AP® PHYSICS C: MECHANICS

About the Advanced Placement Program® (AP®)

The Advanced Placement Program® enables willing and academically prepared students to pursue college-level studies — with the opportunity to earn college credit, advanced placement, or both — while still in high school. AP® Exams are given each year in May. Students who earn a qualifying score on an AP Exam are typically eligible to receive college credit and/or placement into advanced courses in college. Every aspect of AP course and exam development is the result of collaboration between AP teachers and college faculty. They work together to develop AP courses and exams, set scoring standards, and score the exams. College faculty review every AP teacher's course syllabus.

AP Physics Program

The AP Program offers four physics courses: AP Physics 1: Algebra-Based, AP Physics 2: Algebra-Based, AP Physics C: Mechanics, and AP Physics C: Electricity and Magnetism.

Guided by the National Research Council and National Science Foundation, the AP Program collaborated with college and university educators and AP teachers to develop two yearlong AP Physics courses to replace AP Physics B.

AP Physics 1: Algebra-Based and AP Physics 2: Algebra-Based are the equivalent of the first and second semesters of introductory, algebra-based college courses. Because these courses are intended to be yearlong courses, teachers have time to foster deeper conceptual understanding through student-centered, inquiry-based instruction. Students have time to master foundational physics principles while engaging in science practices to earn credit, placement, or both.

In addition, there are two AP Physics C courses: Physics C: Mechanics and Physics C: Electricity and Magnetism. Each corresponds to one semester of an introductory, calculus-based college course. Physics C: Mechanics is taught prior to Physics C: Electricity and Magnetism.

AP Physics C: Mechanics Course Overview

AP Physics C: Mechanics is equivalent to a one-semester, calculus-based, college-level physics course, especially appropriate for students planning to specialize or major in physical science or engineering. The course explores topics such as kinematics; Newton's laws of motion; work, energy and power; systems of particles and linear momentum; circular motion and rotation; and oscillations and gravitation. Introductory differential and integral calculus is used throughout the course.

LABORATORY REQUIREMENT

AP Physics C: Mechanics should include a hands-on laboratory component comparable to a semester-long introductory college-level physics laboratory. Students should spend a minimum of 20 percent of instructional time engaged in hands-on laboratory work. Students ask questions, make observations and predictions, design experiments, analyze data, and construct arguments in a collaborative setting, where they direct and monitor their progress. Each student should complete a lab notebook or portfolio of lab reports.

PREREQUISITE

Students should have taken or be concurrently taking calculus.

AP Physics C: Mechanics Course Content

The AP Physics C: Mechanics course applies both differential and integral calculus and provides instruction in each of the following six content areas:

- Kinematics
- Newton's laws of motion
- Work, energy and power
- Systems of particles and linear momentum
- Circular motion and rotation
- Oscillations and gravitation

Learning Objectives for Laboratory and Experimental Situations

Students establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Focusing on these disciplinary practices and experimental skills enables teachers to use the principles of scientific inquiry to promote a more engaging and rigorous experience for AP Physics C: Mechanics students. Such practices or skills require students to

- Design experiments
- Observe and measure real phenomena
- Organize, display, and critically analyze data
- Analyze sources of error and determine uncertainties in measurement
- Draw inferences from observations and data
- Communicate results, including suggested ways to improve experiments and proposed questions for further study

A minimum of 20 percent of instructional time is devoted to hands-on and inquiry-based laboratory investigations.

AP Physics C: Mechanics Exam Structure

AP PHYSICS C: MECHANICS EXAM: 90 MINUTES

Assessment Overview

The AP Physics C: Mechanics Exam includes questions posed in a laboratory or experimental setting. Questions assess understanding of content as well as experimental skills. The exam may also include questions that overlap several major topical areas or questions on miscellaneous topics such as identification of vectors and scalars, vector mathematics, or graphs of functions.

Students will be allowed to use a calculator on the entire AP Physics C: Mechanics and AP Physics C: Electricity and Magnetism Exams — including both the multiple-choice and free-response sections. Scientific or graphing calculators (including the approved graphing calculators listed at www.collegeboard.org/ap/calculators) may be used, provided that they do not have any unapproved features or capabilities.

Format of Assessment

Section I: Multiple Choice | 35 Questions | 45 Minutes | 50% of Exam Score

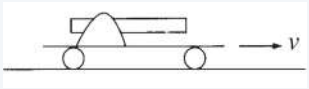
- Discrete Questions
- Questions in Sets

Section II: Free Response | 3 Questions | 45 Minutes | 50% of Exam Score

- Laboratory Based (graphing calculator permitted)
- Discrete Questions (graphing calculator permitted)

AP PHYSICS C : MECHANICS SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question



(a) $\frac{Mv}{m}$

(b) $\frac{(M+m)v}{m}$

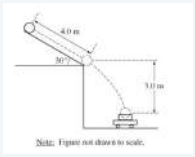
(c) $\frac{(M-m)v}{m}$

(d) $\frac{mv}{M}$

(e) $\frac{mv}{(M-m)}$

Correct Answer: B

Sample Free-Response Question



(a) On the figure below, draw and label the forces (not components) acting on the ball at their points of application as it rolls along the roof.

(b) Calculate the force due to friction acting on the ball as it rolls along the roof. If you need to draw anything other than what you have shown in part (a) to assist in your solution, use the space below. Do NOT add anything to the figure in part (a).

(c) Calculate the linear speed of the center of mass of the ball when it reaches the bottom edge of the roof.

(d) A wagon containing a box is at rest on the ground below the roof so that the ball falls a vertical distance of 3.0 m and lands and sticks in the center of the box. The total mass of the wagon and the box is 12 kg. Calculate the horizontal speed of the wagon immediately after the ball lands in it.

Educators: apcentral.collegeboard.org/apphysicscmechanics

Students: apstudent.collegeboard.org/apphysicscmechanics

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