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

This course requires that 25% of instructional time be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to demonstrate the foundational physics principles and apply the science practices. Colleges may require students to present their laboratory materials from AP science courses before granting college credit for laboratory work, so students are encouraged to retain their notebooks, reports, and other materials.

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:** Force and Translational Dynamics
- **Unit 3:** Work, Energy, and Power
- **Unit 4:** Linear Momentum
- **Unit 5:** Torque and Rotational Dynamics
- **Unit 6:** Energy and Momentum of Rotating Systems
- **Unit 7:** Oscillations

Each unit is broken down into teachable segments called topics.

AP Physics C: Mechanics Science Practices

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

- **Creating Representations:** Create representations that depict physical phenomena.
- **Mathematical Routines:** Conduct analyses to derive, calculate, estimate, or predict.
- **Scientific Questioning and Argumentation:** Describe experimental procedures, analyze data, and support claims.

AP Physics C: Mechanics Exam Structure

AP PHYSICS C: MECHANICS EXAM: 3 HOURS

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 3 hours long and includes 40 multiple-choice questions and 4 free-response questions. The 4 free-response questions appear in the order listed in the table on the right. A four-function, scientific, or graphing calculator is allowed on both sections of the exam.

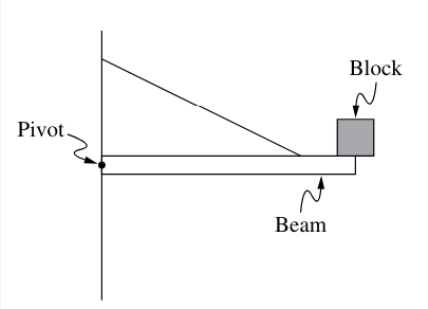
Format of Assessment

Section I:	Multiple-choice | 40 Questions | 80 Minutes | 50% of Exam Score
Section II:	Free-response | 4 Questions | 100 Minutes | 50% of Exam Score

- Question 1: Mathematical Routines **(10 points).**
- Question 2: Translational Between Representations **(12 points).**
- Question 3: Experimental Design and Analysis **(10 points).**
- Question 4: Qualitative/Quantitative Translation **(8 points each).**

Exam Components

Sample Multiple-Choice Question



A uniform beam of length $0.60\ \text{m}$ and mass $4.0\ \text{kg}$ is fixed to a wall by a pivot. The beam is held horizontally by a string fixed to the beam and wall. A block of mass $1.0\ \text{kg}$ is attached at the end of the beam, as shown. Which of the following is nearest to the magnitude of the torque about the pivot exerted by the weight of the block?

(A) 0

(B) $6\ \text{N}\cdot\text{m}$

(C) $10\ \text{N}\cdot\text{m}$

(D) $18\ \text{N}\cdot\text{m}$

Correct Answer: B

SAMPLE FREE RESPONSE QUESTION APPEARS ON NEXT PAGE

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Sample Free-Response Question – Mathematical Routines

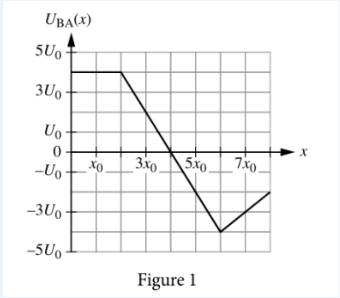

Figure 1

A system is comprised of two objects, A and B, which interact with each other through a conservative force $F_{\mathrm{BA}}(x)$, where x is the position of Object A with respect to Object B. The potential energy $U_{\mathrm{BA}}(x)$ of the two-object system as a function of x is shown in Figure 1. No external forces are exerted on the two-object system.

Object A has mass m_{A} and is released from rest a position $x = 3x_0$. Object A starts moving, and later passes through position $x = 7x_0$.

(a)

i. **Derive** an expression for the speed of Object A at the instant Object A is passing through position $x = 7x_0$. Express your answer in terms of m_{A}, U_0, x_0, and physical constants, as appropriate.

ii. On the grid shown in Figure 2, **draw** a graph of the force exerted on Object A by Object B.

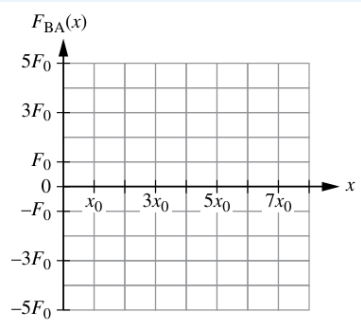

Figure 2

In another scenario, Object A is replaced by Object C. Objects C and B interact with each other through a conservative force $F_{\mathrm{BC}}(x) = -\beta x^2$, where $\beta = \frac{3}{8}\frac{\mathrm{kg}}{\mathrm{s}^2\mathrm{m}}$. The potential energy $U_{\mathrm{BC}}(x)$ of the Object C – Object B system is defined to be zero when Object C is at position $x = -2\ \mathrm{m}$. No external forces are exerted on the two-object system.

(b) **Derive** an equation for $U_{\mathrm{BC}}(x)$. Express your answer only in terms of x.

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