

Overview

The Translation Between Representations (TBR) question is the second free-response question in Section 2 of the AP Physics 1 exam. It requires students to create visual representations of a physics scenario, perform a mathematical derivation, sketch a graph, and then translate between all of those representations by making and justifying a claim.

Points and Timing

- Worth 12 points out of 40 total points in Section 2 – the highest point value of the four free-response questions.
- Suggested time: 25 to 30 minutes out of 100 minutes total in Section 2 – the longest suggested time of the four free-response questions.

Typical Question Structure

A Translation Between Representations question follows this general pattern:

- **Non-graphical representation:** Create a visual model of the scenario. This is typically a free-body diagram or two, or energy bar charts.
- **Mathematical derivation:** Derive at least one equation that supports the non-graphical representation you created, or another representation provided in the question.
- **Graph:** Sketch a graph that models the variables in the physics scenario.
- **Translation and justification:** Connect all of the representations by doing one of the following: justify why your previous answers do or do not agree with one another; make a prediction about a related scenario and justify it; or predict how your answers would change if the scenario were modified and justify your reasoning.

Example from the AP Physics 1 Course and Exam Description (FRQ #2 on [pages 194-196](#))

The spring-block energy question in the AP Physics 1 CED illustrates the typical Translation Between Representations structure clearly:

- **Part a:** Draw shaded rectangles to complete the energy bar charts. This is the non-graphical representation step.
- **Parts b(i) and b(ii):** Given graphs about the scenario, determine an expression for the spring constant and derive an expression for the mass of the block. This is the mathematical derivation step.
- **Part c:** Sketch a graph of the velocity of the block as a function of time. This is the graphing step.

- **Part d:** Given a hypothetical student's claim, justify why the student's sketch and claim are or are not consistent with the graph from part c. This is the translation and justification step.

Key Takeaways

- The Translation Between Representations question has multiple types of representations: non-graphical (diagrams, bar charts), graphical (graphs), and equation (derivations). Some are created by the student; others are provided in the question.
- The final part always requires translating between those representations by making and justifying a claim, not just calculating an answer.
- All Translation Between Representations questions in the Ultimate Exam Slayer practice exams and the Ultimate Review Packet follow this same structure, which is also what to expect on the actual AP Physics 1 exam.