

AP[®] Physics C

AP[®] Physics C is intended to provide a rigorous introductory college level Physics course with laboratory activities. AP[®] Physics C includes mechanics, electricity and magnetism at a level appropriate for college majors in the physical sciences and engineering. Calculus is used to develop concepts. One part of the Physics C examination covers mechanics; the other part covers electricity and magnetism. Students are permitted to take either or both parts of this examination, and separate grades are reported for the two subject areas to provide greater flexibility in planning AP[®] courses and making advanced placement decisions. (apcentral.collegeboard.com) The following course materials are in no way intended to replace the extensive materials provided by the College Board. The AP[®] course outline and recommended laboratory experiences are revised periodically by the College Board. The teacher of this course should have the most current copy of the AP[®] Physics C course description book and materials from the College Board. These materials are available at the AP Central website <http://apcentral.collegeboard.com>.

AP[®] Physics C is recommended as a second-year physics course for students interested in the physical science and/or engineering. Calculus is used to formulate physical principles of electricity and magnetism and solve problems. Inquiry is applied to the study of matter and energy and their interaction. Learners will study natural and technological systems. The program strands and unifying concepts provide a context for teaching content and process skill goals.

All goals should focus on the unifying concepts:

- Systems, Order and Organization
- Evidence, Models, and Explanation
- Constancy, Change, and Measurement
- Evolution and Equilibrium
- Form and Function

Strands: The strands are: Nature of Science, Science as Inquiry, Science and Technology, Science in Personal and Social Perspectives. They provide the context for teaching of the content Goals and Objectives.

COMPETENCY GOAL 1: The learner will develop abilities necessary to do and understand scientific inquiry.

Objectives

- 1.06 Identify questions and problems that can be answered through scientific investigations.
- 1.07 Design and conduct scientific investigations to answer questions about the physical world.
- Create testable hypotheses.
 - Identify variables.

- Use a control or comparison group when appropriate.
 - Select and use appropriate measurement tools.
 - Observe and measure real phenomena.
 - Collect and record data.
 - Organize data into charts and graphs.
 - Analyze and interpret data.
 - Determine uncertainties in measurements.
 - Communicate findings.
- 1.08 Formulate and revise scientific explanations and models using logic and evidence to:
- Explain observations.
 - Make inferences and predictions from data and observations.
 - Explain the relationship between evidence and explanation.
 - Communicate results, including suggested ways to improve experiments and proposed questions for further study.
- 1.09 Apply safety procedures in the laboratory and in field studies:
- Recognize and avoid potential hazards.
 - Safely manipulate materials and equipment needed for scientific investigations.
 1. Analyze reports of scientific investigations of physical phenomena from an informed scientifically literate viewpoints including considerations of:
 - Adequacy of experimental controls.
 - Replication of findings.
 - Alternative interpretations of the data.

COMPETENCY GOAL 2: The learner will build an understanding of electrostatics.

- 2.01 Analyze and evaluate electric field.
- Calculate force, net force and torque on a charge or collection of charges in a specific field.
 - Calculate and sketch equipotentials for a configuration.
 - Use integration to determine electric potential.
 - Utilize the conservation of electric field to solve problems.
- 2.02 Calculate and analyze Coulomb's law, field, and potential of point charges.
- Define magnitude and direction of a force and electric field on a charge.
 - Calculate electric potential near one or more charges.
 - Compute the force and electric field between charges.
 - Determine the work necessary to move charges and potential energy of the system.
- 2.03 Evaluate and analyze fields and potentials of other charge distributions.
- Using the principle of superposition and integration, calculate:
 - Electric field for a wire and ring.
 - Electric potential for a disk.
 - Determine the electric field of
 - Charged plates.
 - Uniformly charged wire.
 - Thin cylindrical shell.

- Determine the mathematical expression for various situation of electric potential.
- 2.04 State and apply Gauss's law.
- Determine the flux of electric field through an arbitrary surface.
 - Use the integral form of Gauss's Law to determine electric flux and charge.
 - Use Gauss's Law to find charge density on a surface.
 - Graph electric field to find maxima and minima.

COMPETENCY GOAL 3: The learner will build an understanding of conductors, capacitors, and dielectrics.

- 3.01 Examine and analyze electrostatics with conductors.
- Describe and sketch the features of electric fields in and outside of a conductor.
 - Describe the charge density on a conductor.
 - Explain charging by induction and how charges are brought near a conductor.
 - Clarify qualitatively the electric field region.
- 3.02 Identify and evaluate capacitors and dielectric.
- Define capacitance with stored charge and voltage.
 - Recognize energy storage in relation to voltage, charge, and energy.
 - Relate voltage, charge, and stored energy in a capacitor.
 - Analyze capacitance and energy of a parallel plate.
 - Define the electric field and capacitance in spherical and cylindrical objects.
 - Explain how a dielectric affects the capacitance field strength and voltage.

COMPETENCY GOAL 4: The learner will build an understanding of electric circuits.

- 4.01 Measure and analyze the current, resistance, and power in electric circuits.
- Relate current and voltage for a resistor.
 - Qualitatively describe what happens in terms of electric field strength, current density, and drift electron velocity in a conductor.
 - Explain and calculate how cross-sectional area, length, and material affect the resistance of a resistor.
 - Explain the rate of how heat is dissipated.
- 4.02 Examine and analyze steady-state direct current circuits with batteries and resistors.
- Define and relate current, resistance, and voltage.
 - Identify series and parallel wiring in a circuit.
 - Determine voltage, current, resistance, and power across series, parallel, and combination circuits.
 - Draw a diagram of a series-parallel circuit using conventional symbols.
 - Calculate terminal voltage and internal resistance for a known battery.
 - Identify and calculate the current, voltage and resistance using Ohm's Law and Kirchoff's rules.
 - Identify the properties and connections of an ammeter and voltmeter.
- 4.03 Evaluate and analyze capacitors in circuits.
- Explain the capacitance for capacitors in parallel and series circuits.
 - Identify and examine energy storage in a capacitor.
 - Explain the charge and voltage for capacitors in parallel and series circuits.

- Graph and mathematically express the discharging of a capacitor over time.
- Calculate and graph voltage and currents over time in a circuit.

COMPETENCY GOAL 5: The learner will build an understanding of magnetostatics.

- 5.01 Derive and analyze the force on a charge in a magnetic field.
- Calculate charge, force, velocity, and magnetic field.
 - Explain why work cannot be performed by a magnetic field.
 - Explain the motion of charged particle in a magnetic field.
- 5.02 Analyze the force on a current-carrying wire in magnetic fields.
- Relate the magnitude and direction of charge, velocity, magnetic field, and force on a moving charges and current-carrying wire in a magnetic field.
 - Analyze the torque on a rectangular loop of wire in a magnetic field.
- 5.03 Examine the magnetic fields of long current-carrying wires.
- Analyze the magnetic fields of long current-carrying wires.
 - Calculate the forces between long current-carrying wires.
- 5.04 Apply and use Biot-Savart and Ampere's law.
- Articulate and utilize Ampere's Law in the integral form to relate current to magnetic field strength.
 - Analyze magnetic field for a long straight wire, solid cylinder, and hollow cylinder using law of superposition.

COMPETENCY GOAL 6: The learner will build an understanding of electromagnetism.

- 6.01 Evaluate and analyze electromagnetic induction using Faraday's law and Lenz's law.
- Calculate the flux of a uniform magnetic field.
 - Calculate the magnetic flux of a nonuniform magnetic field using integration
 - Identify the magnitude and direction of the induced emf and current in a uniform magnetic field for specific and general cases.
 - Develop the skills necessary to solve basic problems with electromagnetic induction.
- 6.02 Formulate and examine inductance (including LR and LC circuits).
- Calculate the magnitude and emf for an inductor through which a specified changing current is flowing.
 - Apply self-inductance for a long solenoid.
 - Develop the skills necessary to solve basic circuits with resistors and inductors.
- 6.03 Explain Maxwell's equations in integral form and discuss their implications.