

Chief Reader Report on Student Responses: 2022 AP[®] Microeconomics Set 1 Free-Response Questions

• Number of Students Scored	84,386		
• Number of Readers	114		
• Score Distribution	Exam Score	N	%At
	5	14,928	17.7
	4	18,987	22.5
	3	15,841	18.8
	2	14,242	16.9
	1	20,388	24.2
• Global Mean	2.93		

The following comments on the 2022 free-response questions for AP[®] Microeconomics were written by the Chief Reader Aaron Lowen, Professor of Economics, Grand Valley State University; Assistant Chief Reader Dee Mecham, 'Iolani School; Exam Leader Lindsey Nagy, Muhlenberg College; and Question Leaders Eric Dodge, Hanover College; Lee Ann Fuller, John Carroll Catholic High School; and Brian Heggood, Stanton College Preparatory School. 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: Graph, Assert, and Explain

Topic: Monopoly, Efficiency, and Total Revenue

Max Score: 10

Mean Score: 4.09

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of how a monopoly would maximize profit in the short run, whether a per-unit tax or a price ceiling would improve allocative efficiency, and the relationship between demand, marginal revenue, and price elasticity of demand.

The question stated that, "A firm has a patent on a new carbon-capture technology, making it the only producer of that device." In part (a) students were asked to draw a correctly labeled graph for a monopoly earning positive economic profit. Part (a)(i) and (a)(ii) asked students to show the profit-maximizing quantity and price, respectively. These parts of the question tested students' knowledge of market conditions for a monopoly and their ability to illustrate these concepts using a graph. This task included demonstrating knowledge of revenue and cost conditions by drawing a downward-sloping demand curve (D) and a downward-sloping marginal revenue curve (MR) that lies below the demand curve and showing the marginal cost (MC) curve. Students were asked to show that the profit-maximizing quantity (Q_M) occurs where MR equals MC and that the profit-maximizing price (P_M) is determined by identifying the price that corresponds to this quantity on the demand curve. These tasks required students to demonstrate marginal analysis in a graphical format. Students also had to draw the average total cost (ATC) curve consistent with the given positive economic profit condition by having the ATC curve below the demand curve at the profit-maximizing quantity such that the rising MC curve passes through the minimum point of the ATC curve. Part (a)(iii) asked students to completely shade the area of consumer surplus. This task required students to demonstrate understanding that consumer surplus exists as the area above price and below the market demand curve.

Part (b) of this question introduced the students to various ways of regulating the monopolist. Part (b)(i) asked whether a per-unit tax could change the firm's output to the socially optimal quantity, followed by an explanation. The students' explanation required demonstration of how a per-unit tax increases marginal cost by the MC curve shifting up (or to the left), reducing the profit-maximizing level of output, and how this would move the firm's output even further from the socially optimal outcome. Part (b)(ii) offered a price ceiling as an alternative way of inducing the socially optimal level of output. Students were asked to draw the price ceiling, P_C , in the graph such that the firm would produce the socially optimal level of output Q_C . This task required students to demonstrate that they know that the socially optimal level of output is where price (demand) equals marginal cost. Part (b)(iii) asked students to determine whether the firm was earning positive economic profit at the price and quantity identified in part (b)(ii). This task required students to demonstrate understanding that positive economic profit exists when the price exceeds average total cost.

Part (c) of this question introduced an alternative level of production. Instead of profit maximization, the firm produces the quantity of output that maximizes total revenue. Part (c)(i) asked the students whether marginal revenue would be positive, negative, or equal to zero if the firm produced one more unit of output. This task required students to know what level of output corresponds to total revenue maximization and how total revenue would change if a firm produced more than that quantity. Part (c)(ii) asked students to determine what would happen to quantity demanded if the price decreased by 10%. This task required students to demonstrate understanding that the firm would now be operating in the inelastic range of the demand curve and quantity demanded would increase by less than 10%.

How well did the responses address the course content related to this question? How well did the responses integrate the skills required on this question?

In part (a) students earned the point for drawing a correctly labeled graph of a monopoly showing downward-sloping demand and marginal revenue curves with the MR curve below the D curve correctly on 63% of responses. Students earned the point for identifying the profit-maximizing quantity, Q_M , where MR equals MC on 64% of responses. The point that associated the profit-maximizing price, P_M , from the D curve and above Q_M was earned on 78% of the responses. Students earned the point for correctly drawing the ATC below the demand curve at Q_M , and with the MC curve intersecting the ATC curve at the minimum point on the ATC curve on 45% of the responses. Students earned the point for completely shading the correct area of consumer surplus on 55% of responses.

In part (b)(i) 10% of students correctly stated that a per-unit tax would not change the firm's output to the socially optimal level because the tax would increase MC and thus decrease quantity. In part (b)(ii) students correctly drew the price ceiling P_C at the output Q_C where the D curve intersected the MC curve on 41% of responses. In part (b)(iii) students correctly determined whether the firm would still earn positive economic profit with the price ceiling by stating whether P_C was still greater than the ATC curve on 34% of responses. This final point was frequently earned when students made a correct assertion about economic profit for a price ceiling that was drawn in (b)(ii) below or equal to the ATC curve.

In part (c)(i) 25% of students earned the point by stating that marginal revenue would be negative with a correct explanation. Most students who earned the point demonstrated that they knew that total revenue is maximized when marginal revenue equals zero, so if the firm increased output by one unit, MR would fall below zero. A smaller number of correct responses explained that MR was negative because the firm was now operating in the inelastic range of demand. In part (c)(ii) students correctly stated that quantity demanded would increase by less than 10% on 31% of responses.

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

<i>Common Misconceptions/Knowledge Gaps</i>	<i>Responses that Demonstrate Understanding</i>
<p>Part (a)</p> <ul style="list-style-type: none"> • Missing labels or showing incorrect labels on the axes or curves drawn. • Drawing a horizontal demand curve, the demand curve from perfect competition rather than from monopoly. • Drawing a graph of a competitive market. • Identifying the MR curve as the same as the D curve. • Omitting the MR curve. • Identifying the profit-maximizing quantity (Q_M) at the intersection of the D and MC curves. • Identifying the profit-maximizing price (P_M) directly across from the intersection of the MR and MC curves. • Omitting the ATC curve. • Placing Q_M or P_M at an intersection in the interior of the graph rather than on the axes. • Shading the area of economic profit rather than consumer surplus. • Shading the area between the D and MR curves as consumer surplus. • Shading the area below the MR curve and above P_M. • Not including relevant areas of consumer surplus because D and MR are not at (or close to) the vertical axis. 	<ul style="list-style-type: none"> • Correctly labelling all axes and curves drawn. • Drawing a downward-sloping demand curve that demonstrates the firm's market power. • Drawing the downward-sloping MR curve twice as steep as the demand curve and below it. • Placing Q_M along the quantity axis where a dashed line extends down from the intersection of the MR and MC curves. • Placing P_M along the price axis where a dashed line extending up from Q_M to the demand curve then extends left to the price axis. • Drawing an ATC curve such that at Q_M the ATC curve is below P_M. • Drawing an MC curve that rises and intersects the ATC curve at the minimum of ATC. • Shading the area of consumer surplus that lies below the D curve and above P_M.

<p>Part (b)(i)</p> <ul style="list-style-type: none"> • Asserting that the per-unit tax would increase the firm’s output to the socially optimal level. • Providing an incomplete explanation for why the firm’s output would not be socially optimal by stating the definition of socially optimal rather than explaining that the increased MC would decrease the firm’s level of output. • Explaining that the MC would increase, but not connecting that to the decrease in the firm’s output. 	<ul style="list-style-type: none"> • Asserting that the per-unit tax would not change the firm’s output to the socially optimal level because the increase in MC would decrease the firm’s profit-maximizing output even further from the efficient level.
<p>Part (b)(ii)</p> <ul style="list-style-type: none"> • Drawing the price ceiling P_C at the intersection of the D and ATC curves. 	<ul style="list-style-type: none"> • Drawing the price ceiling P_C at the quantity Q_C that corresponds to the intersection of the D and MC curves.
<p>Part (b)(iii)</p> <ul style="list-style-type: none"> • Asserting that the firm could not earn positive economic profit with the price ceiling that was drawn above ATC. • Stating that the firm could earn positive profits for “operating above” the ATC curve. • Stating a correct assertion about economic profit but making a comparison of price to MC or total cost. 	<ul style="list-style-type: none"> • Asserting that the firm could still earn positive economic profit because P_C is greater than ATC.
<p>Part (c)(i)</p> <ul style="list-style-type: none"> • Asserting that MR is positive or equal to zero when the additional unit is produced. • Providing an incomplete explanation for why MR is negative by not connecting to how total revenue is maximized when MR equals zero. • Explaining MR is negative because of diminishing marginal returns. 	<ul style="list-style-type: none"> • Asserting that MR is negative and explaining that because total revenue is maximized when MR equals zero, the next unit of output causes total revenue to fall.
<p>Part (c)(ii)</p> <ul style="list-style-type: none"> • Asserting that quantity demand will increase by more than 10% or exactly 10%. 	<ul style="list-style-type: none"> • Asserting that quantity demand will increase by less than 10%.

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

For students to meet with success on the AP exam, it is important that students know how to correctly illustrate and analyze graphs of firms. The monopoly model and its accompanying graph is an important market structure model for students to understand since nearly all firms have some degree of market power. Students were relatively successful at constructing the basic model, correctly drawing demand, marginal revenue, and marginal cost curves, and then using these curves to identify the profit-maximizing quantity and price. Students generally understood the basic mechanics of the quantity and price determination for a firm with market power.

A teaching recommendation is to encourage students to consider all information that is provided in the stem of the problem and ask themselves if and how each piece of information is relevant. Had students been tasked to shade in the positive economic profit, they may have been more likely to draw an ATC curve and place it appropriately. Without this additional cue, it seems many students overlooked the information about profitability. Similar questions on other forms, and on past exams, have consistently had points associated for showing the given profit condition, so encouraging students to always draw the ATC curve would help remind them to identify the profit condition that needs to be illustrated.

Students were relatively successful in showing the correct area of consumer surplus. A teaching recommendation would be to encourage students to begin their D and MR curves at the vertical axis. Students may be drawing these curves to the right of a quantity of zero because they think that consumption begins with the first unit of a good so there cannot be demand for a fraction of a unit. One possible way to overcome this tendency is to ask students to imagine units measured in thousands or millions. If units are measured in thousands, then the demand curve essentially touches the vertical axis for small fractions of a unit. Products such as gallons of gasoline or acres of land are also traded in fractions of a whole unit. If students get in the habit of extending the D and MR curves to the vertical axis, concepts like consumer surplus will be easier to show in the graph.

Students were fairly successful at knowing that the socially optimal, or allocatively efficient, level of output occur when the price paid for the last unit is equal to the marginal cost of producing it. This was evident in the relatively high success rate in showing the correct price ceiling. Students were not as successful in explaining why a per-unit tax would not be a regulation that achieves the socially optimal level of output. Many students drew the conclusion that a tax would fix the monopoly deadweight loss, perhaps thinking it was similar to regulating a negative externality. Other students were unable to articulate the connection between a per-unit tax, an upward (or leftward) shift in MC, and the resulting decrease in the firm's output. A teaching recommendation is to encourage students to illustrate this change in a graph. A quick sketch of a graph, while not required to earn this point, will show how an upward shift in MC creates an even larger gap between the firm's profit-maximizing output and the socially optimal output.

Students scored relatively low in part (c)(i) where they had to demonstrate understanding of how total revenue and marginal revenue were related. A common mistake was to equate profit maximization output ($MR=MC$) with revenue maximization output ($MR=0$). Students that made this mistake concluded that MR would still be positive if the firm produced one more unit. Students had more success in demonstrating that a price decrease at that point on the demand curve would result in an inelastic response in the quantity demanded. A teaching suggestion is to repeatedly reinforce the relationships between demand, price, total and marginal revenue, and price elasticity. Some students understand these concepts with a graphical explanation, some need one or more numerical examples, while others struggle with the intuition. If teachers present these economic concepts to the students using a variety of pedagogical techniques, more students will master them.

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

We recommend that teachers take advantage of the resources available in AP Classroom for the topics and skills covered in this question. AP Daily videos on Topics 2.3 Price Elasticity of Demand, 4.1 Introduction to Imperfect Competition, and 4.2 Monopoly can be assigned to students as warm-ups, lectures, or reviews, and Topic Questions can be assigned to assess student understanding.

Question 2

Task: Identify, Calculate, Explain

Topic: Externalities and Resource Markets

Max Score: 5

Mean Score: 1.33

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of a graph of a market with a positive consumption externality. The question also assessed students' understanding of the hiring decisions of a firm.

The question stated that Bueno is a firm that produces and sells guava and that the market for guava is perfectly competitive. The question included a graph illustrating the marginal private benefit (MPB), marginal private cost (MPC), marginal social benefit (MSB), and marginal social cost (MSC).

In part (a) students were asked to identify the kind of market failure represented in the graph as a positive externality from consumption. In part (b) students were asked to identify the marginal external benefit as \$3 using numbers from the graph. The task required students to know that the marginal external benefit is represented by the vertical difference between the MSB and MPB curves at any given quantity.

Part (c) of this question informed students that Bueno hired workers in a perfectly competitive labor market. The question stated that the guava market is in short-run equilibrium, that Bueno hires workers at a wage of \$20 per hour, and that the marginal product of the last worker hired was 6 units of guava per hour. In part (c)(i) students were expected to calculate the change in Bueno's profit per hour from the last worker hired and were directed to show their work. The task required students to first recognize that the marginal factor cost is equal to the wage (\$20) in a perfectly competitive labor market, identify the equilibrium price of guava to use in determining the marginal revenue product of the last worker hired ($\$5 \times 6 = \30), and then use those values to correctly calculate the change in profit per hour as \$10 by showing it to be the difference between the marginal revenue product and the marginal factor cost ($= (\$5 \times 6) - \20 or $= \$30 - \20).

In part (c)(ii) students were expected to explain how a per-unit subsidy to consumers who buy guava would affect Bueno's marginal revenue product curve. The task required students to demonstrate understanding of how a per-unit subsidy affects the market price and its effect on the marginal revenue product. Students needed to explain that the per-unit subsidy to consumers would increase the demand for guava and increase the price of guava, causing the marginal product curve to shift up (or to the right).

Part (d) of this question introduced a change to the labor market such that Bueno would now hire workers in a monopsony labor market. Students were asked to explain if the number of workers would increase, decrease, or stay the same. Students needed to explain that a monopsony experiences an increasing marginal factor cost (MFC) as the number of workers increases so that MFC is greater than wage, whereas a perfectly competitive firm has a constant MFC that is equal to wage, in order to conclude that the MFC would increase to give Bueno an incentive to decrease the number of workers hired.

How well did the responses address the course content related to this question? How well did the responses integrate the skills required on this question?

In part (a) students identified the market failure as a positive externality on 51% of responses.

In part (b) students identified the marginal external benefit as \$3 using numbers from the graph on 50% of responses.

In part (c)(i) 34% of students correctly calculated the change in profit per hour for Bueno to be \$10 and showed their work. In part (c)(ii) 13% of students correctly identified that the marginal revenue product curve would increase and included the correct explanation.

In part (d) 8% of students correctly stated that the number of workers would decrease under monopsony conditions and included a correct explanation. Many students who did not receive this point did not clearly explain that the marginal factor cost curve lies above the labor supply curve (or $MFC > \text{wage}$) for a monopsony.

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

<i>Common Misconceptions/Knowledge Gaps</i>	<i>Responses that Demonstrate Understanding</i>
<p>Part (a)</p> <ul style="list-style-type: none"> • Comparing MSB to MPB but not identifying the term. • Defining the market failure as the existence of deadweight loss. 	<ul style="list-style-type: none"> • Stating the market failure as a positive externality from consumption.
<p>Part (b)</p> <ul style="list-style-type: none"> • Using the two equilibrium prices of \$7 and \$5 to identify the marginal external benefit as \$2. 	<ul style="list-style-type: none"> • Identifying the marginal external benefit as \$3 ($\\$7 - \\$4$ or $\\$8 - 5$).
<p>Part (c)(i)</p> <ul style="list-style-type: none"> • Using \$7 for the market price to incorrectly calculate the profit per hour, $(\\$7 \times 6) - \\$20 = \\$42 - \\$20 = \\$22$. • Identifying values of \$30, \$20, and \$10 but showing no calculations to define the relationship between them. 	<ul style="list-style-type: none"> • Identifying the change in cost (MFC) as the wage in a perfectly competitive labor market. • Determining the marginal revenue product as \$30 ($\\5×6). • Showing how to calculate the change in the profit per hour as the difference between marginal revenue product and marginal factor cost ($\\$30 - \\$20 = \\$10$).

<p>Part (c)(ii)</p> <ul style="list-style-type: none"> Addressing only the increase in the demand for guava or the price of guava, not both. Identifying derived demand as the reason for the increase in MRP but providing no additional explanation for the specific change. 	<ul style="list-style-type: none"> Identifying that the MRP curve shifts up because the price of the product increased. Explaining that a subsidy to consumers increases consumer demand. Explaining that an increase in consumer demand raises the price paid to sellers.
<p>Part (d)</p> <ul style="list-style-type: none"> Providing an incomplete explanation for why a monopsonist hires fewer workers by simply stating that the monopsonist pays a lower wage, but either not explaining why or else comparing the monopsony to the perfectly competitive market. Stating that the monopsonist hires fewer workers because it produces less output with no further explanation. Asserting that the monopsonist hires more workers because the firm is the only one hiring labor or is a wage/price setter. 	<ul style="list-style-type: none"> Explaining that the MFC for a monopsony is greater than the MFC for a perfectly competitive market. Explaining that the MFC increases as a monopsonist pays higher wages for every worker as it hires each additional worker whereas the MFC (or wage) is constant for a firm in a perfectly competitive labor market. Determining the change in the number of workers as the firm adjusts to a new profit-maximizing amount of labor after the increase in MFC.

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

Externalities are important in fully understanding the limits of a market. Unfortunately, the content is often pushed towards the end of the semester and not given enough classroom attention. Externality questions have consistently proven to be challenging for students. Holistically, students should think of externalities as market failures resulting in market equilibrium quantities (determined by the intersection of MPB and MPC) that are different from socially efficient quantities (determined by the intersection of MSB and MSC). In the case of a negative externality, the market produces more than the socially efficient quantity, resulting in overproduction when there is a negative production externality and overconsumption when there is a negative consumption externality. In the case of a positive externality, the market produces less than the socially efficient quantity, resulting in underproduction when there is a negative production externality and underconsumption when there is a positive consumption externality.

Teachers should help students recognize the different sources of externalities and how each can be accurately graphed to reflect the difference between the market equilibrium quantity and the socially optimal quantity. Graphical models of the market with each externality case can be found on page 172 of the Appendix of the AP Microeconomics Course and Exam Description. Teachers should provide opportunities for students to practice identifying examples of each type of externality, as well as interpreting and drawing graphs of each of the possible externalities.

Students were relatively successful in identifying the marginal external benefit shown on the externality graph. Many of the students who were not making the correct identification were subtracting the two equilibrium prices (at the socially optimal quantity and market equilibrium quantity) shown in the graph as

the marginal external benefit rather than the vertical distance between the MSB and MPB. Teachers should review the position of the MSB and MSC curves relative to the MPB and MPC curves in graphs of each of the externality cases to help students understand how external costs or external benefits are reflected in the model.

Students were somewhat successful at calculating the change in profit per hour. Those who were not correct were often choosing the price at the intersection of marginal social benefit and marginal private cost. A teaching recommendation is to start from the beginning of the course using the terms marginal private benefit to describe demand and marginal private cost to describe supply so that students are comfortable looking for the correct equilibrium in a market, whether or not it has an externality.

Students showed an understanding of the concept of derived demand but struggled to correctly articulate all the reasons that the marginal product curve changes. A teaching recommendation is to show all pieces of causation on shifts in curves throughout the course (i.e., an increase in the subsidy increases the demand for the good which increases the price of the good).

Many students showed an understanding of the difference between the wages paid by and number of workers hired by a monopsonist and a perfectly competitive firm. However, some students failed to earn the point in part (d) because they were unable to explain why these differences occur between the two market structures. A teaching recommendation is to emphasize the “why” for all market structures and to review the details of the curves so that an appropriate comparison and contrast can be made by the students.

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

We recommend that teachers take advantage of the resources available in AP Classroom for the topics and skills covered in this question. AP Daily videos on Topics 6.2: Externalities, 5.2: Changes in Factor Demand and Factor Supply, Topic 5.3: Profit-Maximizing Behavior in Perfectly Competitive Factor Markets, and Topic 5.4: Monopsonistic Markets can be assigned to students as warm-ups, lectures, or reviews, and Topic Questions can be assigned to assess student understanding.

Question 3

Task: Graph, Assert, and Explain

Topic: Demand, Elasticity, Market Equilibrium, and Marginal Analysis

Max Score: 5

Mean Score: 1.79

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of the market demand curve's relationship to individual demand schedules, market equilibrium, price elasticity of demand, and how the demand curve reflects key assumptions underpinning buying decisions using marginal analysis.

The question stated that there are four individual buyers in the market for Good X. Students were provided with a table of prices and individual quantities demanded at each price for each buyer. In part (a) students were asked to draw a correctly labeled graph for the market where market supply (S) is perfectly elastic. This part of the question tested students' ability to draw a horizontal S curve at a given price and a downward-sloping demand (D) curve. Students were asked to label the market equilibrium for Good X at a price and quantity combination based on the given equilibrium price and the quantity at which the market demand intersects the market supply. This task tested students' understanding of how, at a given price, the quantity demanded by the market is the summation of the quantities demanded by all individual buyers.

Part (b) of this question asked students to calculate a measure of elasticity and to reach a conclusion based on the value of the calculation. Part (b) stated that the price of Good X increased from \$5 to \$7. Part (b)(i) required students to first calculate the market quantity demanded at each price, and to then calculate the price elasticity of demand by calculating the absolute value of the percentage change in quantity demanded divided by the percentage change in price. Students successfully demonstrated understanding of this concept by writing an equation with the correct percentage changes in price and quantity and a correct result. Part (b)(ii) asked students to identify whether the value calculated in (b)(i) was elastic, inelastic, or unit elastic over the range of prices. This tested students' knowledge of categorizing the responsiveness of buyers to a change in price by comparing the absolute value of the price elasticity of demand calculated to the value of 1. Students demonstrated understanding by identifying the value of the measure of elasticity as elastic when it exceeded 1.

Part (c) of this question asked students whether or not a particular marginal benefit and quantity combination was consistent with an individual's marginal benefit. This tested students' understanding of marginal analysis in buying decisions by recognizing that an individual's willingness to pay a given price for a specific unit of the good indicates that their marginal benefit for that unit is at least as great as the price. Students were expected to assert the marginal benefit and quantity combination could not be the buyer's marginal benefit and to explain how the marginal benefit of the quantity specified could not be less than the price the individual was willing to pay for that particular unit of Good X.

How well did the responses address the course content related to this question? How well did the responses integrate the skills required on this question?

Part (a) tested the students' ability to graphically depict a product market for Good X with a perfectly elastic supply and a downward-sloping demand curve. Students were asked to identify the market equilibrium at a price of \$5 and a quantity of 8. For the graphical depiction, 48% of responses included a correctly labeled graph of the market. For identifying the market equilibrium, 44% of students earned the point for correctly determining the market equilibrium quantity and labelling it and the market equilibrium price on the graph.

Part (b) tested the students' ability to calculate price elasticity of demand over a particular range of prices and to identify if the good was elastic, inelastic, or unit elastic over that range. In part (b)(i) 19% of responses correctly calculated the value of the magnitude of the elasticity to be 1.25 as a result of the percentage change in quantity demanded (-50%) divided by the percentage change in price (40%). In part (b)(ii) students correctly identified whether the good was elastic, inelastic, or unit elastic based on whether the magnitude of the elasticity value was greater than, less than, or equal to 1 in 63% of the responses.

Part (c) tested the students' ability to demonstrate an understanding of the relationship between an individual's willingness to pay and their marginal benefit. Students correctly found and explained that Emily's marginal benefit could not equal \$4.50 for the second unit 12% of the time. To answer this question, most students correctly explained that Emily's marginal benefit was at least \$6 since she had been willing to purchase two units when the price was \$6, but few students gave the full explanation that Emily's marginal benefit for the second unit had to be greater than or equal to \$7, the price she was willing and able to pay for the second unit, but less than \$8 since Emily only purchased one unit when the price was \$8.

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

<i>Common Misconceptions/Knowledge Gaps</i>	<i>Responses that Demonstrate Understanding</i>
<p>Part (a)</p> <ul style="list-style-type: none"> ● Drawing a perfectly elastic supply curve as upward sloping. ● Drawing an upward-sloping demand curve. ● Identifying individual demand as the same as market demand. 	<ul style="list-style-type: none"> ● Drawing a perfectly elastic supply (S) curve as a horizontal line at the price of \$5. ● Drawing a downward-sloping demand (D). ● Labeling price (P) and quantity (Q) axes. ● Correctly summing the individual quantities demanded at the equilibrium price of \$5 to determine the market quantity demanded as 8.
<p>Part (b)(i)</p> <ul style="list-style-type: none"> ● Calculating $E_d = \frac{8-4}{7-5} = 2$. ● Calculating $E_d = \frac{7-5}{8-4} = \frac{1}{2}$. ● Incorrectly calculating E_d as a percentage (e.g., 60%). ● Incorrectly using a single individual's quantities demanded to calculate the percentage change in the market quantity demanded in the E_d formula. 	<ul style="list-style-type: none"> ● Calculating $E_d = (4 - 8)/8 \times 100 \div (7 - 5)/5 \times 100 = (-50\%)/(40\%) = 1.25$. ● Calculating $E_d = (-50\%)/(40\%) = 1.25$.

<p>Part (b)(ii)</p> <ul style="list-style-type: none"> Incorrect identifying a negative number as inelastic. 	<ul style="list-style-type: none"> Identifying 1.25 as elastic.
<p>Part (c)</p> <ul style="list-style-type: none"> Calculating marginal benefit as equivalent to the difference in total cost or expenditure. Calculating marginal benefit as the marginal benefit divided by the quantity demanded. Describing marginal benefit as the least an individual would be willing and able to pay for a particular unit of a good. 	<ul style="list-style-type: none"> Explaining Emily's marginal benefit should be greater than or equal to the price she is willing to pay, \$7, to buy the second unit. Explaining \$4.50 is less than Emily's willingness to pay for a second unit, \$7.

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

For students to be successful on the AP exam, it is important that students know how to correctly draw variations of the standard market graph. In addition to the conventional depiction of a market with an upward-sloping supply and a downward-sloping demand, students should be familiar with how different elasticity values affect the model of the market. Many students struggled with depicting a perfectly elastic supply curve on the market graph. Students also need to recognize how a market demand curve is derived from the summation of individual demand curves (or schedules). Many students failed to recognize a distinction between equilibrium quantity for a market versus the quantity demanded for an individual in the market at the equilibrium price.

Teachers should reinforce with students the understanding of price elasticity of demand that is calculated as the percentage change in quantity demanded divided by the percentage change in price rather than the ratio of the unit change in quantity divided by the unit change in price. Many students attempted to calculate elasticity as the inverse of the slope of the demand curve.

Finally, teachers can help students recognize the relationship between marginal benefit and the demand schedule for an individual. Many students failed to articulate a clear understanding of the relationship between the value of a discrete unit of a good and the price an individual is willing to pay. Many students who attempted to provide marginal analysis to the situation failed to clearly explain the key assumptions consumers build into their individual marginal benefit curves. Also, many students conflated the concepts of marginal benefit and marginal cost. Teachers can improve student understanding by providing additional opportunities to clearly define these terms before instruction on optimal quantities for consumption by an individual.

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

We recommend teachers take advantage of the resources available in AP Classroom for the topics and skills covered in this question. AP Daily videos on Topics 1.5: Cost-Benefit Analysis, 1.6: Marginal Analysis, 2.1: Demand, 2.3: Price Elasticity of Demand, and 2.6: Market Equilibrium and Consumer and Producer Surplus can be assigned to students as warm-ups, lectures, or reviews, and Topic Questions can be assigned to assess student understanding.