AP® Physics 2: 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 2 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: thermodynamics; electrical force, field, and potential; electric circuits; magnetism and electromagnetic induction; geometric and physical optics; and quantum, atomic, and nuclear physics.

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.

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 2 Course Content

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

- **Unit 9:** Thermodynamics
- **Unit 10:** Electric Force, Field, and Potential
- **Unit 11:** Electric Circuits
- **Unit 12:** Magnetism and Electromagnetism
- **Unit 13:** Geometric Optics
- **Unit 14:** Waves, Sound, and Physical Optics
- **Unit 15:** Modern Physics

Each unit is broken down into teachable segments called topics.

AP Physics 2 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 2 Exam Structure

AP PHYSICS 2 EXAM: 3 HOURS

Assessment Overview

The AP Physics 2 Exam assesses student application of the science practices and understanding of the course 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 four 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).**

SAMPLE ITEMS APPEAR ON THE NEXT PAGE

00558-040 (Updated October 2024)

Sample Multiple-Choice Question

A blackbody of temperature T_0 emits a spectrum of light with a peak wavelength λ_0. The rate at which energy is emitted by the blackbody is P_0. The temperature of the blackbody is then changed so that the new peak wavelength emitted by the blackbody is $\frac{\lambda_0}{2}$. Which of the following correctly indicates the rate at which energy is emitted by the blackbody at this new temperature?

(A) $\frac{P_0}{2}$ (B) $\frac{P_0}{16}$ (C) $2P_0$. (D) $16P_0$

Correct Answer: D

Sample Free-Response Question: Mathematical Routines

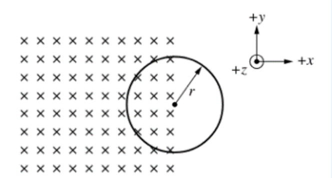

Figure 1

A circular conducting loop of radius r is held at rest in the xy-plane, as shown in Figure 1. The resistance of the loop is R. Half of the loop is in a region with a uniform magnetic field of magnitude B_0 that is directed into the page ($-z$-direction). During a time interval Δt, the magnitude of the magnetic field is increased at a constant rate from B_0 to $4B_0$.

(a) Express your answers for (a)(i) and (a)(ii) in terms of r, R, B_0, Δt, and physical constants, as appropriate.

(i) **Derive** an expression for the emf $\mathcal{E}$ induced in the loop during the interval Δt.

(ii) **Derive** an expression for the total energy dissipated by the loop during the interval Δt.

(iii) Complete the following tasks on Figure 2:

- Draw an arrow labeled I to indicate the direction of the current in the loop during the interval Δt.
- **Draw** an arrow labeled F to indicate the direction of the net magnetic force exerted on the loop during the interval t.

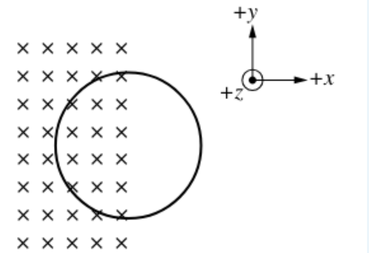

Figure 2

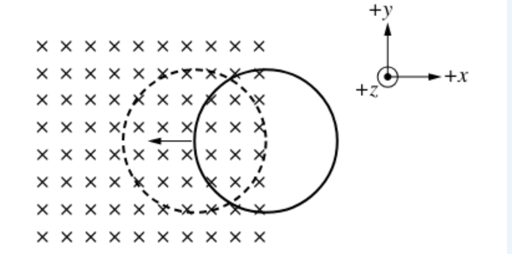

Figure 3

The magnitude of the magnetic field is now held constant while the loop is pulled in the $-x$-direction by an external force until the loop is completely inside the region with the magnetic field, as indicated by the dashed line in Figure 3.

(b) On both blanks below, **write** "yes" or "no" to indicate whether an emf is induced in the loop when the loop is partially in the region with the magnetic field and when the loop is completely in the region.

________ When the loop is partially in the region

________ When the loop is completely in the region

Justify your answers using physics principles.

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