learning process. In this article, we'll provide an in-depth overview of the Physics Study Guide 13 answer key, highlighting key concepts, common questions, and helpful tips to enhance your studying experience. Whether you're a student preparing for exams or a self-learner seeking clarity on physics topics, this guide will serve as an invaluable resource.

## Understanding the Purpose of the Physics Study Guide 13 Answer Key

The primary goal of the answer key is to assist students in self-assessment and reinforce learning. It provides solutions to the exercises and problems presented in Study Guide 13, ensuring that learners can check their work, identify mistakes, and understand the correct application of physics principles.

## How the Answer Key Enhances Learning

- Facilitates self-paced study by allowing students to verify answers immediately.
- Clarifies complex concepts through detailed solutions and explanations.
- Builds confidence by providing correct solutions to challenging problems.
- Supports teachers and tutors in assessing student progress efficiently.

## Key Topics Covered in Physics Study Guide 13

Physics Study Guide 13 typically concentrates on advanced topics in mechanics, electromagnetism, or waves, depending on the curriculum. Understanding these core areas is essential for mastering the material and succeeding in assessments.

## Common Topics Include:

- Newton's Laws of Motion and Applications
- Work, Energy, and Power

- Momentum and Collisions
- Electromagnetic Induction
- Waves and Sound
- Optics and Light

Each topic is accompanied by practice problems designed to test conceptual understanding and problem-solving skills.

## How to Use the Physics Study Guide 13 Answer Key Effectively

Using the answer key optimally involves more than just checking your answers. Here are some tips to maximize your learning:

### Steps for Effective Studying

- **Attempt Problems First:** Solve the problems on your own before consulting the answer key.
- **Compare Your Work:** Carefully review the solutions provided in the answer key and identify any discrepancies.
- **Understand the Solutions:** Don't just memorize answers; study the explanations to grasp the underlying physics principles.
- **Review Mistakes:** Focus on problems you got wrong to understand your misconceptions and reinforce learning.
- **Revisit Difficult Concepts:** Use the answer key explanations as a springboard to revisit textbook chapters or online resources for deeper understanding.

## Sample Problems and Solutions from Physics Study Guide 13 Answer Key

Let's explore a few example problems you might find in the guide, along with summarized solutions to illustrate how the answer key supports your learning.

### Example 1: Calculating Force in a Pulley System

**Problem:** A block of mass 5 kg is lifted using a pulley system. If the acceleration due to gravity is  $9.8 \text{ m/s}^2$ , what is the force needed to lift the block at constant speed?

#### Answer Key Solution:

- Identify the force required: The weight of the block is given by  $W = m \times g = 5 \times 9.8 =$

49 N).

- Since the block is lifted at constant speed, the net acceleration is zero, so the applied force equals the weight.
- Therefore, the force needed is 49 N.

This example demonstrates the straightforward application of Newton's second law in equilibrium conditions.

## Example 2: Determining the Speed of a Wave

Problem: A wave travels along a string with a wavelength of 2 meters and a frequency of 5 Hz. What is the wave's speed?

### Answer Key Solution:

- Use the wave speed formula:  $v = f \times \lambda$ .
- Calculate:  $v = 5 \text{ Hz} \times 2 \text{ m} = 10 \text{ m/s}$ .

This illustrates how to connect wave properties using fundamental equations.

## Common Challenges and How the Answer Key Addresses Them

Many students encounter difficulties with certain physics problems, especially those involving multiple steps or abstract concepts. The answer key helps by offering detailed solutions and step-by-step explanations.

### Addressing Difficult Topics:

- **Conceptual Confusion:** Clear explanations help clarify misunderstandings about principles like conservation of energy or momentum.
- **Mathematical Procedures:** The answer key guides students through algebraic manipulations and formula applications.
- **Application to Real-World Problems:** Solutions often include context that relates physics principles to everyday phenomena or experiments.

## Additional Resources for Physics Study

While the answer key is a valuable tool, supplementing it with other resources can deepen your understanding.

## Recommended Study Aids:

- **Textbooks:** Review chapters related to the problems to reinforce theoretical knowledge.
- **Online Tutorials:** Websites like Khan Academy, Coursera, or YouTube channels offer visual explanations and practice problems.
- **Physics Forums and Study Groups:** Engage with peers or instructors to discuss challenging topics and solutions.
- **Practice Tests:** Regularly attempt practice exams to simulate test conditions and improve problem-solving speed.

## Conclusion: Making the Most of the Physics Study Guide 13 Answer Key

The Physics Study Guide 13 answer key is an essential resource for students aiming to excel in physics. It provides accurate solutions, clarifies complex concepts, and builds confidence through practice. To maximize its benefits, approach it as a learning tool rather than just an answer checker?use it to understand mistakes, explore alternative problem-solving methods, and deepen your comprehension of physics principles.

Remember, mastering physics is a gradual process that combines consistent practice, active engagement with the material, and utilizing resources like the answer key effectively. With dedication and strategic studying, you'll be well on your way to achieving your academic goals in physics.

Good luck, and happy studying!

### Physics Study Guide 13 Answer Key: An In-Depth Review and Analysis

The Physics Study Guide 13 Answer Key is a vital resource for students aiming to excel in physics coursework, particularly for those engaged in structured learning environments that utilize this guide as a primary or supplementary tool. As physics often challenges students with its complex concepts, problem-solving requirements, and mathematical rigor, having access to a comprehensive answer key can significantly enhance understanding, boost confidence, and improve overall performance. This review will explore the key features, benefits, potential drawbacks, and practical applications of the Physics Study Guide 13 Answer Key, providing a detailed overview for educators, students, and physics enthusiasts alike.

## Overview of the Physics Study Guide 13 Answer Key

The Physics Study Guide 13 Answer Key is designed to complement a corresponding textbook or

curriculum, offering detailed solutions, explanations, and step-by-step methods to solve a wide array of physics problems. Its primary goal is to facilitate self-study, homework assistance, and exam preparation by providing accurate and clear answers that help students verify their work and deepen their conceptual understanding.

Features of the Answer Key:

- Comprehensive solutions to all exercises in Chapter 13
- Clear, step-by-step problem-solving methods
- Diagrams and illustrations to clarify complex concepts
- Summaries of key formulas and principles relevant to Chapter 13 topics
- Cross-references to related chapters for integrated understanding

Target Audience:

- High school physics students
- College-level introductory physics learners
- Physics teachers seeking supplemental resources
- Homeschooling parents guiding physics education

## In-Depth Analysis of Chapter 13 Topics Covered

Chapter 13 in most physics textbooks often deals with advanced topics such as Electric Fields and Forces, Potential Energy and Electric Potential, or Capacitance and Dielectrics. The answer key typically provides solutions aligned with these themes.

### Electric Fields and Forces

The answer key's solutions clarify how to compute electric forces using Coulomb's law, analyze electric field lines, and understand the superposition principle.

Strengths:

- Step-by-step derivations of Coulomb's law applications
- Visual aids illustrating electric field lines
- Practice problems with varying complexity levels

Limitations:

- May assume prior knowledge of vector addition without detailed review
- Some solutions could benefit from more visual explanations for visual learners

## Potential Energy and Electric Potential

This section covers potential energy stored in configurations of charges, calculations of electric potential, and the relationship between electric potential and electric field.

Strengths:

- Clear derivations linking electric potential to work done
- Examples illustrating potential energy in different charge arrangements
- Use of real-world analogies to aid understanding

Limitations:

- Occasionally assumes familiarity with calculus concepts without review
- May lack alternative explanations for students struggling with the mathematical concepts

## Capacitance and Dielectrics

The answer key provides solutions for calculating capacitance in various configurations, understanding dielectric materials' effects, and energy stored in capacitors.

Strengths:

- Includes formulas for parallel-plate capacitors with dielectrics
- Practical problems involving real-world capacitor applications
- Emphasis on units and dimensional analysis

Limitations:

- Some solutions are terse, potentially confusing beginners
- Less focus on experimental setups and real-life applications

## Pros and Cons of the Physics Study Guide 13 Answer Key

**Pros:**

- Accuracy and Reliability: Carefully checked solutions ensure students can trust the answers.
- Step-by-Step Explanations: Facilitates understanding of problem-solving processes.
- Visual Aids: Diagrams support comprehension of abstract concepts.
- Time-Saving: Quick verification of answers reduces study time.
- Supplemental Learning: Reinforces textbook material and prepares students for exams.

**Cons:**

- Lack of Conceptual Depth: Focuses primarily on solutions rather than underlying concepts.
- Limited Explanations for Theoretical Foundations: Assumes prior knowledge.
- Potential Over-Reliance: Students may depend too heavily on answer keys without developing problem-solving skills.
- Format Constraints: Sometimes lacks detailed commentary on common misconceptions.

## Features That Enhance Learning

The answer key's design incorporates several features aimed at maximizing educational value:

- Detailed Solutions: Break down complex problems into manageable steps.
- Cross-Referencing: Links to related concepts and previous chapters for integrated learning.
- Practice Problems: Additional exercises for mastery.
- Common Mistakes Highlighted: Notes on typical errors to avoid.
- Summary Tables: Key formulas and unit conversions summarized for quick review.

## Practical Applications and Usage Tips

For optimal benefit, users should consider the following strategies when utilizing the Physics Study Guide 13 Answer Key:

- Use as a Learning Tool: Don't just look at the answers; study the step-by-step methods.
- Compare with Textbook: Cross-reference solutions with textbook explanations for deeper understanding.
- Practice Independently: Attempt problems on your own before consulting the answer key.
- Identify Weak Areas: Use incorrect answers to pinpoint topics requiring further review.
- Combine with Visual Aids: Supplement with videos or diagrams for complex topics.

## Conclusion: Is the Physics Study Guide 13 Answer Key Worth It?

Overall, the Physics Study Guide 13 Answer Key is a valuable resource for anyone engaged in physics studies focusing on the topics typically covered in Chapter 13. Its detailed solutions, clear explanations, and supportive visuals make it an effective tool for self-study, homework assistance, and exam preparation. While it has some limitations, particularly regarding depth of conceptual explanations, these can often be mitigated by supplementing with textbooks, online tutorials, and classroom instruction.

### Final Verdict:

- Ideal for: Students seeking reliable answer verification and problem-solving strategies.
- Less suitable for: Complete beginners requiring foundational concept explanations without additional guidance.
- Recommended for: Learners aiming to strengthen their problem-solving skills and confirm their understanding.

In conclusion, pairing the Physics Study Guide 13 Answer Key with active engagement in physics concepts and supplementary resources will maximize its educational potential, leading to improved comprehension and academic success in physics.

**Question** What topics are typically covered in the Physics Study Guide 13 Answer Key? The Physics Study Guide 13 Answer Key generally covers topics such as mechanics, energy and work, momentum, and rotational motion, providing solutions to practice problems in these areas. **Answer** How can the Physics Study Guide 13 Answer Key help improve my understanding of physics concepts? It provides step-by-step solutions and explanations for problems, enabling students to grasp the problem-solving process, identify mistakes, and reinforce key physics principles. Is the Physics Study Guide 13 Answer Key suitable for all grade levels or only advanced students? It is typically designed for high school or introductory college physics courses, making it suitable for students at various levels seeking to reinforce their understanding. Where can I find the official Physics Study Guide 13 Answer Key online? Official answer keys are often available through your course instructor, school resources, or authorized educational websites. Be cautious of unofficial sources to ensure accuracy. Can using the Physics Study Guide 13 Answer Key help me prepare for physics exams effectively? Yes, practicing with the answer key allows you to verify your problem-solving methods, understand correct solutions, and build confidence for exam situations.

**Related keywords:** physics study guide, answer key, physics practice questions, physics solutions, physics review, physics textbook answers, physics homework help, physics exam prep, physics concepts, physics problem sets

## serway physics 8th edition

### Serway Physics 8th Edition: An In-Depth Guide for Students and Educators

**Serway Physics 8th Edition** is a comprehensive textbook widely used by physics students and educators to understand foundational and advanced concepts in physics. Authored by Raymond A. Serway, this edition continues the tradition of providing clear explanations, engaging problems, and real-world applications that enhance the learning experience. Whether you're a student preparing for exams or an instructor seeking a dependable teaching resource, the 8th edition of Serway's physics book offers valuable insights into the fundamental principles of physics, making complex topics accessible and engaging.

### Overview of Serway Physics 8th Edition

#### Key Features and Highlights

- Clear and Concise Explanations: The book breaks down complex physics concepts into easily understandable segments, making it suitable for both beginners and advanced learners.
- Rich Visual Content: The inclusion of detailed diagrams, illustrations, and graphs helps visualize phenomena and reinforce understanding.
- Variety of Problems: The book offers numerous practice problems, from basic to challenging, to test comprehension and develop problem-solving skills.
- Real-World Applications: Examples drawn from everyday life and current technology demonstrate the relevance of physics principles.
- Integrated Learning Tools: Supplementary online resources, including quizzes, animations, and tutorials, are available to enhance the learning experience.

#### Target Audience

Serway Physics 8th Edition is primarily designed for:

- Undergraduate students taking introductory or intermediate physics courses
- Instructors seeking a reliable textbook for classroom teaching
- Self-learners interested in gaining a solid understanding of physics fundamentals

### Content Structure of Serway Physics 8th Edition

## Organizational Layout

The book is organized into multiple chapters, each focusing on specific areas of physics, such as mechanics, thermodynamics, electromagnetism, optics, and modern physics. This logical flow ensures a progressive build-up of concepts, facilitating better comprehension.

## Major Sections Covered

- Introduction to Physics and Measurement: Fundamentals of scientific measurement, units, and dimensional analysis.
- Kinematics: Describing motion in one and two dimensions.
- Dynamics: Newton's laws, applications, and friction.
- Work, Energy, and Power: Conservation laws and energy transfer.
- Momentum and Collisions: Impulse, conservation of momentum.
- Rotational Motion: Angular velocity, torque, and rotational dynamics.
- Oscillations and Waves: Simple harmonic motion, wave properties.
- Thermodynamics: Heat, temperature, laws of thermodynamics.
- Electromagnetism: Electric fields, circuits, magnetic fields.
- Optics: Reflection, refraction, lenses, and mirrors.
- Modern Physics: Quantum mechanics, atomic physics, nuclear physics.

## Why Choose Serway Physics 8th Edition?

### Comprehensive Coverage and Depth

The 8th edition provides in-depth explanations of core physics concepts, making it suitable for courses that require a thorough understanding. It balances theory with practical applications, ensuring students grasp both the "how" and the "why."

### Effective Learning Resources

The textbook is complemented by online tools, including:

- Interactive simulations
- Video tutorials
- Practice quizzes
- Problem-solving guides

These resources aid in reinforcing learning and preparing for exams effectively.

## Updated Content and Pedagogical Approach

The 8th edition incorporates:

- Recent scientific developments
- Updated problem sets reflecting current technology
- Pedagogical features such as summary boxes, key terms, and review questions to facilitate active learning

## How to Maximize Learning with Serway Physics 8th Edition

### Study Strategies

- Read Actively: Engage with the text by highlighting key points and taking notes.
- Work Through Problems: Practice a variety of problems to strengthen problem-solving skills.
- Use Online Resources: Supplement your study with online tutorials and simulations.
- Form Study Groups: Collaborate with peers to discuss complex topics.
- Regular Review: Revisit previous chapters to reinforce retention.

### Supplementary Tools and Resources

- Solution Manuals: For guided problem-solving.
- Online Quizzes: To assess understanding.
- Instructor Resources: Lecture slides and test banks for educators.

## Where to Find Serway Physics 8th Edition

### Purchasing Options

- Bookstores: Academic and general bookstores often stock the latest editions.
- Online Retailers: Amazon, eBay, and other e-commerce platforms offer new and used copies.
- Digital Versions: E-books and PDF formats available for quick access and portability.
- Library Access: University and public libraries may have copies available for borrowing.

### Pricing and Editions

While newer editions are available, the 8th edition remains popular for its proven content and

teaching approach. Prices vary based on condition, format, and seller.

## Conclusion: The Value of Serway Physics 8th Edition

Choosing the right physics textbook can significantly impact your learning journey. **Serway Physics 8th Edition** stands out as a trusted, comprehensive resource that bridges theory and practice. Its well-structured content, rich visual aids, and variety of problems make it an ideal choice for students aiming to excel in physics. Educators also benefit from its pedagogical features and supplementary resources, making it a versatile tool for effective teaching.

Whether you're tackling your first physics course or delving into more advanced topics, the 8th edition of Serway's physics book provides a solid foundation and a pathway to mastery. Invest in this edition to enhance your understanding of the universe's fundamental laws and prepare for future scientific pursuits.

Keywords for SEO Optimization:

Serway physics 8th edition, physics textbook, introductory physics, physics problems, physics solutions, physics study guide, physics concepts, physics learning resources, physics for students, physics for educators

### Serway Physics 8th Edition: A Comprehensive Review and In-Depth Analysis

Physics textbooks are foundational tools for students and educators alike, serving as both instructional guides and reference materials. Among these, Serway Physics 8th Edition has garnered substantial attention for its thorough content, pedagogical approach, and clarity. This article aims to provide an in-depth, expert-level review of this edition, exploring its features, strengths, and areas for improvement.

## Introduction to Serway Physics 8th Edition

Serway Physics 8th Edition, authored primarily by Raymond A. Serway and John W. Jewett, stands as a pivotal resource in college-level physics education. Building upon previous editions, the 8th edition emphasizes conceptual understanding, problem-solving skills, and real-world applications. Its comprehensive coverage spans classical mechanics, electromagnetism, thermodynamics, waves, optics, and modern physics.

This edition is tailored for undergraduate students, aiming to foster both conceptual insight and mathematical proficiency. Its pedagogical design integrates visual aids, examples, and exercises to enhance learning outcomes.

## Content Organization and Scope

### Structured Approach to Physics Topics

One of the defining features of Serway Physics 8th Edition is its logical, systematic organization of topics. The book begins with fundamental concepts, gradually progressing toward more complex theories. The typical structure includes:

- Mechanics ? motion, forces, energy, momentum
- Thermal Physics ? temperature, heat, thermodynamics
- Electromagnetism ? electric and magnetic fields, circuits
- Waves and Optics ? wave properties, light behavior
- Modern Physics ? quantum mechanics, nuclear physics

This progression ensures students build a solid foundation before tackling advanced material.

### Depth and Breadth of Content

The 8th edition offers an expansive treatment of topics, including:

- Classical Mechanics: Newtonian principles, rotational motion, oscillations
- Electromagnetic Theory: Maxwell's equations, electromagnetic waves
- Thermodynamics: laws of thermodynamics, entropy, applications
- Quantum Physics: photoelectric effect, wave-particle duality
- Nuclear Physics: radioactivity, nuclear reactions

The content depth is appropriate for introductory courses but also provides enough detail for advanced exploration, making it versatile across different levels.

## Pedagogical Features and Learning Tools

### Clear Explanations and Visual Aids

Serway's writing style emphasizes clarity. Complex concepts are broken down into manageable parts, often accompanied by diagrams, illustrations, and graphs that clarify the material. For example:

- Illustrations of vectors, forces, and fields

- Diagrams depicting experimental setups
- Graphs illustrating relationships between variables

These visual tools aid in conceptual understanding and retention.

## Worked Examples and Practice Problems

The textbook features numerous worked examples that demonstrate problem-solving techniques step-by-step. These examples are critical for bridging theory and application, fostering analytical skills.

The end-of-chapter problems vary in difficulty, including:

- Basic comprehension questions
- Application-based problems
- Challenging exercises for advanced students

Solutions are provided for selected problems, encouraging self-assessment.

## Special Features

- Conceptual Questions: To test understanding beyond calculations
- Summary Sections: Brief overviews of each chapter's key points
- Real-World Applications: Connecting physics principles to everyday phenomena
- Online Resources: Companion website offering additional quizzes, animations, and supplementary materials

## Strengths of Serway Physics 8th Edition

### Comprehensive Coverage

The textbook covers a wide array of topics thoroughly, making it suitable for a full semester or even a two-course sequence. Its balanced approach ensures students grasp fundamental principles while appreciating their applications.

### Pedagogical Design

The combination of clear explanations, visual aids, and varied exercises caters to diverse learning styles. The inclusion of conceptual questions enhances critical thinking.

## Problem-Solving Focus

Serway emphasizes developing problem-solving skills. The step-by-step worked examples and end-of-chapter problems bolster confidence and competence in tackling physics questions.

## Quality of Visual Content

High-quality illustrations and diagrams significantly enhance comprehension. Visual learning is particularly vital in physics, where spatial reasoning is often key.

## Relevance and Applications

Real-world examples and applications help students see the relevance of physics in everyday life, motivating engagement and curiosity.

## Limitations and Areas for Improvement

### Mathematical Rigor

While the book balances conceptual and mathematical content, some students may find certain derivations and formulas presented without sufficient background explanation, potentially posing challenges for complete novices.

### Digital Integration

Although the accompanying online resources are valuable, their integration could be more seamless. Interactive simulations, for example, could be more prominently featured to enhance engagement.

### Coverage of Modern Physics

Modern physics topics, such as quantum mechanics and nuclear physics, are introduced but could benefit from more in-depth discussion or additional supplementary materials for students interested in advanced concepts.

### Accessibility

Language and explanations are generally clear, but some sections contain dense technical language that may require supplementary tutoring or guidance for struggling readers.

## Comparison with Other Textbooks

When compared to other introductory physics texts like Halliday & Resnick or Knight's Physics for Scientists and Engineers, Serway 8th Edition holds its own in clarity and pedagogical approach. Its strengths lie in the structured presentation and emphasis on conceptual understanding.

However, some educators and students prefer the more mathematically rigorous or application-focused content found in alternative texts. The choice ultimately depends on the course objectives and student preparedness.

## Target Audience and Usage Recommendations

Serway Physics 8th Edition is ideally suited for:

- Undergraduate students taking introductory physics courses
- Instructors seeking a balanced, student-friendly textbook
- Self-learners interested in foundational physics concepts

For maximum benefit, students should complement the textbook with online simulations, problem-solving practice, and supplemental resources, especially if they aim to pursue more advanced physics topics.

## Conclusion: Is Serway Physics 8th Edition a Worthy Investment?

In sum, Serway Physics 8th Edition remains a highly valuable resource in the realm of introductory physics education. Its comprehensive coverage, pedagogical clarity, and emphasis on problem-solving make it a dependable choice for students and educators alike.

While it has areas where enhancements could be made—particularly in integrating more interactive digital content and expanding on modern physics topics—it continues to serve as a robust foundation for understanding the physical universe.

For those seeking a well-structured, conceptually rich, and pedagogically sound physics textbook, Serway Physics 8th Edition stands out as a commendable option that can support learning at various levels of expertise.

**Question** What are the main topics covered in Serway Physics 8th Edition? Serway Physics 8th Edition covers fundamental topics such as mechanics, thermodynamics, electromagnetism, optics, and modern physics, providing a comprehensive overview suitable for introductory physics courses. **Answer** How does Serway Physics 8th Edition incorporate real-world applications? The book integrates real-world examples and problem-solving scenarios to help students understand the practical relevance of physics principles in everyday life and technological

advancements. Are there online resources or supplements available for Serway Physics 8th Edition? Yes, students can access online resources like solution manuals, practice problems, and interactive tutorials through the publisher's website to enhance their learning experience. What are the most effective ways to use Serway Physics 8th Edition for exam preparation? Focus on understanding core concepts, practice end-of-chapter problems, utilize online resources, and review summary sections to reinforce learning and prepare effectively for exams. How does Serway Physics 8th Edition address modern physics topics? The edition introduces modern physics topics such as quantum mechanics, atomic physics, and relativity, providing foundational knowledge aligned with current scientific understanding. Is Serway Physics 8th Edition suitable for self-study students? Yes, the clear explanations, worked examples, and problem sets make it a valuable resource for self-study students seeking to learn physics independently. What are the updates or new features in Serway Physics 8th Edition compared to previous editions? The 8th edition includes updated problem sets, new illustrations, expanded sections on contemporary physics topics, and enhanced online resources to improve clarity and engagement. Can Serway Physics 8th Edition help with understanding laboratory physics experiments? While primarily a theoretical textbook, it offers explanations of fundamental principles behind experiments, aiding students in understanding laboratory concepts and procedures. How do instructors typically incorporate Serway Physics 8th Edition into their curriculum? Instructors use the book for lecture material, assign problem sets from the end-of-chapter exercises, and leverage the online resources to supplement classroom instruction.

**Related keywords:** Serway physics, physics textbook, college physics, physics problems, physics solutions, physics exercises, physics concepts, physics study guide, physics practice problems, introductory physics

**Read the full article online:** [Serway physics 8th edition](#)