AP® Physics 1: Algebra-Based

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 1 Course Overview

AP Physics 1 is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: kinematics, dynamics, circular motion and gravitation, energy, momentum, simple harmonic motion, torque and rotational motion, electric charge and electric force, DC circuits, and mechanical waves and sound.

PREREQUISITES

Students should have completed Geometry and be concurrently taking Algebra II or an equivalent course. Although the Physics 1 course includes basic use of trigonometric functions, this understanding can be gained either in the concurrent math course or in the AP Physics 1 course itself.

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 1 Course Content

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

- **Unit 1:** Kinematics
- **Unit 2:** Dynamics
- **Unit 3:** Circular Motion and Gravitation
- **Unit 4:** Energy
- **Unit 5:** Momentum
- **Unit 6:** Simple Harmonic Motion
- **Unit 7:** Torque and Rotational Motion
- **Unit 8:** Electric Charge and Electric Force
- **Unit 9:** DC Circuits
- **Unit 10:** Mechanical Waves and Sound

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:

- **Systems:** Objects and systems have properties such as mass and charge.
- **Fields:** Fields existing in space can be used to explain interactions.
- **Force Interactions:** The interactions of an object with other objects can be described by forces.
- **Change:** Interactions between systems can result in changes in those systems.
- **Conservation:** Changes that occur as a result of interactions are constrained by conservation laws.
- **Waves:** Waves can transfer energy and momentum from one location to another without the permanent transfer of mass.

AP Physics 1 Science Practices

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

- **Modeling:** Use representations and models to communicate scientific phenomena and solve scientific problems.
- **Mathematical Routines:** Use mathematics appropriately.
- **Scientific Questioning:** Engage in scientific questioning to extend thinking or guide investigations.
- **Experimental Methods:** Plan and implement data collection strategies in relation to a particular scientific question.
- **Data Analysis:** Perform data analysis and evaluation of evidence.
- **Argumentation:** Work with scientific explanations and theories.
- **Making Connections:** Connect and relate knowledge across various scales, concepts, and representations in and across domains.

AP Physics 1 Exam Structure

AP PHYSICS 1 EXAM: 3 HOURS

Assessment Overview

The AP Physics 1 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 50 multiple-choice questions and 5 free-response questions. The 5 free-response questions may appear in any order. A four-function, scientific, or graphing calculator is allowed on both sections of the exam.

Format of Assessment

Section I: Multiple-choice | 50 Questions | 90 Minutes | 50% of Exam Score

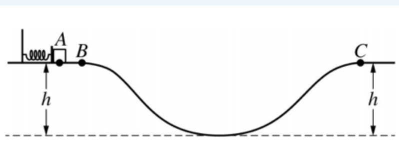
- 45 single-select multiple-choice questions (discrete or in sets).
- 5 multiple-select multiple-choice items (all discrete).

Section II: Free-response | 5 Questions | 90 Minutes | 50% of Exam Score

- Question 1: Experimental Design **(12 points).**
- Question 2: Qualitative/Quantitative Translation **(12 points).**
- Question 3: Paragraph Argument Short Answer **(7 points).**
- Questions 4 and 5: Short Answer **(7 points each).**

Exam Components

Sample Multiple-Choice Question



A block is held at rest against a compressed spring at point *A* at the top of a frictionless track of height *h*, as show. The block is released, loses contact with the spring at point *B*, and slides along the track until it passes point *C*, also at height *h*. How do the potential energy *U* of the block-Earth system and the kinetic energy *K* of the block at point *C* compare with those at point *A*?

Potential Energy of Block-Earth System	Kinetic Energy of Block
(A) $U_C = U_A$	$K_C = K_A$
(B) $U_C = U_A$	$K_C > K_A$
(C) $U_C > U_A$	$K_C = K_A$
(D) $U_C > U_A$.	$K_C > K_A$

Correct Answer: B

Sample Free-Response Question: Paragraph Argument Short Answer

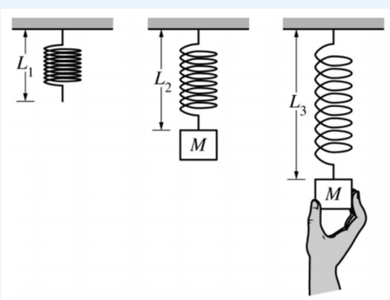


Figure 1 Figure 2 Figure 3

A spring with unstretched length L_1 is hung vertically, with the top end fixed in place, as shown in Figure 1. A block of mass *M* is attached to the bottom of the spring, as shown in Figure 2, and the spring has length $L_2 > L_1$ when the block hangs at rest. The block is then pulled downward and held in place so that the spring is stretched to a length $L_3 > L_2$, as shown in Figure 3.

(A) On the dot, which represents the block in Figure 3, draw and label the forces (not components) exerted on the block. Each force must be represented by a distinct arrow starting on, and pointing away from, the dot.

(B) The student releases the block. Consider the time during which the block is moving upward toward its equilibrium position and the spring length is still longer than L_2.

In a clear, coherent paragraph-length response that may also contain diagrams and/or equations, indicate why the total mechanical energy is increasing, decreasing, or constant for each of the systems listed below.

- System 1: The block
- System 2: The block and the spring
- System 3: The block, the spring, and Earth

Use E_1, E_2, and E_3 to denote the total mechanical energy of systems 1, 2, and 3, respectively.