

College Physics



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OpenStax College

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Connexions

The technology platform supporting OpenStax College is Connexions (<http://cnx.org>), one of the world's first and largest open-education projects. Connexions provides students with free online and low-cost print editions of the OpenStax College library and provides instructors with tools to customize the content so that they can have the perfect book for their course.

Rice University

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Table of Contents

Preface	7
1 Introduction: The Nature of Science and Physics	11
Physics: An Introduction	12
Physical Quantities and Units	18
Accuracy, Precision, and Significant Figures	25
Approximation	29
2 Kinematics	35
Displacement	36
Vectors, Scalars, and Coordinate Systems	38
Time, Velocity, and Speed	39
Acceleration	43
Motion Equations for Constant Acceleration in One Dimension	51
Problem-Solving Basics for One-Dimensional Kinematics	60
Falling Objects	62
Graphical Analysis of One-Dimensional Motion	68
3 Two-Dimensional Kinematics	85
Kinematics in Two Dimensions: An Introduction	86
Vector Addition and Subtraction: Graphical Methods	88
Vector Addition and Subtraction: Analytical Methods	95
Projectile Motion	101
Addition of Velocities	108
4 Dynamics: Force and Newton's Laws of Motion	125
Development of Force Concept	126
Newton's First Law of Motion: Inertia	127
Newton's Second Law of Motion: Concept of a System	128
Newton's Third Law of Motion: Symmetry in Forces	134
Normal, Tension, and Other Examples of Forces	136
Problem-Solving Strategies	144
Further Applications of Newton's Laws of Motion	146
Extended Topic: The Four Basic Forces—An Introduction	152
5 Further Applications of Newton's Laws: Friction, Drag, and Elasticity	165
Friction	166
Drag Forces	171
Elasticity: Stress and Strain	175
6 Uniform Circular Motion and Gravitation	189
Rotation Angle and Angular Velocity	190
Centripetal Acceleration	193
Centripetal Force	196
Fictitious Forces and Non-inertial Frames: The Coriolis Force	200
Newton's Universal Law of Gravitation	203
Satellites and Kepler's Laws: An Argument for Simplicity	209
7 Work, Energy, and Energy Resources	223
Work: The Scientific Definition	224
Kinetic Energy and the Work-Energy Theorem	226
Gravitational Potential Energy	230
Conservative Forces and Potential Energy	235
Nonconservative Forces	238
Conservation of Energy	242
Power	245
Work, Energy, and Power in Humans	249
World Energy Use	251
8 Linear Momentum and Collisions	263
Linear Momentum and Force	264
Impulse	266
Conservation of Momentum	268
Elastic Collisions in One Dimension	271
Inelastic Collisions in One Dimension	273
Collisions of Point Masses in Two Dimensions	276
Introduction to Rocket Propulsion	279
9 Statics and Torque	291
The First Condition for Equilibrium	292
The Second Condition for Equilibrium	293
Stability	297
Applications of Statics, Including Problem-Solving Strategies	300
Simple Machines	303
Forces and Torques in Muscles and Joints	306
10 Rotational Motion and Angular Momentum	319
Angular Acceleration	320
Kinematics of Rotational Motion	324
Dynamics of Rotational Motion: Rotational Inertia	328
Rotational Kinetic Energy: Work and Energy Revisited	331

Angular Momentum and Its Conservation	338
Collisions of Extended Bodies in Two Dimensions	343
Gyroscopic Effects: Vector Aspects of Angular Momentum	346
11 Fluid Statics	359
What Is a Fluid?	360
Density	361
Pressure	363
Variation of Pressure with Depth in a Fluid	365
Pascal's Principle	368
Gauge Pressure, Absolute Pressure, and Pressure Measurement	370
Archimedes' Principle	373
Cohesion and Adhesion in Liquids: Surface Tension and Capillary Action	379
Pressures in the Body	386
12 Fluid Dynamics and Its Biological and Medical Applications	399
Flow Rate and Its Relation to Velocity	400
Bernoulli's Equation	402
The Most General Applications of Bernoulli's Equation	406
Viscosity and Laminar Flow; Poiseuille's Law	409
The Onset of Turbulence	415
Motion of an Object in a Viscous Fluid	416
Molecular Transport Phenomena: Diffusion, Osmosis, and Related Processes	418
13 Temperature, Kinetic Theory, and the Gas Laws	431
Temperature	432
Thermal Expansion of Solids and Liquids	438
The Ideal Gas Law	444
Kinetic Theory: Atomic and Molecular Explanation of Pressure and Temperature	449
Phase Changes	455
Humidity, Evaporation, and Boiling	460
14 Heat and Heat Transfer Methods	471
Heat	472
Temperature Change and Heat Capacity	473
Phase Change and Latent Heat	478
Heat Transfer Methods	483
Conduction	484
Convection	488
Radiation	492
15 Thermodynamics	507
The First Law of Thermodynamics	508
The First Law of Thermodynamics and Some Simple Processes	512
Introduction to the Second Law of Thermodynamics: Heat Engines and Their Efficiency	519
Carnot's Perfect Heat Engine: The Second Law of Thermodynamics Restated	524
Applications of Thermodynamics: Heat Pumps and Refrigerators	528
Entropy and the Second Law of Thermodynamics: Disorder and the Unavailability of Energy	532
Statistical Interpretation of Entropy and the Second Law of Thermodynamics: The Underlying Explanation	538
16 Oscillatory Motion and Waves	551
Hooke's Law: Stress and Strain Revisited	552
Period and Frequency in Oscillations	556
Simple Harmonic Motion: A Special Periodic Motion	557
The Simple Pendulum	561
Energy and the Simple Harmonic Oscillator	563
Uniform Circular Motion and Simple Harmonic Motion	565
Damped Harmonic Motion	568
Forced Oscillations and Resonance	571
Waves	573
Superposition and Interference	575
Energy in Waves: Intensity	579
17 Physics of Hearing	591
Sound	592
Speed of Sound, Frequency, and Wavelength	594
Sound Intensity and Sound Level	597
Doppler Effect and Sonic Booms	600
Sound Interference and Resonance: Standing Waves in Air Columns	605
Hearing	611
Ultrasound	616
18 Electric Charge and Electric Field	629
Static Electricity and Charge: Conservation of Charge	631
Conductors and Insulators	635
Coulomb's Law	639
Electric Field: Concept of a Field Revisited	640
Electric Field Lines: Multiple Charges	642
Electric Forces in Biology	645
Conductors and Electric Fields in Static Equilibrium	646
Applications of Electrostatics	650

19 Electric Potential and Electric Field	665
Electric Potential Energy: Potential Difference	666
Electric Potential in a Uniform Electric Field	670
Electrical Potential Due to a Point Charge	673
Equipotential Lines	675
Capacitors and Dielectrics	677
Capacitors in Series and Parallel	683
Energy Stored in Capacitors	686
20 Electric Current, Resistance, and Ohm's Law	697
Current	698
Ohm's Law: Resistance and Simple Circuits	703
Resistance and Resistivity	705
Electric Power and Energy	709
Alternating Current versus Direct Current	712
Electric Hazards and the Human Body	716
Nerve Conduction—Electrocardiograms	719
21 Circuits, Bioelectricity, and DC Instruments	735
Resistors in Series and Parallel	736
Electromotive Force: Terminal Voltage	744
Kirchhoff's Rules	750
DC Voltmeters and Ammeters	754
Null Measurements	758
DC Circuits Containing Resistors and Capacitors	761
22 Magnetism	775
Magnets	776
Ferromagnets and Electromagnets	778
Magnetic Fields and Magnetic Field Lines	781
Magnetic Field Strength: Force on a Moving Charge in a Magnetic Field	782
Force on a Moving Charge in a Magnetic Field: Examples and Applications	783
The Hall Effect	787
Magnetic Force on a Current-Carrying Conductor	790
Torque on a Current Loop: Motors and Meters	792
Magnetic Fields Produced by Currents: Ampere's Law	794
Magnetic Force between Two Parallel Conductors	798
More Applications of Magnetism	799
23 Electromagnetic Induction, AC Circuits, and Electrical Technologies	813
Induced Emf and Magnetic Flux	815
Faraday's Law of Induction: Lenz's Law	816
Motional Emf	819
Eddy Currents and Magnetic Damping	822
Electric Generators	825
Back Emf	828
Transformers	828
Electrical Safety: Systems and Devices	832
Inductance	836
RL Circuits	839
Reactance, Inductive and Capacitive	841
RLC Series AC Circuits	844
24 Electromagnetic Waves	861
Maxwell's Equations: Electromagnetic Waves Predicted and Observed	862
Production of Electromagnetic Waves	864
The Electromagnetic Spectrum	866
Energy in Electromagnetic Waves	878
25 Geometric Optics	887
The Ray Aspect of Light	888
The Law of Reflection	889
The Law of Refraction	891
Total Internal Reflection	895
Dispersion: The Rainbow and Prisms	900
Image Formation by Lenses	904
Image Formation by Mirrors	915
26 Vision and Optical Instruments	929
Physics of the Eye	930
Vision Correction	933
Color and Color Vision	936
Microscopes	939
Telescopes	944
Aberrations	947
27 Wave Optics	955
The Wave Aspect of Light: Interference	956
Huygens's Principle: Diffraction	957
Young's Double Slit Experiment	959
Multiple Slit Diffraction	963

Single Slit Diffraction	967
Limits of Resolution: The Rayleigh Criterion	970
Thin Film Interference	974
Polarization	978
Extended Topic Microscopy Enhanced by the Wave Characteristics of Light	985
28 Special Relativity	997
Einstein's Postulates	998
Simultaneity And Time Dilation	1000
Length Contraction	1005
Relativistic Addition of Velocities	1009
Relativistic Momentum	1013
Relativistic Energy	1015
29 Introduction to Quantum Physics	1029
Quantization of Energy	1030
The Photoelectric Effect	1032
Photon Energies and the Electromagnetic Spectrum	1035
Photon Momentum	1041
The Particle-Wave Duality	1045
The Wave Nature of Matter	1046
Probability: The Heisenberg Uncertainty Principle	1049
The Particle-Wave Duality Reviewed	1053
30 Atomic Physics	1063
Discovery of the Atom	1064
Discovery of the Parts of the Atom: Electrons and Nuclei	1065
Bohr's Theory of the Hydrogen Atom	1071
X Rays: Atomic Origins and Applications	1077
Applications of Atomic Excitations and De-Excitations	1081
The Wave Nature of Matter Causes Quantization	1088
Patterns in Spectra Reveal More Quantization	1090
Quantum Numbers and Rules	1092
The Pauli Exclusion Principle	1096
31 Radioactivity and Nuclear Physics	1113
Nuclear Radioactivity	1114
Radiation Detection and Detectors	1117
Substructure of the Nucleus	1119
Nuclear Decay and Conservation Laws	1123
Half-Life and Activity	1129
Binding Energy	1134
Tunneling	1138
32 Medical Applications of Nuclear Physics	1149
Medical Imaging and Diagnostics	1150
Biological Effects of Ionizing Radiation	1153
Therapeutic Uses of Ionizing Radiation	1158
Food Irradiation	1160
Fusion	1161
Fission	1166
Nuclear Weapons	1170
33 Particle Physics	1183
The Yukawa Particle and the Heisenberg Uncertainty Principle Revisited	1184
The Four Basic Forces	1185
Accelerators Create Matter from Energy	1187
Particles, Patterns, and Conservation Laws	1190
Quarks: Is That All There Is?	1194
GUTs: The Unification of Forces	1201
34 Frontiers of Physics	1211
Cosmology and Particle Physics	1212
General Relativity and Quantum Gravity	1218
Superstrings	1223
Dark Matter and Closure	1223
Complexity and Chaos	1226
High-temperature Superconductors	1227
Some Questions We Know to Ask	1229
A Atomic Masses	1237
B Selected Radioactive Isotopes	1243
C Useful Information	1247
D Glossary of Key Symbols and Notation	1253
Index	1264

PREFACE

About OpenStax College

OpenStax College is a non-profit organization committed to improving student access to quality learning materials. Our free textbooks are developed and peer-reviewed by educators to ensure they are readable, accurate, and meet the scope and sequence requirements of modern college courses. Unlike traditional textbooks, OpenStax College resources live online and are owned by the community of educators using them. Through our partnerships with companies and foundations committed to reducing costs for students, OpenStax College is working to improve access to higher education for all. OpenStax College is an initiative of Rice University and is made possible through the generous support of several philanthropic foundations.

About This Book

Welcome to *College Physics*, an OpenStax College resource created with several goals in mind: accessibility, affordability, customization, and student engagement—all while encouraging learners toward high levels of learning. Instructors and students alike will find that this textbook offers a strong foundation in introductory physics, with algebra as a prerequisite. It is available for free online and in low-cost print and e-book editions.

To broaden access and encourage community curation, *College Physics* is “open source” licensed under a Creative Commons Attribution (CC-BY) license. Everyone is invited to submit examples, emerging research, and other feedback to enhance and strengthen the material and keep it current and relevant for today’s students. You can make suggestions by contacting us at info@openstaxcollege.org. You can find the status of the project, as well as alternate versions, corrections, etc., on the StaxDash at <http://openstaxcollege.org> (<http://openstaxcollege.org>).

To the Student

This book is written for you. It is based on the teaching and research experience of numerous physicists and influenced by a strong recollection of their own struggles as students. After reading this book, we hope you see that physics is visible everywhere. Applications range from driving a car to launching a rocket, from a skater whirling on ice to a neutron star spinning in space, and from taking your temperature to taking a chest X-ray.

To the Instructor

This text is intended for one-year introductory courses requiring algebra and some trigonometry, but no calculus. OpenStax College provides the essential supplemental resources at <http://openstaxcollege.org>; however, we have pared down the number of supplements to keep costs low. *College Physics* can be easily customized for your course using Connexions (<http://cnx.org/content/col11406>). Simply select the content most relevant to your curriculum and create a textbook that speaks directly to the needs of your class.

General Approach

College Physics is organized such that topics are introduced conceptually with a steady progression to precise definitions and analytical applications. The analytical aspect (problem solving) is tied back to the conceptual before moving on to another topic. Each introductory chapter, for example, opens with an engaging photograph relevant to the subject of the chapter and interesting applications that are easy for most students to visualize.

Organization, Level, and Content

There is considerable latitude on the part of the instructor regarding the use, organization, level, and content of this book. By choosing the types of problems assigned, the instructor can determine the level of sophistication required of the student.

Concepts and Calculations

The ability to calculate does not guarantee conceptual understanding. In order to unify conceptual, analytical, and calculation skills within the learning process, we have integrated Strategies and Discussions throughout the text.

Modern Perspective

The chapters on modern physics are more complete than many other texts on the market, with an entire chapter devoted to medical applications of nuclear physics and another to particle physics. The final chapter of the text, “Frontiers of Physics,” is devoted to the most exciting endeavors in physics. It ends with a module titled “Some Questions We Know to Ask.”

Supplements

Accompanying the main text are a **Student Solutions Manual and an Instructor Solutions Manual** (<http://openstaxcollege.org/textbooks/college-physics>). The Student Solutions Manual provides worked-out solutions to select end-of-module Problems and Exercises. The Instructor Solutions Manual provides worked-out solutions to all Exercises.

Features of OpenStax *College Physics*

The following briefly describes the special features of this text.

Modularity

This textbook is organized on Connexions (<http://cnx.org>) as a collection of modules that can be rearranged and modified to suit the needs of a particular professor or class. That being said, modules often contain references to content in other modules, as most topics in physics cannot be discussed in isolation.

Learning Objectives

Every module begins with a set of learning objectives. These objectives are designed to guide the instructor in deciding what content to include or assign, and to guide the student with respect to what he or she can expect to learn. After completing the module and end-of-module exercises, students should be able to demonstrate mastery of the learning objectives.

Call-Outs

Key definitions, concepts, and equations are called out with a special design treatment. Call-outs are designed to catch readers' attention, to make it clear that a specific term, concept, or equation is particularly important, and to provide easy reference for a student reviewing content.

Key Terms

Key terms are in bold and are followed by a definition in context. Definitions of key terms are also listed in the Glossary, which appears at the end of the module.

Worked Examples

Worked examples have four distinct parts to promote both analytical and conceptual skills. Worked examples are introduced in words, always using some application that should be of interest. This is followed by a Strategy section that emphasizes the concepts involved and how solving the problem relates to those concepts. This is followed by the mathematical Solution and Discussion.

Many worked examples contain multiple-part problems to help the students learn how to approach normal situations, in which problems tend to have multiple parts. Finally, worked examples employ the techniques of the problem-solving strategies so that students can see how those strategies succeed in practice as well as in theory.

Problem-Solving Strategies

Problem-solving strategies are first presented in a special section and subsequently appear at crucial points in the text where students can benefit most from them. Problem-solving strategies have a logical structure that is reinforced in the worked examples and supported in certain places by line drawings that illustrate various steps.

Misconception Alerts

Students come to physics with preconceptions from everyday experiences and from previous courses. Some of these preconceptions are misconceptions, and many are very common among students and the general public. Some are inadvertently picked up through misunderstandings of lectures and texts. The Misconception Alerts feature is designed to point these out and correct them explicitly.

Take-Home Investigations

Take Home Investigations provide the opportunity for students to apply or explore what they have learned with a hands-on activity.

Things Great and Small

In these special topic essays, macroscopic phenomena (such as air pressure) are explained with submicroscopic phenomena (such as atoms bouncing off walls). These essays support the modern perspective by describing aspects of modern physics before they are formally treated in later chapters. Connections are also made between apparently disparate phenomena.

Simulations

Where applicable, students are directed to the interactive PHeT physics simulations developed by the University of Colorado (<http://phet.colorado.edu> (<http://phet.colorado.edu>)). There they can further explore the physics concepts they have learned about in the module.

Summary

Module summaries are thorough and functional and present all important definitions and equations. Students are able to find the definitions of all terms and symbols as well as their physical relationships. The structure of the summary makes plain the fundamental principles of the module or collection and serves as a useful study guide.

Glossary

At the end of every module or chapter is a glossary containing definitions of all of the key terms in the module or chapter.

End-of-Module Problems

At the end of every chapter is a set of Conceptual Questions and/or skills-based Problems & Exercises. Conceptual Questions challenge students' ability to explain what they have learned conceptually, independent of the mathematical details. Problems & Exercises challenge students to apply both concepts and skills to solve mathematical physics problems. Online, every other problem includes an answer that students can reveal immediately by clicking on a "Show Solution" button. Fully worked solutions to select problems are available in the Student Solutions Manual and the Teacher Solutions Manual.

In addition to traditional skills-based problems, there are three special types of end-of-module problems: Integrated Concept Problems, Unreasonable Results Problems, and Construct Your Own Problems. All of these problems are indicated with a subtitle preceding the problem.