Chief Reader Report on Student Responses:

2025 AP® Physics 1: Algebra-Based Free-Response Questions

• Number of Students Scored	174,992		
• Number of Readers	840		
• Score Distribution	Exam Score	N	%At
	5	34,546	19.7%
	4	43,172	24.7%
	3	40,026	22.9%
	2	23,491	13.4%
	1	33,757	19.3%
• Global Mean	3.12		

The following comments on the 2025 free-response questions for AP® Physics 1: Algebra-Based were summarized by the Chief Reader, Brian Utter, Teaching Professor and Associate Dean of Undergraduate Education, University of California, Merced. They give an overview of each free-response question and of how students performed on the question, including typical student errors. General comments regarding the skills and content that students frequently have the most problems with are included. Some suggestions for improving student preparation in these areas are also provided. Teachers are encouraged to attend a College Board workshop to learn strategies for improving student performance in specific areas.

Question 1

Task: Mathematical Routines
Topic: Conservation of Momentum

	Max Points:	**Mean Score:**
A1	1	0.84
A2	1	0.44
A3	1	0.58
A4	1	0.52
A5	1	0.72
A6	1	0.55
A7	1	0.41
B1	1	0.36
B2	1	0.10
B3	1	0.22

Overall Mean Score: 4.74/10

What were the responses to this question expected to demonstrate?

The responses were expected to:

- Recognize conservation of momentum in an inelastic collision
- Apply conservation of momentum to derive an expression for the final velocity of the object post-collision
- Demonstrate qualitative knowledge of the vector nature of momentum by independently assessing motion in the horizontal direction
- Analyze an inelastic collision using both graphs and derivations
- Recognize that while momentum is constant in the collision, kinetic energy is not constant
- Classify forces as internal or external to a system
- Apply conservation of momentum to a system with only internal forces

How well did the responses address the course content related to this question? How well did the responses integrate the skill(s) required on this question?

- Approximately 85% of responses sketched a horizontal line representing constant momentum through at least part of the collision. Less than 50% of responses recognized that the line would be continuous and horizontal throughout the entire period from $t = 0$ to $t > t_2$ due to conservation of momentum. A small number of responses represented the motion as a straight line with a positive slope, indicating a continual change in momentum.
- More than half of the responses began the derivation for post-collision speed using conservation of momentum. Some responses successfully used the mass of the block-car system while other responses failed to make the proper substitution. Many responses included incorrect simplification for expressions, likely due to misconceptions with fraction operations and other algebraic processes.
- Some responses correctly indicated that kinetic energy was not constant in the collision, but some responses demonstrated an attempt to apply conservation of energy to find the change in kinetic energy. Some responses correctly recognized that kinetic energy changed but incorrectly attempted to use the work-energy expression $\Delta K = W = Fd\cos\theta$ to determine the change.
- Approximately 73% of responses indicated the correct relationship between mass, velocity, and kinetic energy in order to complete the derivation. Many responses recognized the impact of the change in mass and velocity on kinetic energy. Again, some responses demonstrated an inability to successfully complete algebraic operations with fractions.

- Fewer than half of the responses indicated that if the frictional force between the block and cart allowed the block to move, momentum would remain constant. Many responses recognized that a change in the net force exerted on the system would relate to the change in momentum. Some responses classified the frictional force as internal to the system.

What common student misconceptions or gaps in knowledge were seen in the responses to this question?

Common Misconceptions/Knowledge Gaps	*Responses that Demonstrate Understanding*
• Responses sometimes represented momentum as a line with a nonzero slope instead of indicating momentum as constant. • Many responses showed momentum as two, noncontinuous horizontal lines, showing momentum as constant during some intervals but with some momentum loss during the collision.	• Correct responses indicated that momentum was nonzero and constant by drawing a horizontal line that extended beyond $t = t_2$.
• Responses often began with momentum in some form, but some responses failed to use conservation of momentum. For example: $p = mv$ $p = \left(m_c + \frac{1}{5}m_c\right)v_f$ • Some responses attempted to use energy conservation to solve for the final velocity.	• Correct responses included a derivation that began with conservation of momentum. For example: $p_i = p_f$ $m_c v_c = \left(m_c + \frac{1}{5}m_c\right)v_f$ $m_c v_c = \frac{6}{5}m_c v_f$ $v_f = \frac{5}{6}v_c$
• Responses often started with kinetic energy but did not include an appropriate expression for the change in kinetic energy. Many responses attempted to use energy conservation. • The substitution for the new mass was often done correctly, but some responses showed that the new mass was substituted for both before and after the collision. • A few responses failed to write down a fundamental physics principle to begin the derivation. Many struggled to complete the derivation correctly with complex fraction operations. • Many responses failed to substitute for the final velocity.	• Correct responses included derivations of the change in energy beginning with the expression for final minus initial kinetic energy and the relationship between mass, velocity, and kinetic energy. $\Delta K = K_f - K_i$ $\Delta K = \frac{1}{2}m_f v_f^2 - \frac{1}{2}m_i v_i^2$ $\Delta K = \frac{1}{2}\left(\frac{6}{5}m_c\right)\left(\frac{5}{6}v_c\right)^2 - \frac{1}{2}m_c v_c^2$ $\Delta K = \frac{5}{12}m_c v_c^2 - \frac{1}{2}m_c v_c^2$ $\Delta K = -\frac{1}{12}m_c v_c^2$

• Responses often failed to reference the new scenario but did indicate that momentum remained constant. Some used conservation of momentum as the justification for the momentum remaining constant. • Some responses recognized the frictional force as internal to the system, but did not correctly connect the relationship between internal and external forces to the momentum of a system. • Some responses correctly defined the relationship between no net external force and momentum conservation but did not sufficiently connect that principle to the given scenario.	• Correct responses describe the forces on the cart from the block and from the block on the cart as equal and opposite and therefore with a net force of zero. • Correct responses demonstrated understanding that a net external force of zero implies conservation of momentum for the system and thus the given momentum remained constant even when the frictional force was present and the block was allowed to slide.

Based on your experience at the AP® Reading with student responses, what advice would you offer teachers to help them improve student performance on the exam?

- Students benefit greatly from the opportunity to explain concepts both verbally and in written responses. The AP Physics 1 Student Workbook is a scaffolded collection of pages that encourages students to think critically and represent information using both quantitative and qualitative forms. See pages 5.D and 5.M.
- Practice derivations beginning with fundamental principles and writing answers in terms of given variables. Choosing derivations with several algebraic combinations allows extra practice for students who struggle with algebraic manipulation.
- Make sure students understand the intention and expected outcomes of a mathematical routines problem. These problems ask students to derive a symbolic expression, calculate, and think conceptually about changing a particular variable. When doing mathematical problems, it is beneficial to ask students to describe conceptually how the outcome would change with a change in one of the variables.
- Be deliberate about using physics-specific vocabulary and require students to do the same in both speaking and writing. For example, students often use conservation of energy and conservation of momentum interchangeably, leading to confusion between the two. The correct use of scientific language in derivations and annotations of mathematical solutions helps solidify understanding of related physics concepts.
- Practice sketching graphs to represent physical phenomena. Require students to identify what is independent and what is dependent in the scenario.
- Practice items in AP Classroom that illustrate particular science practices and be sure students understand the format of the exam.
- Be intentional about using task verbs during instruction and on teacher-made assignments or assessments. These words are bolded in the free-response questions to help students understand the type of response that is expected for a given question. A complete list of task verbs can be found in the Exam Information portion of the course and exam description.

What resources would you recommend to teachers to better prepare their students for the content and skill(s) required on this question?

- Teachers should direct students to the AP Daily videos on linear momentum, change in momentum and impulse, conservation of linear momentum, and elastic and inelastic collisions.
- Teachers should assign topic questions as well as personal progress check items to monitor progress being made in the mastery of content.
- Additional questions involving conservation of momentum and collisions can be found in the AP Physics 1 Student Workbook. These scenarios help students practice using the concepts of conservation of momentum and re-expressing physical phenomena with graphs.

Question 2

Task: Translating Between Representations
Topic: Conservation of Energy

	Max Points:	Mean Score:
A1	1	0.76
A2	1	0.76
A3	1	0.71
B1	1	0.64
B2	1	0.48
B3	1	0.38
B4	1	0.17
C1	1	0.60
C2	1	0.48
C3	1	0.43
D1	1	0.46
D2	1	0.22

Overall Mean Score: 6.09/12

What were the responses to this question expected to demonstrate?

The responses were expected to:

- Identify which forms of mechanical energy are present at different positions in a defined system
- Identify the total mechanical energy of a system, given an energy bar graph
- Draw bar graphs, perform derivations, and analyze line graphs with values for energy and distance given as multiples of a fundamental unit
- Make appropriate substitutions in a derivation based on conservation of energy
- Derive an expression for the spring constant using appropriate variables and the information provided in the prompt
- Sketch total energy and gravitational potential energy on an energy versus position graph given the curve for spring potential energy as a function of position
- Analyze a graph of energy as a function of position to determine kinetic energy, given total mechanical energy, gravitational potential energy, and spring potential energy

How well did the responses address the course content related to this question? How well did the responses integrate the skill(s) required on this question?

- More than three-quarters of responses correctly identified which types of mechanical energy were present at the defined positions in the energy bar chart. A slightly smaller percentage identified, given a complete energy bar graph, the correct value for total energy in the system. While nearly this many earned credit for correctly indicating the total energy value, many incorrectly split that value between kinetic and gravitational potential energies at the second position, though this concept was not directly assessed in this question. Overall, responses did well in analyzing and drawing energy bar graphs.
- Approximately 66% of responses included conservation of energy in the derivation, while only around half correctly related initial and final energy values that could be determined from the information provided. The most common correct response compared gravitational potential energy at the top of the ramp to the spring potential energy at the position the block came to rest.

- Approximately 40% of responses correctly identified the substitutions for either the change in height of the block or the distance the spring compresses. Many responses that attempted the derivation found it difficult to correctly identify the change in height of the block given the distance traveled on the incline and the angle of the incline. Most of the responses earning the substitution point earned the point through the correct substitution of the spring compression distance.
- Less than 20% of responses correctly combined all steps in the derivation and arrived at a correct final expression for the spring constant.
- Most responses correctly drew a constant, horizontal line representing the constant total energy on the graph of energy as a function of position. However, there were some responses that showed changing total energy in ways that were inconsistent with the information in the prompt.
- Approximately half of the responses correctly identified the linear relationship between gravitational potential energy and position on their graph as the block slid down the ramp. Many of the incorrect responses attempted to show a change in gravitational potential energy as a function of time. Overall, responses demonstrated better understanding of the energy bar charts compared to drawing graphs for the energy as a function of position.
- Most responses did not correctly connect the change in gravitational potential energy and the change in spring potential energy to what the response indicated happened to total energy from $x = 8D$ to $x = 9D$ in order to determine the change in kinetic energy and therefore the change in speed between the two points.

What common student misconceptions or gaps in knowledge were seen in the responses to this question?

Common Misconceptions/Knowledge Gaps	*Responses that Demonstrate Understanding*
• Many responses incorrectly included kinetic energy in the derivation at positions where there was no motion in the system. For example: $mgy_0 = \frac{1}{2}mv^2 + \frac{1}{2}k\left(\Delta x_{\max}\right)^2$	• When a kinetic energy term was included in a correct response, the derivation indicated that it was equal to zero at a later step. For example: $mgy_0 = \frac{1}{2}mv^2 + \frac{1}{2}k\left(\Delta x\right)^2$ $mg\left(12D\sin\theta\right) = 0 + \frac{1}{2}k\left(4D\right)^2$
• A common algebraic error was equating $(4D)^2$ to $4D^2$ For example: $mg\Delta y = \frac{1}{2}k\left(\Delta x\right)^2$ $mg\Delta y = \frac{1}{2}k4D^2$	• Correct responses indicated that $(4D)^2 \neq 4D^2$. For example: $mg\Delta y = \frac{1}{2}k\Delta x^2 = \frac{1}{2}k\left(4D\right)^2$ or $mg\Delta y = \frac{1}{2}k16D^2$
• Some responses demonstrated the misconception that a moving object that makes contact with a spring will always slow down.	• Whether the object slows down, speeds up, or has the same speed at different positions when height is also changing is dependent on the stiffness of the spring. Without knowing the spring force constant for the spring, a correct response must rely on comparing the changes in both gravitational potential energy and spring potential energy to determine any changes in kinetic energy and therefore how speed changes.

• Many responses had incomplete or incorrect justifications because the responses did not address all the variables that were associated in the problem. • For incomplete justifications, many responses only addressed how either the gravitational potential or spring potential energy changed as opposed to both.	• Complete and correct responses included a justification that referenced the changes in both gravitational potential energy and spring potential energy between $x = 8D$ and $x = 9D$.
• Common incorrect responses included a straight line with a negative slope for the total mechanical energy of the system.	• Correct responses indicated that the total mechanical energy of the system was constant by drawing a horizontal line.
• Many responses included an incorrect line or curve for the gravitational potential energy of the system. • Incorrect responses often included graphs that indicated that the gravitational potential energy decreased at a decreasing rate, decreased at an increasing rate, or increased linearly. • A common incorrect graph was the mirror image of the spring potential energy graph that was provided in the prompt.	• Correct responses indicated that the gravitational potential energy of the system decreased linearly with height by drawing a straight line with a negative slope.

Based on your experience at the AP® Reading with student responses, what advice would you offer teachers to help them improve student performance on the exam?

- Encourage students to write legibly, both when doing mathematical work and when writing prose.
- Remind students to carefully read the information in the prompt and in each question to ensure their response uses the correct information and answers the question that is asked.
- When doing derivations, always encourage students to use the reference material when writing equations. Many responses include an incorrect equation; for example, forgetting to square a variable, which leads to issues in carrying out the derivation.
- Encourage students to use a straight edge when drawing a straight line on a graph.

What resources would you recommend to teachers to better prepare their students for the content and skill(s) required on this question?

- Teachers should direct students to AP Daily videos on translational kinetic energy, work, potential energy, and conservation of energy.
- Teachers should assign topic questions as well as personal progress check items to monitor progress being made in the mastery of content.
- Additional questions involving conservation of energy can be found in the *AP Physics 1 Student Workbook*. These scenarios help students practice derivations, re-expressing physical phenomena with bar charts and graphs, and justifying consistency between representations.

Question 3

Task: Experimental Design and Analysis
Topic: Torque and Rotational Dynamics

	Max Points:	Mean Score:
A1	1	0.67
A2	1	0.76
B1	1	0.44
B2	1	0.20
C1	1	0.60
C2	1	0.39
C3	1	0.65
C4	1	0.66
D1	1	0.28
D2	1	0.28

Overall Mean Score: 4.93/10

What were the responses to this question expected to demonstrate?

The responses were expected to:

- Describe what quantities should be measured using a specified set of equipment, including how to reduce experimental uncertainty
- Describe how to graph experimental data to create a linear graph whose slope could be used to find an unknown quantity, and indicate the relationship between the slope of the graph and the unknown quantity
- For given data, determine what to plot to create a linear graph to be used to determine an unknown quantity
- Label an axis with a physical quantity, with its appropriate unit, and with a linear scale
- Plot points in a scatter plot and draw an appropriate line of best fit
- Calculate an unknown quantity within a given range using features of the graph

How well did the responses address the course content related to this question? How well did the responses integrate the skill(s) required on this question?

- Approximately 70% of responses were able to describe a way to gather data using limited lab equipment. Most responses discussed reading the spring scale while the block was attached and either hanging the block from more than one hole or taking multiple spring scale measurements.
- Approximately 46% of responses were able to describe a way to graph the data so that the block's mass could be found using the graph, although only around 20% were able to describe how mass could be found using the slope. The biggest challenge students had was differentiating quantities with the same name (e.g., differentiating "distance from the spring scale to the stand" from "distance from the block to the stand").
- For part C (ii) a major challenge was providing both a label and a matching unit for the graph's vertical axis. While many students correctly indicated a correct way to plot a linear graph, many did this by providing **only** a label or **only** a unit.
- Responses did very well scaling axes and plotting points, with nearly all students creating a linear scale. Most students were able to draw an appropriate best-fit line through their points using a straight line for linear data and an appropriate smooth curve for curved data.
- For part D most responses included an attempt to calculate the graph's slope. As in part B a much smaller number accurately linked their graph's slope to the mass of the meterstick.

What common student misconceptions or gaps in knowledge were seen in the responses to this question?

Common Misconceptions/Knowledge Gaps	*Responses that Demonstrate Understanding*
• Some responses incorrectly indicated that the force exerted by the spring scale was equal to the weight of the hanging block regardless of the block's position along the ruler: $F_s = m_0 g$.	• Correct responses indicated that the torque exerted by the spring scale is equal in magnitude to the torque exerted by the hanging block: $F_s \left(0.5 \text{ m}\right) = m_0 g R_{\text{block}}$.
• Some responses indicated that spring scales could be used to directly measure torque.	• Correct responses indicated that the spring scale should be used to measure the force needed to keep the meterstick horizontal.
• Responses sometimes only included a label or a unit on the axis of the graph.	• Correct responses included both a label and a unit on the axis of the graph. For example, "Force (N)" indicates that the values on the axis are forces measured in Newtons.
• Some responses were unable to determine what should be graphed on vertical and horizontal axes such that the mass of the meterstick was the slope or could be determined from the slope. In some cases, responses indicated to plot the inverse of the appropriate quantity (e.g., $\frac{1}{F_T}$) to get a $y \mu \frac{1}{x}$ plot, which does not produce a straight line.	• Correct responses included a description of a graph where the slope could be used to find the mass. These responses recognized the correct functional dependence between the quantities. For example, if a relationship can be expressed as a fraction, a graph of the numerator as a function of the denominator will have a slope equal to the quantity.
• Responses sometimes included a best-fit line that was created by connecting points in a scatterplot in a connect-the-dots fashion.	• Correct responses included a best-fit line by drawing a single smooth line or curve that followed the pattern of the plotted points and showed the general trend of the data.

Based on your experience at the AP® Reading with student responses, what advice would you offer teachers to help them improve student performance on the exam?

- Perform experiments with limited equipment, such as this one and the others in the practice exams. As part of a write-up for a lab, ask students to briefly explain how they took measurements and how they reduced experimental uncertainty. Encourage editing and rewriting to clarify vague quantities and eliminate extra steps like "gather equipment" and "record data in a neat table."
- The Laboratory Investigations portion of the *AP Physics 1 Course and Exam Description* contains a section about lab equipment and defines what each common piece of lab equipment can measure. Students should be familiar with how to use a spring scale and what a spring scale can measure.

- For every equation on the reference sheet provided, have students practice determining what could be measured and plotted on each axis to get a linear relationship, and then what the equation of the line could be used to determine. Ask students to predict the consequences of changing physical properties of that situation: “According to this equation, how would our measurement change if the blocks were smaller in volume but the same mass?” Students too often view an arrangement of variables as something to be solved rather than a relationship between variables.
- Frequently and consistently practice asking students to describe a graph whose slope is related to a particular quantity. Ask students to plot on axes they’ve described and then draw a best-fit line. Ask students to show a calculation of slope of the best fit line and to demonstrate explicitly how the slope is related to what they were trying to calculate.
- Pages in the AP Physics 1 Student Workbook that can be used to support these skills include 1.L, 2.D, 2.H, 2.L, 2.N, 3.K, 7.O, and 11.C.

What resources would you recommend to teachers to better prepare their students for the content and skill(s) required on this question?

- Teachers should direct students to AP Daily videos on torque and rotational equilibrium and Newton’s first law in rotational form.
- Teachers should assign topic questions as well as personal progress check items to monitor progress being made in the mastery of content.
- Additional questions involving torque and rotational equilibrium can be found in the *AP Physics 1 Student Workbook*. These scenarios help students practice analyzing systems in equilibrium through derivations and re-expressing physical phenomena with graphs.

Question 4

Task: Qualitative/Quantitative Translation
Topic: Fluids and Newton's Laws

	Max Points:	Mean Score:
A1	1	0.73
A2	1	0.32
A3	1	0.52
B1	1	0.72
B2	1	0.67
B3	1	0.39
C1	1	0.69
C2	1	0.60

Overall Mean Score: 4.64/8

What were the responses to this question expected to demonstrate?

The responses were expected to:

- Compare the forces exerted on an object in fluids with different densities
- Justify a claim about the acceleration of an object in a fluid using Newton's second law and the relationship between forces and acceleration
- Derive an expression for the acceleration of an object submerged in a fluid
- Relate the density of a fluid to the buoyant force on an object
- Evaluate consistency between a stated claim and a derived equation

How well did the responses address the course content related to this question? How well did the responses integrate the skill(s) required on this question?

- More than three quarters of responses were able to correctly indicate that the acceleration of a submerged object that is less dense than the fluid will increase as the density of the fluid increases.
- About 60% of responses were able to relate the increase in the density of the fluid to an increase in the buoyant force on the object. However, the acceleration of the object is related to the net force on the object and only a third of the responses indicated that the force of gravity on the block stays the same if the density of the fluid is changed.
- Around three quarters of the responses were able to use Newton's second law in a multistep derivation of the acceleration of the submerged object.
- About 70% of the responses correctly stated the relationship between density of a fluid and the buoyant force in their derivation.
- Over 70% of the responses attempted to address the functional dependence between the acceleration and density in their derived equation. Over 60% were able to correctly relate the functional dependence between acceleration and density to their claim comparing acceleration in fresh water to saltwater.

What common student misconceptions or gaps in knowledge were seen in the responses to this question?

Common Misconceptions/Knowledge Gaps	*Responses that Demonstrate Understanding*
• Responses frequently indicated or implied that the buoyant force was the only force acting on a submerged object.	• Correct responses stated that the gravitational force on the submerged object stayed the same in both fluids. • When deriving the expression for acceleration, correct responses included the buoyant force and the gravitational force on the object in a net force equation.
• Several responses indicated that a greater density fluid will have a greater impedance on the motion of the object without recognizing that the buoyant force increases.	• Responses demonstrating correct understanding indicated that two forces (buoyant force and weight) were exerted on the object and that the object with the greater buoyant force would have greater acceleration.
• In many responses the symbol rho ρ was confused with the letter p and was described as pressure or momentum, both in the written justification and as an expression in the derivation.	• Correct responses described ρ as the density of the fluid and expressed the buoyant force as $F_b = \rho V g$.
• Some responses began the derivation with Bernoulli's equation, despite the prompt explicitely stating, "Starting with Newton's second law … "	• Correct responses followed the prompt's instructions by beginning the derivation with Newton's second law.
• Some responses equated the pressure an object experiences when submerged as being the buoyant force acting on the object (i.e., pressure is a force).	• Correct responses tended to focus on the forces acting on the submerged object without reference to pressure.
• A small number of responses provided a justification that opposed the selected inequality statement, possibly misinterpreting the greater-than and less-than symbols.	• Correct responses indicated that the acceleration in the denser fluid would be greater than that of the less dense fluid with a justification that included both the buoyant force and weight of the object.

- A few responses failed to distinguish the direction of the force vectors in the derivation for acceleration. A common error indicated that the buoyant force and gravitational force were in the same direction.	- In deriving the expression for acceleration, correct responses indicated that the net force was equal to the difference between the buoyant force and the gravitational force: $F_{\text{net}} = F_b - F_g$. (Note that the fluid dynamics concept of added or virtual mass is outside the scope of AP Physics 1 but would also be accepted.)

Based on your experience at the AP® Reading with student responses, what advice would you offer teachers to help them improve student performance on the exam?

- Make sure students understand the specific purpose of the types of free-response questions. The purpose of the qualitative/quantitative translation is for students to connect qualitative claims based on physics principles to a mathematical representation of the same principle. Students should anticipate that parts of the question will prompt them to address the functional dependence of one or more variables on another in a function. Students need practice connecting mathematical arguments to physics principles.
- Be familiar with the task verbs used in free-response questions listed in the course and exam description, which can be found on AP Central.
- Practice questions that involve writing a justification. These types of questions can be found in the AP Physics 1 Student Workbook, or in AP Classroom. Demonstrate for students what a good written response looks like and how each step of the process supports their claim by connecting physics principles.
- Define for students the functional dependencies of variables in an equation (i.e., proportional, inversely proportional, directly proportional). Have students practice working with equations to identify variables and describe how changes in a variable will lead to changes in the derived quantity.
- Model deriving expressions for students starting with equations or concepts from the equations provided in the reference material. Students should practice these types of derivations throughout the school year. The AP Physics 1 Student Workbook has scaffolding for derivation practice. The workbook suggests a two-column chart where the words explaining the step are on one side and the math steps are on the other.
- Students should be familiar with the variables and symbols used on the AP Physics 1 Exam found in the reference information. Many students confused rho ρ with the letter p, interpreting it as pressure or momentum.
- The fluids unit is a newer addition to the CED. It is important to schedule the time during the school year to cover this unit in class. Understanding topics 8.1: Internal Structure and Density and 8.3: Fluids and Newton's Laws were essential for success on this question.

What resources would you recommend to teachers to better prepare their students for the content and skill(s) required on this question?

- Teachers should direct students to AP Daily videos on internal structure and density, fluids, and Newton's laws.
- Teachers should assign topic questions as well as personal progress check items to monitor progress being made in the mastery of content.
- Additional questions involving fluids can be found in the *AP Physics 1 Student Workbook*. These scenarios help students practice using free-body diagrams as well as complete derivations in order to justify consistency between representations.