AP® PHYSICS 2

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 is a full-year course that is the equivalent of a first-semester introductory college course in algebra-based physics. The course covers 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.

AP Physics 2 is a full-year course, equivalent to a second-semester introductory college course in algebra-based physics.

AP Physics C: Mechanics is a half-year course that is the equivalent of a semester-long, introductory calculus-based college course. It covers kinematics; Newton's laws of motion; work, energy, and power; systems of particles and linear momentum; circular motion and rotation; and oscillations and gravitation.

AP Physics C: Electricity and Magnetism is a half-year course following Physics C: Mechanics that is the equivalent of a semester-long, introductory calculus-based college course and covers electrostatics; conductors, capacitors, and dielectrics; electric circuits; magnetic fields; and electromagnetism.

AP Physics 2: Algebra-Based Course Overview

AP Physics 2 is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics through inquiry-based investigations as they explore these topics: fluids; thermodynamics; electrical force, field, and potential; electric circuits; magnetism and electromagnetic induction; geometric and physical optics; and quantum, atomic, and nuclear physics.

LABORATORY REQUIREMENT

This course requires that 25 percent of the instructional time will 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.

Inquiry-based laboratory experiences support the AP Physics 2 course and AP Course Audit curricular requirements by providing opportunities for students to engage in the seven science practices as they design plans for experiments, make predictions, collect and analyze data, apply mathematical routines, develop explanations, and communicate about their work.

Colleges may require students to present their laboratory materials from AP science courses before granting college credit for laboratory work, so students should be encouraged to retain their laboratory notebooks, reports, and other materials.

PREREQUISITES

Students should have completed AP Physics 1 or a comparable introductory physics course, and should have taken or be concurrently taking pre-calculus or an equivalent course.

AP Physics 2: Algebra-Based Course Content

Students explore principles of fluids, thermodynamics, electricity, magnetism, optics, and topics in modern physics. The course is based on seven big ideas, which encompass core scientific principles, theories, and processes that cut across traditional boundaries and provide a broad way of thinking about the physical world. The following are the big ideas:

- Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Fields existing in space can be used to explain interactions.
- The interactions of an object with other objects can be described by forces.
- Interactions between systems can result in changes in those systems.
- Changes that occur as a result of interactions are constrained by conservation laws.
- Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.
- The mathematics of probability can be used to describe the behavior of complex systems and to interpret the behavior of quantum mechanical systems.

Science Practices

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

- Use representations and models to communicate scientific phenomena and solve scientific problems;
- Use mathematics appropriately;
- Engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course;
- Plan and implement data collection strategies in relation to a particular scientific question;
- Perform data analysis and evaluation of evidence;
- Work with scientific explanations and theories; and
- Connect and relate knowledge across various scales, concepts, and representations in and across domains.

AP Physics 2 Exam Structure

AP PHYSICS 2 EXAM: 3 HOURS

Assessment Overview

Exam questions are based on learning objectives, which combine science practices with specific content. Students are assessed on their ability to:

- Provide both qualitative and quantitative explanations, reasoning, or justification of physical phenomena, grounded in physics principles and theories;
- Solve problems mathematically — including symbolically — but with less emphasis on only mathematical routines used for solutions;
- Interpret and develop conceptual models; and
- Transfer knowledge and analytical skills developed during laboratory experiences to design and describe experiments and analyze data and draw conclusions based on evidence.

Students will be allowed to use a four-function, scientific, or graphing calculator on the entire AP Physics 1 and AP Physics 2 Exams. Scientific or graphing calculators (including the approved graphing calculators listed at www.collegeboard.org/ap/calculators) cannot have any unapproved features or capabilities.

Format of Assessment

Section I: Multiple Choice: 50 Questions | 1 Hour, 30 Minutes | 50% of Exam Score

- Discrete questions
- Questions in sets
- Multiple-correct questions (two options will be correct)

Section II: Free Response: 4 Questions | 1 Hour, 30 Minutes | 50% of Exam Score

- Experimental Design (1 question)
- Quantitative/Qualitative Translation (1 question)
- Short Answer (2 questions, one requiring a paragraph-length argument)

AP PHYSICS 2 SAMPLE EXAM QUESTIONS

Sample Multiple-Choice Question

A student writes the following information for a process that involves a fixed quantity of ideal gas.

$W = -P\Delta V$

$\Delta U = Q + W$

$P = 2.0\text{x}10^5\text{Pa}$

$\Delta V = -2.0\text{x}10^{-3}\text{m}^3$

$\Delta U = -600J$

Which of the following descriptions best represents the process?

(A) The gas expands at a constant pressure of 200 kPa.

(B) The gas is cooled at constant volume until its pressure falls to 200 kPa.

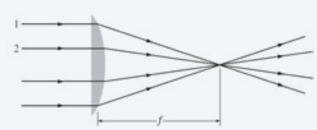
(C) The gas is compressed at a constant pressure of 200 kPa.

(D) The gas is heated and its pressure increases at constant volume.

Correct Answer: C

Sample Free-Response Question: Experimental Design

Quantitative/Qualitative Translation



The figure at left represents a glass lens that has one flat surface and one curved surface. After incoming parallel rays pass through the lens, the rays pass through a focal point.

(A) The rays undergo refraction and change direction at the right surface of the lens, as shown. Explain why the angle of refraction of ray 1 is greater than that of ray 2.

(B) The index of refraction of the glass is n_{glass}, and the radius of curvature of the lens's right edge is R. (The radius of curvature is the radius of the sphere of which that edge is a part. A smaller R corresponds to a lens that curves more). A teacher who wants to test a class's understanding about lenses asks the students if the equation $f = n_{glass}R$ makes sense for the focal length of the lens in air. Is the teacher's equation reasonable for determination of the focal length? Qualitatively explain your reasoning, making sure you address the dependence of the focal length on both R and n_{glass}.

(C) An object is placed a distance $f/2$ (half of the focal length) to the left of the lens. On which side of the lens does the image form, and what is its distance from the lens in terms of f? Justify your answer. (Assume this is a thin lens.)

(D) The lens is now placed in water, which has an index of refraction that is greater than air but less than the glass. Indicate below whether the new focal length is greater than, less than, or equal to the focal length f in air.

____ Greater than in air

____ Less than in air

____The same as in air

Justify your answer qualitatively, with no equations or calculations.

00678-0009 (Updated June 2017)