Exam Overview

The AP Physics C: Electricity and Magnetism 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. A four-function, scientific, or graphing calculator is allowed on both sections of the exam. The details of the exam, including exam weighting and timing, can be found below:

Section	Type of Questions	Number of Questions	Weighting	Timing
I	Multiple-choice questions	40	50%	80 minutes
II	Free-response questions	4	50%	100 minutes
	Question 1: Mathematical Routines			
	Question 2: Translation Between Representations			
	Question 3: Experimental Design and Analysis			
	Question 4: Qualitative/Quantitative Translation			

The exam also assesses each of the six units of instruction with the following exam weightings on the multiple-choice section of the AP exam:

Exam Weighting for the Multiple-Choice Section of the AP Exam

Units of Instruction	Exam Weighting
Unit 8: Electric Charges, Fields, and Gauss's Law	**15–25%**
Unit 9: Electric Potential	**10–20%**
Unit 10: Conductors and Capacitors	**10–15%**
Unit 11: Electric Circuits	**15–25%**
Unit 12: Magnetic Fields and Electromagnetism	**10–20%**
Unit 13: Electromagnetic Induction	**10–20%**

How Student Learning Is Assessed on the AP Exam

Exam Weighting by Science Practice

Science Practices 2 and 3 are assessed in the multiple-choice section with the following weighting (Science Practice 1 will not be assessed in the multiple - choice section). Science Practices 1, 2 and 3 are all assessed in the free-response section with the following weighting.

Please note: Required course content (Learning Objectives and Essential Knowledge) can be assessed with any skill.

Science Practice		Approximate MCQ Exam Weighting	Approximate FR Exam Weighting
1.A	Create diagrams, tables, charts, or schematics to represent physical situations.	N/A	20–35%
1.B	Create quantitative graphs with appropriate scales and units, including plotting data.		
1.C	Create qualitative sketches of graphs that represent features of a model or the behavior of a physical system.		
2.A	Derive a symbolic expression from known quantities by selecting and following a logical mathematical pathway.	25–30%	40–45%
2.B	Calculate or estimate an unknown quantity with units from known quantities, by selecting and following a logical computational pathway.	20–25%	
2.C	Compare physical quantities between two or more scenarios or at different times and locations in a single scenario.	10–15%	
2.D	Predict new values or factors of change of physical quantities using functional dependence between variables.	10–15%	

Science Practice		Approximate MCQ Exam Weighting	Approximate FR Exam Weighting
3.A	Create experimental procedures that are appropriate for a given scientific question.	N/A	30–35%
3.B	Apply an appropriate law, definition, theoretical relationship, or model to make a claim.	15–25%	
3.C	Justify or support a claim using evidence from experimental data, physical representations, or physical principles or laws.	5–10%	

Free-Response Questions

The free-response section of the AP Physics C: Electricity and Magnetism exam consists of four question types listed below in the order they will appear on the exam.

Mathematical Routines (MR)

Science Practices: 1.A 1.C 2.A 2.B 3.B 3.C

10 Points; suggested time: 20–25 minutes

The Mathematical Routines question (MR), assesses students' ability to use mathematics to analyze a scenario and make predictions about that scenario. Students will be expected to create and use representations that describe the scenario, either to help guide the mathematical analysis (such as drawing a free-body diagram) or that are applicable to the scenario (such as sketching a graph of velocity as a function of time).

Translation Between Representations (TBR)

Science Practices: 1.A 1.C 2.A 2.D 3.B 3.C

12 Points; suggested time: 25–30 minutes

The Translation Between Representations question (TBR) assesses students' ability to connect different representations of a scenario. Students will be expected to create a visual representation that describes a given scenario. Students will derive equations that are mathematically relevant to the scenario. Students will draw graphs that relate quantities within the scenario. Finally, students will be asked to do any one of the following:

- Justify why their answers to any two of the previous parts do/do not agree with each other.
- Use their representations, mathematical analysis, or graphs to make a prediction about another situation and justify their prediction using that reasoning or analysis.
- Use their representations, mathematical analysis, or graph to make a prediction about how those representations would change if properties of the scenario were altered and justify that claim using consistent reasoning or analysis.

Experimental Design and Analysis (LAB)

Science Practices: 1.B 2.B 2.D 3.A

10 Points; suggested time: 25–30 minutes

The Experimental Design and Analysis question (LAB) assesses students' ability to create scientific procedures that can be used with appropriate data analysis techniques to determine the answer to given questions. The LAB question can roughly be divided into two sections: Design and Analysis. In the Design portion of the LAB question, students will be asked to develop a method by which a question about a given physical scenario could be answered. Then experimental procedure is expected to be scientifically sound: vary a single parameter, and measure how that change affects a single characteristic. Methods must be able to be performed in a typical high school laboratory. Measurements must be made with realistically obtainable equipment or sensors. Students will be expected to describe a method by which the collected data could be analyzed in order to answer the posed question, by either graphical or comparative analysis.

Students will then be given experimental data collected in order to answer a similar, but not identical, equation to what was asked in the Design portion of the question. Students will be asked to use the data provided to create and plot a graph that can be analyzed to determine the answer to the given question. For instance, the slope or intercepts of the line my be used to determine a physical quantity or perhaps the nature of the slope would answer the posed question.

Qualitative/Quantitative Translation (QQT)

Science Practices: 2.A 2.D 3.A 3.C

8 points; suggested time: 15–20 minutes

The Qualitative/Quantitative Translation question (QQT) assesses a students' ability to connect the nature of the scenario, the physical laws that govern the scenario, and the mathematical representations of that scenario to each other. Students will be asked to make and justify a claim about a given scenario, as well as derive an equation related to that scenario. Finally, students will be asked to do any one of the following:

- Justify why their answers to any of the previous parts do/do not agree with each other.
- Use their representations or mathematical analysis to make a prediction about another situation and justify their prediction using that reasoning or analysis.
- Use their representations and mathematical analysis to make a prediction about how those representations would change if properties of the scenario were altered and justify that claim using consistent reasoning or analysis.

While students may not be directly assessed on their ability to create diagrams or other representations of the system to answer the QQT, those skills may still help students to answer the QQT. For instance, some students may find that drawing a free-body diagram is useful when determining the acceleration of the system. However, the students will earn points for the explanation and conclusions that diagram indicates (or perhaps the derivation that results from the diagram), rather than for creating the diagram itself.

Task Verbs Used in Free-Response Questions

The following task verbs are commonly used in the free-response questions.

Calculate: Perform mathematical steps to arrive at a final answer, including algebraic expressions, properly substituted numbers, and correct labeling of units and significant figures.

Compare: Provide a description or explanation of similarities and/or differences.

Derive: Starting with a fundamental law or relationship, perform a series of mathematical steps to arrive at a final answer.

Describe: Provide the relevant characteristics of a specified topic.

Determine: Make a decision or arrive at a conclusion after reasoning, observation, or applying mathematical routines (calculations).

Draw: Create a diagram or schematic that illustrates relationships, depicts physical objects, or demonstrates consistency between different types of representation. Labels may or may not be required.

Estimate: Roughly calculate numerical quantities, values (greater than, equal to, less than), or signs (negative, positive) of quantities based on experimental evidence or provided data. When making estimations, showing steps in calculations are not required.

Indicate: Provide information about a specified topic, without elaboration or explanation.

Justify: Provide qualitative reasoning beyond mathematical derivations or expressions to support, qualify, or defend a claim.

Label: Provide labels indicating unit, scale, and/or components in a diagram, graph, model, or representation.

Plot: Draw data points in a graph using a given scale or indicating the scale and units, demonstrating consistency between different types of representations.

Rank: Arrange quantities in relation to each other, typically by size or magnitude.

Sketch: Create a diagram, graph, representation, or model that illustrates or explains relationships or phenomena, demonstrating consistency between different types of representations. Labels may or may not be required.

Verify: Confirm that the conditions of a scientific definition, law, theorem, or test are met to explain why it applies in a given situation. Also, use empirical data, observations, tests, or experiments to prove, confirm, and/or justify a hypothesis.