Chief Reader Report on Student Responses:

2021 AP® Microeconomics Free-Response Questions

• Number of Students Scored	80,199		
• Number of Readers	165		
• Score Distribution	Exam Score	N	%At
	5	14,845	18.5
	4	19,266	24.0
	3	13,315	16.6
	2	13,600	17.0
	1	19,173	23.9
• Global Mean	2.96		

The following comments on the 2021 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, The Bishop's School; Question Leader, Julia Frankland, Malone University; 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   **Topic:** Monopoly and Game Theory
                         Explain

Max. Points: 10   **Mean Score:** 4.56

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, where the firm would operate if they were to offer the product at an output that still allowed the firm to break even, and whether this output was allocatively efficient. Students were also expected to use game theory to identify the presence, or absence, of a dominant strategy and a Nash equilibrium between two rivals.

The question stated that NCHart is a corporation that has developed and patented a new drug to treat heart disease. There are no substitutes for this drug, giving NCHart a monopoly. In part (a) students were asked to draw a correctly labeled graph for a monopoly. Part (a)(i) and (a)(ii) asked students to show the profit-maximizing quantity and price, labeled as Q_m and P_m 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 both the marginal cost (MC) and average total cost (ATC) curves. 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 from the demand curve. These tasks required students to demonstrate marginal analysis in a graphical format. Students also had to draw an ATC curve consistent with the given positive economic profit condition by having the ATC curve below the demand curve at the profit-maximizing quantity and having ATC's minimum where the rising MC curve and ATC curve intersected.

Part (b) of this question asked students whether demand was elastic, inelastic, or unit elastic at the profit-maximizing quantity. The students' explanation required the use of information from the graph. This part required students to demonstrate knowledge that the monopolist's profit-maximizing output was in the elastic range of demand because marginal revenue is positive at that quantity.

Part (c) of this question introduced an alternative level of production to the profit-maximizing decision. Specifically, this asked students to consider the possibility that NCHart would provide the new drug to as many patients as possible as long as it could generate enough revenue to cover its total costs. Part (c)(i) asked students to show, in the graph from part (a), the quantity (Q_z) that is consistent with this goal. This part required students to demonstrate knowledge that the firm would break even if output were set where price equals average total cost (P=ATC). Part (c)(ii) asked the students whether deadweight loss existed at the quantity identified in (c)(i). Students needed to explain that deadweight loss exists when P≠MC and apply that condition to the quantity, Q_z, shown in the graph.

Part (d) of this question introduced the possible entry of a rival firm, TXDrug, when the patent held by NCHart expired. Students were told that these two firms independently and simultaneously choose their actions. NCHart can choose between Q_m or Q_z, while TXDrug can choose between entry into the market or staying out. The payoff matrix was provided for the students.

Part (d)(i) of the question asked whether TXDrug has a dominant strategy. Students were instructed to explain their answer using strategies and payoffs from the payoff matrix. This part required students to demonstrate knowledge of how to determine whether a dominant strategy exists and how to read the payoff matrix. Students needed to state that there was not a dominant strategy for TXDrug. The explanation required students to analyze the best response for TXDrug, given each possible action by NCHart, and to compare the payoffs for TXDrug under both scenarios. If NCHart chooses Q_m, TXDrug would enter because earning $1 is better than earning $0. If NCHart chooses Q_z, TXDrug would stay out because earning $0 is better than losing $1.

Part (d)(ii) of the question asked students to state the best response for NCHart if TXDrug chose to stay out of the market. This part required students to demonstrate that they could read the payoff matrix and determine that NCHart would choose output Q_m if TXDrug stayed out of the market.

Part (d)(iii) of the question asked students to identify the Nash equilibrium of this game. This part required students to understand what the Nash equilibrium is, and how to locate it in the payoff matrix. Students needed to state that NCHart would produce Q_m, and TXDrug would enter the market.

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 drew downward-sloping demand and marginal curves with the MR curve below the D curve correctly on 66.7% of responses. Students earned the point for identifying the profit-maximizing quantity, Q_m, where MR equals MC on 67.4% of responses. The point that associated the profit-maximizing price, P_m, from the D curve and above Q_m was earned on 71.5% 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 ATC at the minimum point on the ATC curve on 48.3% of the responses.

In part (b) 21.9% of students correctly stated that demand was elastic at Q_m because MR is greater than zero.

For the two points possible in part (c), students correctly identified and labeled Q_Z on the graph in part (a) as the quantity that would allow for total revenue to just cover total cost at the intersection of the demand and ATC curves (P=ATC) on 37.8% of the responses. Students sufficiently explained deadweight loss at Q_Z on 11.4% of the responses.

In part (d)(i) students correctly stated that TXDrug did not have a dominant strategy, with an explanation that included the correct strategies and payoffs on 21% of the responses. In part (d)(ii), students correctly stated that Q_m was the best response for NCHart if TXDrug chose to stay out of the market on 82.9% of the responses. And, in part (d)(iii), students correctly identified the Nash equilibrium as the combination of NCHart choosing Q_m and TXDrug entering on 56.3% of the responses.

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

Common Misconceptions/Knowledge Gaps	Responses that Demonstrate Understanding
Part (a) • Drawing a horizontal demand curve, confusing perfect competition with monopoly. • 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.	• 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 extends 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.

• Incorrect or missing labels on the axis or curves drawn.	• Drawing an MC curve that rises and intersects the ATC curve at the minimum of ATC.
Part (b) • Asserting that demand is unit elastic or inelastic at Q_m. • Providing an insufficient explanation for why demand is elastic by stating what an elastic response means without referring to the graph. • Providing an explanation that describes the "total revenue test" without referring to the graph.	• Asserting that demand is elastic because MR is positive or because Q_m is to the left of the midpoint of the demand curve.
Part (c) • Identifying Q_z at the intersection of D and MC. • Identifying Q_z at the quantity that minimizes ATC. • Providing an insufficient explanation for why deadweight loss exists by only stating that Q_Z is not allocatively efficient or is not socially optimal.	• Placing Q_z along the quantity axis where a dashed line extends down from the intersection of the D and ATC curves. • Providing an explanation that deadweight loss exists because P≠MC at Q_z. • If Q_Z was placed at the output at the intersection of the D and MC curves, providing an explanation that deadweight loss does not exist because P = MC at Q_z.
Part (d) • Explaining that TXDrug does not have a dominant strategy, but not using the strategies of NCHart or the payoffs to explain. • Conflating the choices available to NCHart with the choices available to TXDrug. • Incorrectly reading the payoff matrix and not using the correct payoffs for comparison. • Stating the Nash equilibrium only with the payoffs rather than the strategies.	• Providing an explanation of why TXDrug does not have a dominant strategy, with an explanation that uses the potential strategies of NCHart and accurately compares relevant payoffs for TXDrug. • Correctly determining that the best response for NCHart is Q_M if TXDrug stays out of the market. • Correctly identifying the Nash equilibrium as NCHart choosing Q_M and TXDrug choosing to enter the market.

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 perhaps the most important market structure model for students to understand because 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. So, 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 not as successful in explaining why a monopolist sets output in the elastic range of the demand curve. The prompt required students to refer to the graph in their explanation, but a common error was to restate what it means to have an elastic response or to state that the monopolist always prices in the elastic range. A teaching recommendation would be to give students opportunities to make connections between elasticity, total revenue, and marginal revenue. For students who explained using the "total revenue test," they connected elasticity with total revenue but needed to take the next step to connect the change in total revenue to the marginal revenue drawn on the graph.

Students scored relatively low in part (c)(i) where they had to demonstrate understanding of how much output a firm would produce if it were breaking even. The most common incorrect response was to identify Q_z at the intersection of demand and marginal cost, the socially optimal quantity. This could be the result of being prepared to discuss deadweight loss in part (c)(ii). The point in (c)(ii) proved difficult to earn, indicating that students often cannot explain why deadweight loss does, or does not, exist at a given output by identifying the connection between deadweight loss and the condition for the socially optimal quantity.

Students should be able to identify several alternate price and quantity combinations associated with different outcomes, for example, profit-maximizing, revenue-maximizing, socially optimal, and break-even quantities. Teachers should incorporate graphical analysis activities often throughout the course to give students opportunities to identify quantities for which different objectives or outcomes are met. The concept of allocative efficiency is introduced during coverage of competitive markets; total surplus in a market is maximized when the price of the last unit consumed is equal to the marginal cost of the last unit produced. Teachers should revisit economic concepts, like allocative efficiency, from earlier topics and ask students to consider how they apply to subsequent topics, like monopoly. This will help students become more adept with the newer topics and gain more comprehensive understanding of economic concepts.

Many students were able to see that TXDrug did not have a dominant strategy but could not clearly explain with the strategies and payoffs given in the payoff matrix. A teaching recommendation is to ask students to support their conclusions with specific numbers from the payoff matrix and to do so with a variety of situations where both firms, only one firm, or neither firm has a dominant strategy. Having students justify conclusions with numbers from the payoff matrix can allow teachers to accurately assess that students are reading the payoff matrix correctly and making the correct comparisons to evaluate if a firm has a dominant strategy or not. Students were quite successful in seeing that Q_m was the best response for NCHart if TXDrug stayed out of the market, and most students were able to identify the Nash equilibrium. The most common mistake in part (d)(iii) was stating the Nash equilibrium in terms of the payoffs and not the strategies of the firms.

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

We would 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 4.2: Monopoly and 4.5: Oligopoly and Game Theory can be assigned to students as warm-ups, lectures, or reviews. There is also a University Faculty Lecture video on Unit 4: Imperfect Competition led by Professor David Anderson that provides a more detailed overview of imperfectly competitive market structures. Topic Questions and past AP Exam questions from the Question Bank can be assigned to assess student understanding.

In addition to the resources available in AP Classroom, there is a lesson titled "Teaching About Game Theory" in the *Mastering Economic Thinking Skills* module that is available in the Classroom Resources section of the AP Microeconomics course page.

Question #2   **Task:** Graph, Assert, and Explain   **Topic:** Externalities and the Effects of Government Intervention in Markets

Max. Points: 5   **Mean Score:** 1.08

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of the negative production externalities, graphing marginal social costs and benefits, marginal private costs and benefits, how a change in demand would change the market deadweight loss, determining the size of a per-unit tax to correct for the externality, and evaluating the effect of a lump-sum tax. Students were expected to draw and label a graph for a market with a negative production externality and to show the market quantity compared to the socially optimal quantity. Additionally, students were expected to analyze a change in demand conditions to determine how it would affect deadweight loss in the market. Finally, students were also expected to calculate the level of the per-unit tax needed to correct for the externality and to explain why a lump-sum tax would not correct for the same externality.

The question stated that copper is produced in a perfectly competitive market; however, its production creates liquid waste that seeps into local rivers and causes human illness and crop failures downstream. This marginal external cost is constant at all quantities. In part (a) students were asked to draw a correctly labeled graph for the copper market labeling MSB, MPB, MSC, and MPC. Part (a)(i) and (a)(ii) asked students to show the market equilibrium quantity labeled Q_M and socially efficient quantity labeled Q_S, respectively. These parts of the question tested students' knowledge of a negative production externality while using a graph. This task included demonstrating knowledge of MSC being greater than MPC at all quantities while MSB and MPB were equal to each other. Students had to draw both the upward sloping MPC and MSC lines with MPC<MSC at all quantities. The marginal external cost was constant so these two lines should have been parallel. Students were asked to show the market equilibrium at the intersection of the MPC and MPB curves as well as the socially efficient quantity at the intersection of MSC and MSB curves. There was no positive or negative externality of consumption, so the MPB and MSB were expected to be the same downward sloping line. These tasks required students to demonstrate the skill of correctly labeling the y-axis as price and showing Q_M and Q_S on the X axis with dotted lines from their respective equilibrium and socially optimal conditions.

Part (b) introduced a demand-side change and asked students to redraw the new demand curve to the left of the original (MPB, MSB) and shade the new deadweight loss. Specifically, this part of the question told students to assume that the demand for copper decreases. Students were then required to shade the area above the new demand curve, below the original MSC and between the new socially optimal quantity and the new market equilibrium quantity.

Part (c) asked students to consider a government imposed per-unit tax on the copper market. Students were asked what level of per-unit tax would achieve the socially optimal quantity and to explain why a lump-sum tax on producers would not achieve the socially optimal quantity. In part (c)(i), students needed to state that the level of per-unit tax needed to be equal to the marginal external cost of producing copper. In part (c)(ii), students needed to explain that a lump-sum tax would not achieve the socially optimal quantity because it would not change the marginal cost of producing copper.

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 drew a downward sloping MPB curve and an upward sloping MPC curve with the correct Q_M labeled where MPB and MPC intersected on 36.1% of the responses. And, students drew an upward sloping MSC curve above the MPC curve and labeled MSB=MPB with the correct Q_S identified where MSB and MSC intersected on 37.1% of the responses.

For the point in part (b), students were mostly successful in shifting the demand (MPB=MSB) curve to the left; however, only 11.7% of them also correctly shaded the new deadweight loss.

In part (c)(i) students correctly identified the level of the per-unit tax as the size of the marginal external cost (MSC–MPC) on 17.1% of the responses. In part (c)(ii), 20.1% of responses correctly explained that the lump-sum tax would not result in the socially optimal quantity because it would not affect marginal costs.

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

Common Misconceptions/Knowledge Gaps	*Responses that Demonstrate Understanding*
Part (a) • Drawing the firm graph instead of the market graph. • Drawing the MPC and/or MSC curves as downward sloping or horizontal. • Drawing the MPB and/or MSB curves as upward sloping. • Drawing the supply curve separate from MPC. • Drawing the demand curve separate from MPB. • Drawing MSB above MPB. • Drawing MSC below MPC or as equal to MPC. • Omitting the price label in the Y axis.	• Drawing a market graph with the downward-sloping demand as MPB and the upward-sloping supply as MPC. • Identifying the market equilibrium quantity where MPB=MPC. • Illustrating a negative external cost of production by drawing the MSC curve above the MPC curve at all quantities. • Identifying the socially efficient quantity where MSB=MSC.
Part (b) • Shifting the MPC or MSC curves. • Shifting the MPB=MSB curve to the right. • Shading DWL without first shifting the MPB=MSB curve to the left. • Shading DWL pointing in the wrong direction (triangle pointing to the right toward the new equilibrium quantity instead of toward the new socially optimal quantity). • Shading DWL using Q_S and/or Q_M from part a.	• Shading a new DWL below the original MSC, above the new demand (MPB=MSB), and between the new socially efficient quantity and new market equilibrium quantity.

• Shading DWL with a new market equilibrium quantity where MSC=MPB.	
Part (c) • Specifying the value of per-unit tax as MSC. • Specifying the value of per-unit tax as socially optimal price minus the market equilibrium price. • Explaining the lump-sum tax will burden or be passed on to consumers.	• Identifying that the per-unit tax equal to the marginal external cost (MSC–MPC) would be the level of per-unit tax that would shift the supply (MPC) curve up to internalize the externality and result in a new equilibrium quantity equal to the socially efficient quantity. • Explaining the lump-sum tax would not change the output decisions of firms to get closer to the socially efficient quantity because the incentives for firms to change production at the margin were unchanged. The lump-sum tax would not change the marginal cost, as it would ONLY affect total fixed cost and total cost.

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 toward 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 that are different from socially efficient quantities. In the case of a negative externality there is overproduction and overconsumption (the market produces more than the socially efficient quantity), and in the case of a positive externality there is underproduction and underconsumption (the market produces less than the socially efficient quantity). Thinking in these terms will allow students to check the outcomes they illustrate against the expected outcomes.

For this question, students struggled to get started in the correct graph. Students confused the broader analysis of a perfectly competitive market with the more specific analysis of a perfectly competitive firm. Teachers should continue to create opportunities for students to think about the entire market and contrast changes in the market with the changes made by individual firms. Students that started part (a) by drawing a firm graph instead of a market graph found it very difficult to correctly graph marginal social costs and benefits. Similarly, many students did not recognize that MPB was demand and MPC was supply and started with graphs that included as many as six separate curves (D, S, MPB, MPC, MSB, and MSC). These students also struggled to correctly identify the market equilibrium quantity where MPB=MPC and the socially efficient quantity where MSB=MSC as well as having the additional challenge of shading deadweight loss after adding a new demand curve into the mix. Taking the time to describe demand as the marginal private benefit and supply as the marginal private cost would improve student understanding and performance, even when MPB and MPC are not explicitly drawn.

Students also struggled to shade the area of deadweight loss. This was more difficult in this specific question because students were asked to shade the DWL after the shift in demand. With the shift in demand, both the market equilibrium quantity and the socially efficient quantity decreased. Students who marked those new quantities, although not required, were more successful in correctly sharing the new DWL. Students needed to identify the intersection of the new MSB curve and MSC and the intersection of the new MPB curve and MPC, and then shade the area between MSB and MSC between those intersections. As a rule, deadweight losses should point toward the socially efficient quantity, with DWL associated with negative externalities pointing to the left and the DWL associated with positive externalities pointing to the right. Deadweight loss is not a concept unique to externalities. These skills can be practiced when discussing the

effects of monopoly behavior, price floors and ceilings and tax incidence, recognizing that in the absence of externalities (MSB=MPB and MSC=MPC).

Finally, while some students were successful in differentiating the outcomes of per-unit and lump-sum taxes, the question asked them to contrast why they had differing outcomes on market quantity. Teachers should be more deliberate in helping students differentiate that per-unit taxes (and subsidies) affect the marginal costs (benefits) and therefore cause profit-maximizing firms and utility-maximizing consumers to reanalyze their production and consumption decisions. As such, they become valuable tools in correcting for externalities. Conversely, lump-sum taxes (and subsidies) do not affect marginal costs (benefits) and are ineffective at correcting for externalities.

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

We would recommend that teachers take advantage of the resources available in AP Classroom for the topics and skills covered in this question. Externalities are covered in topics 6.1 and 6.2, and the effects of government intervention in markets are addressed in both topics 2.8 and 6.4. AP Daily videos can be assigned to students as warm-ups, lectures, or reviews, and Topic Questions and past AP Exam questions from the Question Bank can be assigned to assess student understanding.

Question #3 **Task:** Calculate, Explain, Assert **Topic:** Cost-Benefit Analysis

Max. Points: 5 **Mean Score:** 2.47

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of marginal analysis using total costs and total benefits. Additionally, the question examined students' knowledge of the characteristics of market structures.

The question began with a table showing the total cost and total benefit of advertisements placed by AZY Foods, a firm in the retail food market. In part (a) students were asked to calculate the total net benefit of placing three advertisements, showing their work. Students were expected to show the subtraction of the total cost from the total benefit ($3,000 − $800) to get the total net benefit of $2,200. In part (b) students were asked to calculate the marginal net benefit of placing three advertisements, showing their work. Students were expected to show the marginal cost, the total cost of the third advertisement less the total cost of the second advertisement ($800 − $300), from the marginal benefit, the total benefit of the third advertisement less the total benefit of the second advertisement ($3,000 − $2,200), to get the marginal net benefit ($800 − $500) of the third advertisement as $500. Both parts are designed to assess whether students know the concept of net values and whether they can distinguish marginal net benefits from total net benefits.

Part (c) asked students for the optimal number of advertisements placed by AZY Foods and an explanation of their answer using marginal analysis. Students needed to identify four advertisements as optimal and explain that the marginal benefit of the fourth advertisement was greater than the marginal cost of the fourth advertisement ($600 > $500), but the marginal net benefit of the fifth advertisement was less than the marginal cost of the fifth advertisement ($400 < $800). This could also be demonstrated by showing the marginal net benefit of the fourth advertisement to be positive ($600 − $500 = $100) and the marginal net benefit of the fifth advertisement to be negative ($400 − $800 = −$400). The idea that four advertisements would be optimal because the fourth advertisement increases the total net benefit to its maximum while the fifth advertisement would cause the total net benefit to decrease.

Part (d) asked students to identify the optimal number of advertisements if the marginal benefit AZY Foods receives from each advertisement increases by $300. The optimal number was still four advertisements. Students would have needed to recognize that the increase in marginal benefit for the fifth advertisement (from $400 to $700) was not sufficient to make the marginal net benefit of the fifth advertisement positive and increase the total net benefit.

Part (e) states that the retail food market has many firms, and each firm places its own firm-specific advertisements without considering the actions of its competitors. The question asked students to identify the market structure. Students needed to identify that AZY Foods was operating in a monopolistically competitive market.

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) 61.8% of responses included a correct calculation of the total net benefit as $2,200 with work shown.

In part (b) 52.2% of responses included a correct calculation of the marginal net benefit as $500 with work shown.

In part (c) 36.3% of responses identified the optimal number of advertisements as four and sufficiently explained that conclusion using marginal analysis.

In part (d) 57.7% of responses had a correct assertion that four advertisements was still the optimal number after the $300 increase in the marginal benefit of each advertisement.

In part (e) 41.7% of responses identified the market structure as monopolistic competition.

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

Common Misconceptions/Knowledge Gaps	*Responses that Demonstrate Understanding*
Part (a) • Calculating marginal net benefit instead of the total net benefit. • Using the sum of total benefits minus the sum of total costs, treating the total values as if they were marginal.	• Showing how to calculate net benefits for a specific level of output as the difference between benefits and costs. • Distinguishing between total and marginal net benefits.
Part (b) • Calculating total net benefit instead of marginal net benefit. • Only calculating marginal benefit but not subtracting marginal cost to get marginal net benefit.	• Showing how to calculate marginal benefit as the change in total benefit and marginal cost as the change in total cost. • Showing how to calculate the marginal net benefit of a specific advertisement as the difference in the marginal benefit and the marginal cost for that advertisement. • Distinguishing between total and marginal net benefits.
Part (c) • Using total net benefits instead of marginal analysis to explain the optimal number of ads. • Not explaining why four advertisements would be better than five advertisements.	• Demonstrating how the marginal benefit and marginal cost would affect the total net benefit to determine the optimal number of advertisements, the number that would maximize the total net benefit. • Including a discussion of MC < MB for the fourth advertisement but MC > MB for the fifth advertisement.

Part (d)	
• Incorrectly asserting the optimal number of advertisements to be something other than four.	• Indicating the optimal number of advertisements will be four.
Part (e)	
• Incorrectly identifying the market structure as one of the other market structures. • Identifying the market structure unclearly, i.e., as a competitive monopolist, or vaguely, i.e., as an imperfectly competitive market.	• Identifying the market structure as monopolistic competition.

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?

Some students were challenged by having to calculate net values. Teachers can help improve student performance by ensuring that students understand that net means something must be subtracted, something that might often be assumed as understood.

Some students struggled with differentiating between total and marginal. Teachers should encourage students to always identify whether the values in a table are total or marginal. If the values in the table are totals, the marginal values for each unit would be determined by subtracting the total of the previous unit from the total of the current unit. If the values in the table are marginal, the total values for a given number of units would be the running sum of marginal values up to that unit.

The point missed on the most responses was the one earned by using marginal analysis to explain the optimal number of advertisements. Students were expected to demonstrate marginal analysis by evaluating marginal net benefits or comparing marginal benefit and marginal cost. It is important to understand that why they chose the value depends not only on the marginal conditions at the optimal level of advertisements, but also on using the marginal conditions for the next unit to explain why they did not choose it. Marginal analysis using marginal net benefit may not be a common way of looking at marginal analysis, but it is useful for providing more context in explaining marginal analysis that simply compares marginal benefit to marginal cost. If MB>MC, marginal net benefit is positive and total net benefit increases with that unit; and, if MB<MC, marginal net benefit is negative and total net benefit decreases with that unit. Whether teaching basic marginal thinking, utility maximization, profit maximization, etc., explicitly showing the marginal net values when comparing the difference between marginal benefits and marginal costs will quickly illustrate the use of marginal net values in marginal analysis.

Finding the optimal number of advertisements when marginal benefits change can be done the same way as in part (c) without having to provide an explanation. The result of no change in the optimal number of advertisements after the $300 increase in the marginal benefit of each advertisement may have seemed counterintuitive, but it is easily identified by students who have identified that the marginal benefit of the fifth advertisement was $400 and increased to $700 and that was not enough of an increase to have made MB>MC for the fifth.

Most students did not earn the point for identifying monopolistic competition as the market structure. In many cases, they did not even identify one of the four market structures. Common responses included the other three market structures (among those responses, perfect competition and oligopoly were most frequently identified) and also included terms that were imprecise, unclear, or vague in identifying the specific market structure, terms such as competitive monopoly, monopolistic market, and imperfect competition. A teaching recommendation is to review the characteristics of market structures in ways that allow students to identify any overlapping characteristics and emphasize correct terminology. One way to do that would be to play a game where students are given different characteristics, some of which are not

sufficient to identify only one market structure, and have a game penalty for answering before enough information is given. In this particular question, the information that there were many firms ruled out monopoly (one firm) and oligopoly (few firms), and the information about firm-specific advertising ruled out perfect competition where firms would not engage in such advertising with homogeneous, or standardized, goods, and the information about the lack of strategic interdependence between firms further ruled out oligopoly, if there was any hesitation about whether many firms was enough to be more than few firms.

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

We would recommend that teachers take advantage of the resources available in AP Classroom for the topics (1.5, 1.6, and 4.1) and skills covered in this question. AP Daily videos can be assigned to students as warm-ups, lectures, or reviews, and Topic Questions and past AP Exam questions from the Question Bank can be assigned to assess student understanding.