straighterline

Syllabus

PHY250 | **General Physics I**

Course Text

No need to track down a textbook; 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.

Learning Outcomes

After completing this course, students will be able to:

1. Understand the basic principles pertaining to Newtonian Mechanics
2. Apply these principles to solve practical problems in these areas of study

Course Prerequisites

There are no prerequisites for this course. However, it is suggested that students complete Calculus I (MAT250) prior to enrollment.

Academic Integrity Statement

Academic integrity is the pursuit of scholarly activity in an honest, truthful and responsible manner. Violations of academic integrity include, but are not limited to, plagiarism, cheating, fabrication and academic misconduct. Failure to comply with the Academic Integrity Policy can result in a failure and/or zero on the attempted assignment/examination, a removal from the course, disqualification to enroll in future courses, and/or revocation of an academic transcript.

Course Completion Policy

In order for a course to be considered complete, **all required coursework must be attempted, submitted, and graded.** Required coursework consists of graded assignments. Any Academic Integrity Policy violations may prevent a course from being considered complete.

Assessment Types

StraighterLine courses may include any combination of the assessment types described below. Review the descriptions to learn about each type, then review the Course Evaluation Criteria to understand how your learning will be measured in this course.

Benchmarks
Benchmarks test your mastery of course concepts. You have 3 attempts, and your highest score counts.
Note: Cumulative Benchmarks (final exams) only allow 1 attempt.

Capstones
Capstones are project-based assessments that help you apply concepts to real-world scenarios. You have 2 attempts, and your highest score counts.

Checkpoints
Checkpoints are quick knowledge checks on important course concepts. All are open-book, and most have 1-3 attempts.

AI Use-Case Policies

StraighterLine Capstone assessments operate under one of three AI Use-Case Policies. These designations are selected intentionally to support learners in developing digital literacy, ethical reasoning, and authentic communication skills. Each model requires students to engage meaningfully with the course outcomes while adhering to academic standards.

Independent Work Requirement: Capstones with this designation must be completed independently without using AI tools. The goal is for learners to showcase their own understanding and skills without AI assistance. Students are expected to generate and submit original work developed solely through their own reasoning and effort.

AI-Assisted Planning Option: Capstones with this designation may allow AI tools to support brainstorming and assessment planning. If allowed, students will be asked to document any AI assistance by noting how it informed their work. Documentation must be included within the assignment or in a designated reflection field. Examples include describing how an AI tool helped organize an outline, generate ideas, or surface sources for further exploration.

AI-Integration Requirement: Capstones with this designation require AI tools as part of the learning process. Students will be asked to reflect upon their AI interactions and AI contributions to the assessment. Reflections must include which tools were used, how they were used, and what insights students gained from the process. This promotes transparency, ethical use, and metacognitive skill-building.

Course Evaluation Criteria

Your score provides a percentage score and letter grade for each course. A passing percentage is 70% or higher.

There are a total of 1000 points in the course:

Assessment	Points
Checkpoint 1: Preliminaries	0

Assessment	Points
Checkpoint 2: Kinematics	0
Checkpoint 3: Dynamics	0
Benchmark 1: Checkpoints 1-3	150
Checkpoint 4: Energy	0
Checkpoint 5: Momentum	0
Checkpoint 6: The Physics of Extended Objects	0
Benchmark 2: Checkpoints 4-6	150
Checkpoint 7: Force of Gravity	0
Benchmark 3: Checkpoints 1-7	200
Checkpoint 8: Fluids	0
Checkpoint 9: Relativity	0
Benchmark 4: Checkpoints 7-9	150
Checkpoint 10: Oscillatory Motion	0
Checkpoint 11: Waves	0
Checkpoint 12: Temperature and Heat	0
Checkpoint 13: Kinetic Theory and Thermodynamics	0
Benchmark 5: Checkpoints 10-13	150
Benchmark 6: Checkpoints 8-13	200
Total	**1000**

Course Roadmap

This roadmap provides an overview of the checkpoints and lessons covered in this course.

Checkpoint 1: Preliminaries

- Welcome to Physics
- Physical Quantities and Unites 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
- Checkpoint 1 Practice Review

Checkpoint 2: Kinematics

- 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 Acceleration Vectors in Two Dimensions
- A First Look at Projectile Motion
- Understanding Projectile Motion
- Physics in Action: Toss-and-Catch from Two Points of View
- Checkpoint 2 Practice Review

Checkpoint 3: Dynamics

- 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
- Checkpoint 3 Practice Review

Checkpoint 4: 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

- Checkpoint 4 Practice Review

Checkpoint 5: Momentum

- 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
- Checkpoint 5 Practice Review

Checkpoint 6: The Physics of Extended Objects

- The Center of Mass of a System of Particles
- The Center of Mass of 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
- Checkpoint 6 Practice Review

Checkpoint 7: Force of Gravity

- Newton's Law of Gravitation
- Gravity of Earth
- Weightlessness
- Gravitational Potential Energy
- Understanding Circular Orbital Motion
- Kepler's Three Laws
- Energy in Orbital Motion
- Checkpoint 7 Practice Review

Checkpoint 8: Fluids

- 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
- Fluid 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
- Checkpoint 8 Practice Review

Checkpoint 9: Relativity

- 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
- Checkpoint 9 Practice Review

Checkpoint 10: Oscillatory Motion

- A Mass on a Spring: Simple Harmonic Motion
- The Equations Describing Simple Harmonic Motion
- Energy in Simple Harmonic Motion
- The Simple Pendulum
- Physical Pedulums
- Damped Simple Harmonic Motion
- Driven Oscillators
- Physics in Action: Resonance
- Checkpoint 10 Practice Review

Checkpoint 11: Waves

- Introduction to Waves
- A Wave on a Rope: Frequency and Wavelength
- A Wave on a Rope: Wave Speedh
- 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
- Sounds Waves and Interference
- Beats
- The Doppler Effect
- Checkpoint 11 Practice Review

Checkpoint 12: Temperature and Heat

- Mechanical Equivalent of Heat
- Specific and Latent Heat
- Heat Transfer and Thermal Expansion
- Checkpoint 12 Practice Review

Checkpoint 13: Kinetic Theory and Thermodynamics

- Ideal Gases
- Law of Thermodynamics
- Checkpoint 13 Practice Review

Related Courses

PHY250L
General Physics I Lab
View Course →

MAT250
General Calculus I
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BIO250
Microbiology
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