Curriculum at a Glance

AP Physics C: Mechanics

Level: 400

Grades 11 or 12

This Advanced Placement Physics course at Darien is a demanding curriculum, designed specifically to prepare students for the AP Physics C: Mechanics test. In this course, students will receive a strong college-level foundation in physics. Emphasis will be placed on solving a variety of high-level problems, requiring calculus. In order to fully understand the intricacies of physics, the students must be guided by the principals of Scientific Thought and Inquiry to solve not only their homework and in-class problems, but also with their experimental investigations in laboratories. Students will often be required to develop their own experimental procedures to answer questions and solve problems posed to them. This course is designed to provide the student with a college-level, calculus-based, introduction to the study of physics. At the completion of the course, all students will be well prepared to take the College Board's Advanced Placement Physics C: Mechanics examination. Throughout all class activities students will present questions for open discussion (among students and with the instructor). These discussions foster an environment of student-centered learning and guided inquiry, as those questions will often times lead to more experimentation on the student's part.

While the main goal of the course is the preparation of the students to take the A.P. exam, it is further intended that upon the completion of the course the students will also be able to:

- Read, understand and interpret both mathematical and graphical information.
- Develop their problem-solving skills, which are reflected by the formulation of questions and hypotheses, and the analysis of the results of those experiments.
- Describe and explain the steps needed to fully analyze a given physics problem or situation and explain those steps in a mathematical, experimental and verbal manner.
- Use calculus to fully analyze and solve complex mathematical application problems.
- Design and perform experiments that analyze a given problem or situation, taking into account experimental uncertainties and the limitations of the theoretical models in use.

Unit Name & Description	Content and/or Skills
Unit 1 One-Dimensional Motion	• Position and Displacement • Average & Instantaneous Speed and Velocity • Acceleration • Kinematics Applications • Free-Fall • Graphical Analysis Position vs. Time Velocity vs. Time Acceleration vs. Time • Solving differential equations to generate v vs t equations of motion
Unit 2 Vector Operations	• Whole & Unit Vectors • Vector Components • Vector Addition • Vector Subtraction • Vector Multiplication Scalar Product (Dot) Vector Product (Cross)
Unit 3 Motion in Two and Three Dimensions	• 3-D position and displacement • 3-D Velocity, Acceleration • Projectile Motion • Relative Motion in One and Two Dimensions

Unit 4 Forces and Motion	• Force • Mass • Newton's Three Laws of Motion • Common Forces: Weight, Normal, Tension • Circular Motion • Problem Solving: Applications of Newton's Laws and Circular Motion
Unit 5 Friction Forces	• Friction Forces: Static & Kinetic, Drag • Solving differential equations with drag to generate v vs t equations to model motion. • Use calculus to derive expressions for x vs t & a vs t
Unit 6 Work and Kinetic Energy	• Work • Kinetic Energy • Work / Energy Theorem
Unit 7 Potential Energy and Non-Conservative Work	• Conservative and nonconservative forces • Potential Energy: Elastic & Gravitational • Work done by the spring force • Work done by the gravitational force • Work done by varying forces • Non conservative work • Energy Conservation
Unit 8 Center of Mass and Momentum	• Center of mass • Impulse • Linear momentum • Impulse momentum theorem • Conservation of momentum • Inelastic & elastic collisions • Rotation quantities: Angular displacement, angular velocity,

	angular acceleration
Unit 9 Rotational Dynamics	• Relationship between linear and rotational quantities • Rotational mass (I) • Using calculus to derive moment of inertia formulas for commonly used rigid bodies • Torque • Newton's second law for rotation • Rotational kinetic energy
Unit 10 Rolling and Angular Momentum	• Rolling as combination of linear and rotational motion • Rolling with slipping • Solving linear and rotational differential equations to analyze rolling with slipping • Angular momentum of particles • Angular momentum of rigid bodies
Unit 11 Equilibrium	• Equilibrium • Linear conditions of equilibrium • Rotational conditions of equilibrium • Applications of equilibrium: levers, ladder problems, hinge problems
Unit 12 Gravitation	• Newton's Law of Gravitation • Gravitational fields • Using calculus to derive equation for Gravitational Potential energy • Escape speed • Orbital motion • Circular: orbital period and speed • Elliptical: Kepler's Laws and Conservation of momentum • Simple Harmonic Motion

Unit 13 Oscillations	• Equations of motions for harmonic oscillators • Using calculus to derive period equations for masses on springs & pendulums • Series and parallel springs • Physical pendulums • Torsion pendulums • Damped harmonic motion (conceptual)