AP® Physics C: Mechanics

About the Advanced Placement Program® (AP®)

The Advanced Placement Program® has enabled millions of students to take college-level courses and 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, in college, to receive credit, placement into advanced courses, or both. 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 is a full-year course that is the equivalent of a first-semester introductory college course in algebra-based physics.

AP Physics 2: Algebra-Based is a full-year course, equivalent to a second-semester introductory college course in physics.

AP Physics C: Mechanics is a half-year course equivalent to a semester-long, introductory calculus-based college course.

AP Physics C: Electricity and Magnetism, a half-year course following Physics C: Mechanics, is equivalent to a semester-long, introductory calculus-based college course.

AP Physics C: Mechanics Course Overview

AP Physics C: Mechanics is a calculus-based, college-level physics course. It covers kinematics; Newton's laws of motion; work, energy, and power; systems of particles and linear momentum; circular motion and rotation; oscillations; and gravitation.

PREREQUISITES

Students should have taken or be concurrently taking calculus.

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 25% 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.

AP Physics C: Mechanics Course Content

The course content is organized into seven commonly taught units, which have been arranged in the following suggested, logical sequence:

- **Unit 1:** Kinematics
- **Unit 2:** Newton's Laws of Motion
- **Unit 3:** Work, Energy, and Power
- **Unit 4:** Systems of Particles and Linear Momentum
- **Unit 5:** Rotation
- **Unit 6:** Oscillations
- **Unit 7:** Gravitation

Each unit is broken down into teachable segments called topics. In addition, the following big ideas serve as the foundation of the course, enabling students to create meaningful connections among concepts and develop deeper conceptual understanding:

- **Change:** Interactions produce changes in motion.
- **Force Interactions:** Forces characterize interactions between objects or systems.
- **Fields:** Fields predict and describe interactions.
- **Conservation:** Conservation laws constrain interactions.

AP Physics C: Mechanics Science Practices

The following science practices describe what skills students should develop during the course:

- **Visual Representations:** Analyze and/or use [nonnarrative/non-mathematical] representations of physical situations, excluding graphs.
- **Question and Method:** Determine scientific questions and methods.
- **Representing Data and Phenomena:** Create visual representations or models of physical situations.
- **Data Analysis:** Analyze quantitative data represented in graphs.
- **Theoretical Relationships:** Determine the effects on a quantity when another quantity or the physical situation changes.
- **Mathematical Routines:** Solve problems of physical situations using mathematical relationships.
- **Argumentation:** Develop an explanation or scientific argument.

AP Physics C: Mechanics Exam Structure

AP PHYSICS C: MECHANICS EXAM: 1 HOUR, 30 MINUTES

Assessment Overview

The AP Physics C: Mechanics Exam assesses student application of the science practices and understanding of the learning objectives outlined in the course framework. The exam is 1 hour and 30 minutes long and includes 35 multiple-choice questions and 3 free-response questions. A four-function, scientific, or graphing calculator is allowed on both sections of the exam.

Format of Assessment

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

- Science Practices 1, 2, 4, 5, 6, and 7 are assessed.
- Science Practice 3 is not assessed.

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

- All Science Practices are assessed.
- One of the three questions will include an experimental or lab-based component.
- Each question is worth **15 points each**.

Exam Components

Sample Multiple-Choice Question

A particle P is located on the x-axis, as shown in the figure. A force exerted on the particle is given by the equation $F = kx^3$, where $k = 4(\text{N/m}^3)$. How much work is done by the force in moving the particle from $x = 2$ m to $x = 1$ m?

(A) 15 J

(B) 28 J

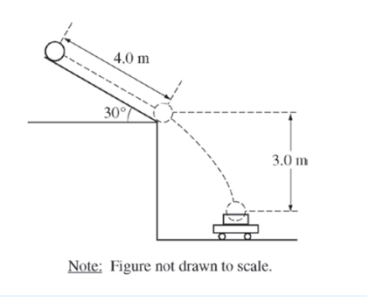
(C) 32 J

(D) 36 J

(E) 60 J

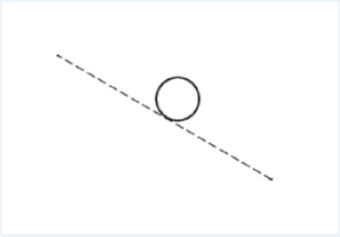
Correct Answer: A

Sample Free-Response Question



A bowling ball of mass 6.0 kg is released from rest from the top of a slanted roof that is 4.0 m long and angled at 30°, as shown. The ball rolls along the roof without slipping. The rotational inertia of a sphere of mass M and radius R about its center of mass is $(2/5)MR^2$.

(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.

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