Physics for scientists and engineers serway jewett 10th edition

by serway and jewwtt · Language: EN

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Overview

Physics for Scientists and Engineers with Modern Physics by Serway and Jewett, 10th Edition, is a comprehensive, calculus-based textbook designed for introductory physics courses at universities and colleges. It systematically covers fundamental principles of physics, starting with classical mechanics and progressing through oscillations, waves, thermodynamics, electricity and magnetism, light and optics, and concluding with an introduction to modern physics concepts. The book is renowned for its clear and logical presentation, making complex topics accessible to students with a strong mathematical background.

The primary goal of the textbook is to foster a deep understanding of physical concepts and to develop robust problem-solving skills essential for students pursuing careers in science and engineering. It achieves this through a pedagogical approach that includes numerous worked examples, conceptual questions, and a vast array of end-of-chapter problems ranging in difficulty. The 10th edition incorporates updated content, enhanced problem sets, and improved illustrations to reflect current teaching methodologies and scientific understanding, ensuring its continued relevance as a foundational text in physics education.

Key Takeaways

- Mastering fundamental physics principles requires a strong grasp of calculus and vector analysis.
- Effective problem-solving in physics involves a systematic approach, including identifying knowns, unknowns, relevant principles, and logical steps.
- Conceptual understanding is as crucial as mathematical proficiency for truly comprehending physical phenomena.
- The interconnectedness of different physics topics means that knowledge from one area often applies to others.
- Regular practice with a variety of problems, from conceptual to quantitative, is essential for solidifying learning.
- Physics is not just about memorizing formulas, but about applying a few core principles to diverse situations.

• Developing an intuition for physical processes through careful observation and critical thinking enhances learning.

Chapter Summaries

Chapters 1-4: Physics, Measurement, and Kinematics

This section introduces the fundamental principles of physics, including units, dimensional analysis, and significant figures. It then delves into kinematics, the description of motion, covering displacement, velocity, and acceleration in one, two, and three dimensions. Key topics include vector algebra, projectile motion, and relative velocity, laying the mathematical and conceptual groundwork for understanding how objects move without considering the forces involved. Students learn to analyze motion using graphical and analytical methods, preparing them for the study of dynamics, which explores the causes of motion. This foundational material ensures a solid understanding of the language and tools of physics.

Chapters 5-8: Newton's Laws and Energy Conservation

This part focuses on dynamics, introducing Newton's three laws of motion as the foundation for understanding why objects move. It covers various types of forces, such as gravitational force, normal force, friction, and tension, and applies Newton's laws to solve problems involving equilibrium and non-equilibrium situations. The concepts of work, kinetic energy, and potential energy (gravitational and elastic) are developed, leading to the powerful principle of conservation of mechanical energy. The role of nonconservative forces like friction and their impact on energy transformations is also discussed, providing a comprehensive understanding of energy within a system and its various forms.

Chapters 9-11: Momentum and Rotational Dynamics

This section explores linear momentum, impulse, and the conservation of linear momentum for systems of particles, particularly in the context of collisions (elastic and inelastic). It then transitions to rotational motion, defining angular displacement, velocity, and acceleration. Key concepts include torque, moment of inertia, and the rotational equivalents of Newton's laws. The conservation of angular momentum is introduced and applied to various systems, such as rotating rigid bodies and planetary motion. This part bridges linear and rotational mechanics, demonstrating how similar principles govern different types of motion and providing tools for analyzing complex mechanical systems.

Chapters 12-14: Static Equilibrium, Gravitation, and Fluid Mechanics

This final section on mechanics covers the conditions for static equilibrium, analyzing forces and torques on extended objects. It introduces concepts of stress, strain, and elastic moduli, describing how materials deform under load. The universal law of gravitation is explored, including gravitational potential energy, Kepler's laws of planetary motion, and orbital

mechanics. The part concludes with fluid mechanics, examining fluid statics (pressure, buoyancy, Pascal's principle, Archimedes' principle) and fluid dynamics (continuity equation, Bernoulli's equation), providing a foundation for understanding the behavior of liquids and gases in various physical scenarios, from atmospheric pressure to blood flow.

Chapters 15-17: Oscillations, Waves, and Sound

This section introduces simple harmonic motion (SHM), analyzing systems like mass-spring systems and pendulums, and discussing damped and forced oscillations. It then delves into wave motion, defining wave types (transverse and longitudinal), wave speed, and the principle of superposition. Key phenomena like interference, standing waves, and resonance are explored. The discussion extends to sound waves, covering their properties, intensity, the decibel scale, and the Doppler effect, providing a comprehensive understanding of mechanical wave propagation and its applications, from musical instruments to medical imaging. This part connects oscillatory motion to the broader concept of wave phenomena.

Chapters 18-21: Thermodynamics

This part begins with temperature, thermal expansion, and the ideal gas law, establishing the macroscopic properties of matter. It then covers heat, specific heat, latent heat, and the mechanisms of heat transfer: conduction, convection, and radiation. The first law of thermodynamics is introduced, relating internal energy, heat, and work for various thermodynamic processes (isobaric, isochoric, isothermal, adiabatic). The second law of thermodynamics is explored through concepts like entropy, heat engines (Carnot cycle), refrigerators, and the limitations on energy conversion, providing a foundational understanding of energy and its transformations at the macroscopic level, crucial for engineering applications.

Chapters 22-24: Electric Fields and Gauss's Law

This section introduces the fundamental concepts of electric charge, Coulomb's law, and the electric field. It describes how to calculate electric fields due to point charges and continuous charge distributions, and visualizes them using electric field lines. Gauss's law is presented as a powerful tool for calculating electric fields, especially for highly symmetric charge distributions like spheres, cylinders, and planes, simplifying complex calculations and providing a deeper understanding of the relationship between charge and electric field. This lays the groundwork for understanding electrostatic interactions and their applications.

Chapters 25-27: Electric Potential, Capacitance, and Current

This part develops the concept of electric potential and electric potential energy, explaining their relationship to the electric field. It covers equipotential surfaces and how to calculate potential differences. Capacitance is introduced, along with the behavior of capacitors in circuits, energy storage in electric fields, and the role of dielectrics in enhancing capacitance. The section then transitions to electric current, resistance, Ohm's law, and resistivity, laying the groundwork for analyzing electric circuits and understanding the flow of charge, including the microscopic model

of current and power in electrical circuits.

Chapters 28-30: DC Circuits and Magnetic Fields

This section focuses on direct current (DC) circuits, applying Kirchhoff's rules to analyze complex circuits with multiple resistors and sources. It also covers RC circuits, discussing charging and discharging processes and their time constants. The introduction to magnetism begins with magnetic fields, the magnetic force on moving charges (Lorentz force), and the magnetic force on current-carrying wires. Applications like the Hall effect, which measures charge carrier density, and magnetic field lines are explored, establishing the fundamental interactions between moving charges and magnetic fields, essential for understanding motors and other electromagnetic devices.

Chapters 31-32: Sources of Magnetic Field and Induction

This part delves into the origins of magnetic fields, using the Biot-Savart law and Ampere's law to calculate magnetic fields produced by various current configurations, including long straight wires, loops, solenoids, and toroids. It then introduces Faraday's law of induction, explaining how changing magnetic flux generates an electromotive force (EMF). Motional EMF and Lenz's law are discussed, providing a comprehensive understanding of electromagnetic induction and its direction, crucial for generators, transformers, and other devices that convert mechanical energy into electrical energy or vice-versa, demonstrating the interconnectedness of electricity and magnetism.

Chapters 33-34: Inductance, AC Circuits, and Maxwell's Equations

This section covers inductance, including self-inductance and mutual inductance, and the energy stored in inductors. It then transitions to alternating current (AC) circuits, analyzing the behavior of resistors, capacitors, and inductors in AC circuits, including series RLC circuits, impedance, phase relationships, and resonance. The culmination of classical electromagnetism is presented through Maxwell's equations, which unify electric and magnetic phenomena and predict the existence of electromagnetic waves, detailing their properties and propagation, including the speed of light. This part provides a complete picture of classical electromagnetism.

Chapters 35-36: Electromagnetic Waves and The Nature of Light

This section begins by detailing the properties of electromagnetic waves, their generation, and the electromagnetic spectrum, confirming Maxwell's predictions. It then focuses on the nature of light, discussing its wave characteristics, the speed of light, and the phenomena of reflection and refraction. Snell's law is introduced to quantify refraction, along with total internal reflection and dispersion, explaining how light interacts with different media and forms phenomena like rainbows. This part establishes light as an electromagnetic wave and explores its fundamental interactions with matter, setting the stage for optics.

Chapters 37-38: Image Formation and Wave Optics

This part explores image formation by mirrors (plane, spherical) and lenses (converging, diverging), using ray tracing and the mirror/thin lens equations. It then delves into wave optics, covering interference phenomena such as Young's double-slit experiment, interference in thin films, and the Michelson interferometer. Diffraction, including single-slit diffraction and diffraction gratings, is discussed, along with the concept of resolution. Finally, polarization of light is introduced, explaining different methods of producing and detecting polarized light, providing a comprehensive understanding of how light interacts with optical components and exhibits wave-like behavior.

Chapters 39-40: Relativity and Early Quantum Theory

This section introduces Einstein's special theory of relativity, covering its postulates, consequences like time dilation, length contraction, and relativistic momentum and energy, challenging classical notions of space and time. It then transitions to the dawn of quantum physics, discussing blackbody radiation, the photoelectric effect (explaining light as photons), and the Compton effect. The wave-particle duality is introduced with de Broglie's hypothesis, suggesting that particles also exhibit wave-like properties, setting the stage for quantum mechanics and fundamentally altering our understanding of matter and energy at the atomic and subatomic scales.

Chapters 41-42: Quantum Mechanics and Atomic Physics

This part delves deeper into quantum mechanics, introducing the uncertainty principle and the Schrödinger equation as the fundamental equation for describing quantum systems. It applies these principles to the hydrogen atom, explaining its quantized energy levels, atomic orbitals, and quantum numbers (principal, orbital, magnetic, spin). Concepts like electron spin, the Pauli exclusion principle, and the periodic table are discussed. The section also covers atomic spectra, X-rays, and the principles behind laser operation, illustrating the quantum nature of matter and light interactions and their technological applications, such as in spectroscopy and medical imaging.

Chapters 43-44: Nuclear Physics and Particle Physics

This final section explores the structure and properties of the atomic nucleus, including nuclear forces, binding energy, and radioactivity (alpha, beta, and gamma decay). It covers nuclear reactions, fission (and its applications in nuclear power), and fusion (the energy source of stars). The book concludes with an introduction to particle physics, discussing elementary particles, fundamental forces (strong, weak, electromagnetic, gravitational), and the Standard Model of particle physics, providing an overview of the most fundamental constituents of matter and their interactions, and the ongoing quest to understand the universe at its most basic level.

Themes

- Problem-Solving Strategies

- Conceptual Understanding
- Application of Calculus
- Foundational Principles
- Scientific Inquiry

Frequently Asked Questions

What is Physics for scientists and engineers serway jewett 10th edition about?

This textbook provides a comprehensive, calculus-based introduction to physics for university students. It covers classical mechanics, thermodynamics, electricity and magnetism, optics, and modern physics, emphasizing conceptual understanding and problem-solving skills essential for science and engineering disciplines.

Is Physics for scientists and engineers serway jewett 10th edition worth reading?

Yes, it is widely regarded as a highly effective and comprehensive textbook for introductory university physics. Its clear explanations, extensive problem sets, and logical structure make it an excellent resource for students seeking a rigorous foundation in physics for STEM fields.

How does Physics for scientists and engineers serway jewett 10th edition end?

Spoiler: The book concludes with an introduction to modern physics, covering topics such as special relativity, quantum physics, atomic physics, nuclear physics, and an overview of particle physics, providing a glimpse into the frontiers of physical understanding.

Who should read Physics for scientists and engineers serway jewett 10th edition?

This book is primarily intended for university students majoring in science, engineering, and other technical fields who are taking a calculus-based introductory physics course. It is also a valuable reference for anyone seeking a deep and rigorous understanding of fundamental physics principles.

How long does it take to read Physics for scientists and engineers serway jewett 10th edition?

Given its extensive coverage and depth, a thorough 'read' (which for a textbook implies studying and working through problems) could take upwards of 50-70 hours for a full pass, and significantly more for complete mastery over a two-semester course.