General Physics I

Course Text

- This course does not require a text.

Course Description

This course will start with a descriptive approach. You will first learn about kinematics-the branch of mechanics that describes motion. From mechanics you'll move to the study of energy, power, and momentum. These concepts will be defined rigorously. You'll learn how Newton's laws need to be modified in order to avoid limitations: a few new and simple ideas introduced by Einstein. To conclude you'll learn about Heat and Thermodynamics, including the 1st and 2nd Law of Thermodynamics. This course requires knowledge of basic algebra, trigonometry, and basic calculus including derivatives, limits and integrals.

Course Objectives

After completing this course, students will be able to:

- understand the basic principles pertaining to Newtonian mechanics
- apply these principles to solve practical problems in these areas of study

Course Prerequisites

StraighterLine does not require prerequisites, however it is suggested that students have finished Calculus I (MAT250) prior to enrolling to ensure the best possible outcome.

Important Terms

In this course, different terms are used to designate tasks:

- **Proctoring**: all final exams require proctoring which can be completed conveniently from your home. A webcam is required.
- **Tutoring**: memberships include online tutoring for students to access with any content/subject related questions in the place of faculty. If your tutor is not able to answer your questions please contact a student advisor.
- **Exam**: A graded online test.
- **Exercises**: ungraded practice exercises and quiz questions.

Course Evaluation Criteria

StraighterLine provides a percentage score and letter grade for each course. See Academic Questions section in FAQ for further details on percentage scores and grading scale. A passing percentage is **70%** or higher.

If you have chosen a Partner College to award credit for this course, your final grade will be based upon that college's grading scale. Only passing scores will be considered by Partner

Colleges for an award of credit.

There are a **total of 1000 points** in the course:

Chapter	Assessment	Points Available
3	Graded Exam 1	150
6	Graded Exam 2	150
7	Midterm Exam	200
9	Graded Exam 3	150
13	Graded Exam 4	150
	Final Exam	200
Total		1000

Course Topics and Objectives

Chapter	Topics	Subtopics
Chapter 1: Preliminaries	• Welcome to Physics • Measuring the World Around us • Vectors • Scalar Products • Vector Products	• Welcome to Physics • Physical Quantities and Units of Measurement • Unit Conversion and Dimensional Analysis • Uncertainty in Measurement and Significant Digits • The Basics of Vectors • Vector Components and Unit Vectors • The Scalar Product • The Vector Product
Chapter 2: Kinematics	• Investigating One-Dimensional Motion • One-Dimensional Motion With Constant Acceleration • Describing Motion in Two and Three Dimensions • Investigating Motion in Two	• Describing Motion • Displacement and Average Velocity • Understanding Instantaneous Velocity • Instantaneous Velocity and the Derivative • Acceleration • Another Look at Position, Velocity, and Acceleration • Describing Motion Under Constant Acceleration • Solving Problems Involving Motion Under Constant Acceleration • Free-Falling Objects • The Position and Velocity Vectors • The Acceleration Vector • Relating Position, Velocity, and

	Dimensions • Uniform Circular Motion • Relative Motion and Reference Frames	Acceleration Vectors in Two Dimensions • A First Look at Projectile Motion • Understanding Projectile Motion • Physics in Action: The Hunter and the Monkey • Describing Uniform Circular Motion • Understanding Relative Motion • Physics in Action: Toss-and-Catch from Two Points of View
Chapter 3: Dynamics	• Newton's Three Laws • Applications of Newton's Three Laws • The Forces of Friction • The Dynamics of Circular Motion	• Newton's First Law • Physics in Action: The Three Balls Demo • Introduction to Newton's Second Law • The Vector Nature of Force and Newton's Second Law • Weight • Actions, Reactions, and Newton's Third Law • Physics in Action: A Tug-of-War • Free-Body Diagrams • Solving Problems Using Newton's Laws: Ropes and Tension • Solving Problems Using Newton's Laws: Inclines and the Normal Force • Understanding the Frictional Force Between Two Surfaces • Problems on Friction and Inclines • Motion Through a Fluid: Drag Force and Terminal Speed • Forces and Uniform Circular Motion • Solving Circular Motion Problems
Chapter 4: Energy	• Work • Work, Kinetic Energy, and Power • Potential Energy • Conservation of Energy	• The Work Done by a Constant Force in One Dimension • The Work Done by a Constant Force in Two Dimensions • The Work Done by a Variable Force • The Work Done by a Spring • The Work-Kinetic Energy Theorem • Solving Problems Involving Work and Kinetic Energy • Power • Work and Gravitational Potential Energy • Conservative and Nonconservative Forces • Calculating Potential Energy • Understanding Conservation of Mechanical Energy • Physics in Action: The Triple Chute • Solving Problems Using Conservation of Mechanical Energy • Potential Energy Functions and Energy Diagrams

		• Work and Nonconservative Forces • Physics in Action: The Giant Nose-Basher • Conservation of Energy in General
Chapter 5: Momentum	• Momentum and Its Conservation • Elastic and Inelastic Collisions	• Linear Momentum and Impulse • Solving Problems Using Linear Momentum and Impulse • Conservation of Momentum • Solving Problems Using Conservation of Momentum • Rocket Propulsion • Elastic Collisions in One Dimension • Inelastic Collisions in One Dimension • Collisions in Two Dimensions
Chapter 6: The Physics of Extended Objects	• Systems of Particles and the Center of Mass • Describing Angular Motion • Rotational Inertia and Kinetic Energy • The Dynamics of Rotational Motion • Rolling • Angular Momentum • Conservation of Angular Momentum • Precession • Statics	• The Center of Mass of a System of Particles • The Center of Mass of a Rigid Body • The Center of Mass and the Motion of a System of Particles • Physics in Action: Motion and the Center of Mass • Angular Displacement, Velocity, and Acceleration • Rotation with Constant Angular Acceleration • Relating Angular and Linear Quantities • The Kinetic Energy of Rotation • Calculating the Rotational Inertia of Solid Bodies • Torque • Newton's Second Law for Rotational Motion • Solving Problems Using Newton's Second Law for Rotational Motion • Work and Power in Rotational Motion • Understanding Rolling Motion • Solving Problems Involving Rolling Motion • Physics in Action: A Downhill Race • The Definition of Angular Momentum • Torque and Angular Momentum • Understanding Conservation of Angular Momentum • Physics in Action: Conservation of Angular Momentum • Solving Problems Using Conservation of Angular Momentum • Understanding Precession • The Conditions for Static Equilibrium • Understanding Stable Equilibrium and the Center of Gravity • Solving Static Equilibrium Problems

Chapter 7: Force of Gravity	• Gravity • Orbital Motion	• Newton's Law of Gravitation • Gravity on Earth • Weightlessness • Gravitational Potential Energy • Understanding Circular Orbital Motion • Kepler's Three Laws • Energy in Orbital Motion
Chapter 8: Fluids	• Fluid Statics • Fluid Dynamics	• Fluids, Density, and Pressure • Physics in Action: A Bed of Nails • How Pressure Varies with Depth • Physics in Action: Pressure in a Graduated Cylinder • Physics in Action: Pressure Changes in a Bell Jar • Physics in Action: Barrel Crunch • Pascal's Principle and Examples of Hydrostatics • Buoyancy and Archimedes' Principle • Physics in Action: Buoyancy in Air • Fluids in Motion: Streamlines and Continuity • Bernoulli's Equation • Physics in Action: A Ball Caught in a Stream of Air • Fluids in the Real World: Surface Tension, Turbulence, and Viscosity
Chapter 9: Relativity	• Understanding Einstein's Special Theory of Relativity • The Lorentz Transformations • Relativistic Dynamics	• Einstein's Postulates • The Relativity of Simultaneity • Time Dilation • Length Contraction • The Lorentz Transformation Equations • Solving Problems Using the Lorentz Transformations • Relativistic Momentum • Relativistic Energy • A Clock Story
Chapter 10: Oscillatory Motion	• Simple Harmonic Motion • Pendulums • Damped and Driven Oscillations	• A Mass on a Spring: Simple Harmonic Motion • The Equations Describing Simple Harmonic Motion • Energy in Simple Harmonic Motion • The Simple Pendulum • Physical Pendulums • Damped Simple Harmonic Motion • Driven Oscillators • Physics in Action: Resonance
Chapter 11:	• The Basics of	• Introduction to Waves

Waves	Waves • Waves on Top of Waves • Standing Waves • Sound • Interference and the Doppler Effect	• A Wave on a Rope: Frequency and Wavelength • A Wave on a Rope: Wave Speed • A Wave on a Rope: Energy and Power • Reflection, Transmission, and Superposition • Interference • Standing Waves: Two Waves Traveling in Opposite Directions • Standing Waves on a String • Physics in Action: Standing Waves on a Rope • Longitudinal Standing Waves • Physics in Action: Standing Waves on a Sheet of Metal • Sound Waves • Physics in Action: Sound Waves in a Flaming Pipe • The Character of Sound and Fourier Analysis • Physics in Action: Musical Instruments and Waveforms • Intensity and Loudness • Sound Waves and Interference • Beats • The Doppler Effect
Chapter 12: Heat and Temperature	• Mechanical Equivalent of Heat • Specific and Latent Heat • Heat Transfer and Thermal Expansion	• "Mechanical equivalent of heat" • Mechanical work. • Quantity of heat added to a substance The melting point and boiling point • Heats of fusion and vaporization • Raising temperature from one specified value to another • Melting and vaporizing • Heat transfer and thermal expansion.
Chapter 13: Kinetic Theory and Thermo-dynamics	• Ideal Gases • Laws of Thermo-dynamics	• Kinetic theory model of an ideal gas. • Ideal gas law • Thermodynamics principles • First law of thermodynamics. • Second law of thermodynamics • Concept of entropy • Heat engines • The Carnot cycle

Review and Final Exam	• Review • Final Exam	• Review • Final Exam