# AP Physics C: Mechanics

2026–2027 Academic Year

## Instructor Information

Instructor: Jan C. Bierowiec (Mr. B.)
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Office Hours:

- Monday 3:00 – 3:30
- Thursday 3:00 – 3:30
- Friday 3:00 – 4:00

## Course Description

Physics provides a mathematical framework for understanding how and why objects move. In AP Physics C: Mechanics, students will explore the fundamental principles of classical mechanics through a rigorous, calculus-based approach. Beginning with motion and kinematics, the course progresses through Newton's laws, work and energy, momentum, rotational motion, oscillations, and gravitation.

Throughout the course, students will learn to approach physical situations as scientists and problem-solvers. Emphasis is placed not only on obtaining a correct numerical answer, but also on understanding the physical principles behind that answer, constructing mathematical models, interpreting graphs and diagrams, and clearly communicating scientific reasoning. Calculus will be used as a natural tool for describing change and connecting quantities such as position, velocity, acceleration, force, momentum, and energy.

Learning will take many forms, including challenging problem-solving, laboratory investigations, experimental design, data analysis, mathematical modeling, collaborative inquiry, and independent exploration. By the end of the course, students will have developed a deeper understanding of mechanics and a strong foundation for further study in physics, engineering, mathematics, and other quantitative sciences.

## Learning Goals

Students will:

1. Develop scientific inquiry, experimental design, data analysis, and mathematical modeling skills.
2. Analyze one-dimensional and two-dimensional motion using **kinematics**, including position, displacement, velocity, acceleration, and projectile motion.
3. Apply **Newton's Laws of Motion** to analyze forces, free-body diagrams, friction, tension, normal forces, and other dynamics problems.
4. Analyze **work, energy, and power**, including the work–energy theorem, potential energy, kinetic energy, and conservation of mechanical energy.
5. Analyze **linear momentum**, impulse, collisions, center of mass, and conservation of momentum.
6. Analyze **rotational motion**, including angular position, angular velocity, angular acceleration, torque, rotational inertia, and rotational dynamics.
7. Apply **conservation of angular momentum** to rotating systems.
8. Analyze **oscillatory motion**, including simple harmonic motion, springs, pendulums, and the energy of oscillating systems.

9. Apply **Newton's Law of Universal Gravitation** to gravitational forces, fields, potential energy, circular orbits, and planetary motion.
10. Use **calculus**—including derivatives and integrals—to describe and analyze relationships among position, velocity, acceleration, force, momentum, work, and energy.
11. Construct, interpret, and connect **graphs, equations, diagrams, and physical models** to explain the behavior of mechanical systems.
12. Apply multiple mechanics concepts together to solve complex, multi-step problems in preparation for the **AP Physics C: Mechanics Exam**.

## Class Policies

1. Be respectful.
2. Be responsible.
3. Communicate.
4. Your work must be your own.

## Technology Policies

1. Smart Devices
   (a) No smart phones
   (b) No apple watches
   (c) No meta glasses

   Every piece of technology must be turned in at the start of class in the respect phone/technology holder.
2. AI
   (a) No AI
      i. Exams **will not** have any AI use of any kind.
      ii. Labs **will not** have any AI use of any kind.
      iii. Quizzes **will not** have any AI use of any kind.
      iv. Classwork **will not** have any AI use of any kind.
   (b) Some AI
      i. Homework **will** have some AI use, however your work must be your own.

## Required Materials

- Calculator
- Pencil (or erasable pen)
- Notebook (all notes must be handwritten)
- Folder or binder for handouts (recommended)

## Course Structure

**Daily Quizzes:** Every class begins with a brief 5-minute quiz reviewing the previous lesson.

**Notes:** Class slides/class notes will be posted prior to each test for review (not after each class period). If absent, you must obtain notes from a classmate or schedule a meeting with me during office hours.

**Investigations:** Learning includes problem-solving, hands-on inquiry, laboratory investigations, and

research projects.

## Accommodations

**Exams:** If you have an approved accommodation from the school, you will be expected to take the first two thirds of the exam with the whole class, which you will then, not be able to have access to again, and the remaining third of the exam, you will complete during ARC.

**Quizzes:** Everyone will take a quiz at the start of class. The quiz will be structured in such a way that if you are a student with accommodations, you will be able to complete the quiz in the same amount of time as students without accommodations.

## Grading Breakdown

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|---|---|
| Tests | 40% |
| Labs | 30% |
| Quizzes | 10% |
| Classwork | 10% |
| Homework | 5% |
| Class Participation | 5% |

## Late Work Policy

All work is due at the start of the class period for which it is assigned. Missing or incomplete work will be penalized 10% per day unsubmitted. Assignments more than one week late will result in a grade of zero.

## Major Topics

- Kinematics:
  - Scalars and Vectors
  - Displacement, Velocity, and Acceleration
  - Representing Motion
  - Reference Frames and Relative Motion
  - Motion in Two or Three Dimensions
- Force & Translational Dyanmics:
  - Systems and Center of Mass
  - Forces and Free-Body Diagrams
  - Newton's Third Law
  - Newton's First Law
  - Newton's Second Law
  - Gravitational Force
  - Kinetic and Static Friction
  - Spring Forces
  - Resistive Forces
  - Circular Motion
- Work, Energy, and Power:

  - Translational Kinetic Energy
  - Work
  - Potential Energy
  - Conservation of Energy
  - Power
- Linear Momentum:
  - Linear Momentum
  - Change in Momentum and Impulse
  - Conservation of Linear Momentum
  - Elastic and Inelastic Collisions
- Torque and Rotational Dynamics:
  - Rotational Kinematics
  - Connecting Linear and Rotational Motion
  - Torque
  - Rotational Inertia
  - Rotational Equilibrium and Newton's First Law in Rotational Form
  - Newton's Second Law in Rotational Form
- Energy and Momentum of Rotating Systems:
  - Rotational Kinetic Energy
  - Torque and Work
  - Angular Momentum and Angular Impulse
  - Conservation of Angular Momentum
  - Rolling
  - Motion of Orbiting Satellites
- Oscillations:
  - Defining Simple Harmonic Motion
  - Frequency and Period of SHM
  - Representing and Analyzing SHM
  - Energy of Simple Harmonic Oscillators
  - Simple and Physical Pendulums

## Communication Expectations

Students are responsible for:

- Checking myLS regularly
- Obtaining notes from a fellow student if absent
- Communicating early regarding academic concerns via email or after class