Chief Reader Report on Student Responses:

2019 AP® Microeconomics Free-Response Questions

Set 2

- Number of Students Scored 91,551
- Number of Readers 101
- Score Distribution

Exam Score	N	%At
5	22,240	24.3
4	25,706	28.1
3	15,792	17.2
2	10,986	12.0
1	16,827	18.4

- Global Mean 3.28

The following comments on the 2019 free-response questions for AP® Microeconomics were written by the Chief Reader Aaron Lowen, Professor of Economics, Grand Valley State University and the Question Leaders Brian Heggood, Julia Frankland, and James Brumbaugh. 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, Explain, Assert	Topic: Monopoly and Factor Markets
	Max. Points: 9	**Mean Score:** 4.99

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of the market conditions for monopoly, how a monopoly sets price and output levels, how changes in the market for the monopoly's product would affect hiring decisions by the firm in a perfectly competitive labor market, and how the introduction of competition into the market would impact producer and consumer surplus.

The question states that Gigantic Pharmaceutical Corporation has monopoly power via its patent for a prescription drug and is currently operating with positive economic profits. In part (a) students were asked to draw a correctly labeled graph for a monopoly and to show the profit-maximizing quantity, the profit- maximizing price, the average total cost curve (ATC) curve, and the area representing the consumer surplus for the firm. To demonstrate this knowledge, students had to graph a downward-sloping demand (D) curve, a downward-sloping marginal revenue (MR) curve below the demand curve, a U-shaped ATC curve below the demand curve at the point of production, and a marginal cost (MC) curve rising through the ATC curve at its minimum point. Finally, students had to shade the area of consumer surplus below D and above the price of the good.

Part (b) asked students to explain how Gigantic's demand for workers would be impacted by an increase in the demand for the drug. This tested students' understanding of the relationship between factor demand and the demand for the product. Students were expected to assert that demand for workers would increase and explain that the increased demand for the drug increased the price of the drug, increasing the marginal revenue product ($MRP_L=MP \times P$) of each worker; thus, increasing the demand for workers. Students were then asked to identify how the change in the demand for the prescription drug would affect the wage rate Gigantic pays its workers and the quantity of workers hired by Gigantic. This tested student understanding of the perfectly competitive factor market in which Gigantic hires workers. Gigantic is a "wage-taker" for warehouse workers. Therefore, the student was expected to recognize there would be no change to the prevailing wage for workers. The increased demand for labor by Gigantic would result in more workers being hired by Gigantic at an unchanged wage rate.

Part (c) asked students to evaluate the impact of a new firm entering the pharmaceutical drug market on producer and consumer surplus. In part (c)(i) students had to identify that Gigantic's producer surplus would decrease as a result of the new firm's entry into the market. In part (c)(ii) students had to identify that consumer surplus would increase with the introduction of a new firm and explain that this occurs as a result of the decrease in equilibrium price and the increase in equilibrium quantity.

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) of the question tested students' ability to graph the monopoly model. A majority of students were able to demonstrate understanding of the monopoly model and its price and output decision-making.

- Most students (66.4%) correctly drew the monopoly's downward-sloping demand curve with a corresponding downward-sloping MR curve below the demand curve. Many of the students who did not earn the point either attempted to use the perfect competition model with its horizontal demand and marginal revenue curve or drew a single curve for demand and marginal revenue as if Gigantic was a perfectly price-discriminating monopolist.
- Most students (66.9%) correctly identified the profit-maximizing output Q_G from the intersection of the downward-sloping MR and rising MC curves. Some students reversed the labeling for the curves or left either one or both of the curves off the graph

- Most students (63.5%) identified the profit-maximizing price P_G by making an explicit connection from Q_G up to the demand curve and over to the price axis and having P_G above the U-shaped ATC curve at Q_G. Some students generated the equilibrium price by drawing the line to the price axis from the intersection of MC and MR without first moving up to the demand curve. Others did not have a U-shaped ATC below the price at Q_G.
- A majority of students (52.3%) correctly drew a marginal cost curve rising through the minimum of the U-shaped ATC. Many students are not making the graphical connection between the MC and ATC curve and do not connect the curves at all. Others illustrate MC intersecting at a point that is clearly not the minimum of the ATC curve,
- A majority of students (52.5%) correctly shaded the area of consumer surplus on the graph. Many students failed to earn the point because they correctly shaded areas of profit, total revenue, or deadweight loss instead.

Part (b) of the question tested students' understanding of the profit-maximizing behavior of firms in the labor market and the impact of changes to determinants of labor demand on the factor market.

- Only 4.8% of students correctly explained how the increase in market demand for the drug manufactured by Gigantic impacted the labor market. Most students identified that the increase in demand for the drug would result in an increase in the demand for labor but then failed to explicitly connect the increased price of the drug to an increase in the marginal revenue product (MRP_L) of labor and, thus, the demand for labor in Gigantic's market for warehouse workers. Many students offered an insufficient explanation that an increase in the price for the drug would lead to increased demand for labor.
- Only 21.6% of students correctly recognized that since Gigantic hires in a perfectly competitive labor market, they would hire where the market-set wage intersects the higher demand for labor, resulting in a decision to hire a greater quantity of workers at the same wage. Many students indicated a greater demand intersecting an upward-sloping supply curve at a greater quantity and wage rate rather than a horizontal wage rate faced by the firm in a perfectly competitive labor market.

Part (c) of the question tested students understanding of how increased competition in the market would affect producer and consumer surplus.

- Most students (74.7%) correctly asserted that the producer surplus for Gigantic would decrease when faced with competition from a new firm offering an identical product at a lower price.
- A majority of students (57.4%) were able to explain how consumer surplus would increase in the prescription drug market with the introduction of a new firm. Most students correctly explained that a lower market price and increased market quantity would result in more consumer surplus.

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 and monopoly. • Identifying the MR curve as the same as the demand curve for the monopoly. • Identifying the profit-maximizing quantity (Q_G) at the intersection of	• Drawing a downward-sloping demand curve for the monopoly. • Drawing a marginal revenue curve, starting at the same point as demand on the price axis, that is downward-sloping but with a steeper slope so that it is below demand. • Identifying Q_G on the quantity axis, marked with a dashed line down from the intersection of the MR and

the MC curve and the demand curve, which indicates the allocatively efficient quantity, or at the minimum of the ATC curve, which indicates the productively efficient quantity. • Identifying the profit-maximizing price (P_G) directly across from the intersection of the MR and MC curves. • Drawing the ATC curve above the demand curve, which indicates negative economic profit. • Drawing the MC curve without intersecting the ATC curve, or intersecting the ATC curve at a point that is clearly not the minimum of the ATC curve. • Shading the area of economic profit instead of the area of consumer surplus.	MC curves. Profit is maximized at the quantity where MR=MC. • Identifying P_G on the price axis, marked with a dashed line up from the intersection of the MR and MC curves to the demand curve, and then over to the price axis. • Drawing the U-shaped ATC curve below the demand curve at Q_G. • Drawing a U-shaped ATC curve with a marginal cost curve that initially falls then rises through the minimum of the ATC. • Shading consumer surplus as the triangle left of demand back to the price axis above P_G.
Part (b)(i) • Not connecting the change of a determinant of labor demand (product price) to the labor market. • Incorrectly stating that demand for labor increases because there is a need to meet increased output.	• Explaining that an increase in product price, a determinant of labor demand, increases the marginal revenue product and, thus, the demand for labor. • Explaining that the increase in factor demand is a result of the increase in the marginal revenue product of labor (MRP_L).
Part (b)(i) • Not recognizing that a "wage-taker" faces a horizontal labor supply curve at the market wage.	• Identifying that the wage rate will not change (the wage rate faced by a firm hiring in a perfectly competitive labor market is constant at the equilibrium market wage rate) and that the number of workers hired will increase.

Part (c)(i) • Asserting that producer surplus will increase.	• Asserting that producer surplus will decrease.
Part (c)(ii) • Not connecting an increase in the area of consumer surplus to a decrease in price and an increase in quantity.	• Explaining that the market responds to the additional drug firm by establishing a lower price and greater quantity, increasing consumer surplus.

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?

Imperfectly competitive markets represent a significant percentage of course content for microeconomics. Students should build enduring understandings of how monopolies differ from perfectly competitive firms with repeated practice in graphing and interpreting the monopoly model. Students are frequently expected to illustrate economic concepts graphically, so regular individual practice with the models is strongly encouraged.

Overall, students struggled to correctly explain the connection between the product market and the factor market. Teachers can spend more time explaining how the concept of derived demand for a factor connects back to the product market. A graph was not required for part (b) of the question, but having students spend time graphing the product market, the labor market, and the firm's market for labor will increase student awareness of the separate but interrelated nature of these markets.

Additionally, many students struggled to recognize the perfectly competitive nature of the labor market in which Gigantic hired warehouse workers. Teachers can remind students that even firms that enjoy monopoly power in the product market may face perfectly competitive market conditions when employing factors like labor.

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

Teachers may log in to AP Classroom to access formative questions and past AP questions on the content and skills addressed in this question.

Question #2	**Task:** Interpret a graph to assert and explain	**Topic:** Effects of Government Intervention in Markets
	Max. Points: 5	**Mean Score:** 2.56

What were the responses to this question expected to demonstrate?

This question assessed students' understanding of tax incidence, as portrayed using a graph when a per-unit sales tax is imposed. The concepts in the question included recognizing the price paid by consumers, the burden of a tax, and identifying the total tax revenue received by the government. Students needed to understand the impact on price for the case of an inelastic demand curve and also determine how the tax revenue to the government and producer surplus change after the demand becomes inelastic.

The question provided a graph showing a per-unit tax on a product. In part (a)(i) students needed to use the graph to determine the after-tax price and quantity paid by the consumer as P3 and Q2. In (a)(ii) they needed to indicate the area that represented the total tax revenue the government received, P1P3SZ.

Part (b) of the question asked the student to assume the demand is perfectly inelastic at quantity Q3, with supply and the per unit tax remaining unchanged. Part (b)(i) required the student to state that the after-tax price paid by consumers is higher than the answer in part (a)(i). In part (b)(ii) the student needed to state that the total tax revenue received by the government is higher than in part (a)(ii). The student also needed to explain that this is because a per-unit tax does not change quantity given perfectly inelastic demand, while it does change quantity given relatively inelastic demand (Q3 is higher than Q2).

Part (c) continued to use the inelastic demand at quantity Q3 and reduced the per-unit sales tax. Students needed to recognize that the producer surplus stayed the same and to explain either that price and quantity do not change or that the consumer bears all the burden of the tax.

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)(i) students correctly identified the after-tax price and after-tax quantity of P_3Q_2 in 79.4% of the responses.

For part (a)(ii) the area of the total tax revenue was correctly identified as P_1P_3SZ by 53.9% of the students.

For part (b)(i) an increase in the price paid by the consumers was identified correctly by 77.3% of the students.

For part (b)(ii) the increase in tax revenue was identified by most students, but only 39.3% of the responses provided a sufficiently accurate and complete explanation to earn the point.

For part (c), 27.4% of students earned the point for identifying that there was no change in producer surplus and including a correct explanation.

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)(i) • Incorrectly identifying the optimal price and quantity combinations as: S; P_4, Q_3; or P_2, Q_3.	• Identifying that price is at P_3 and quantity is at Q_2 at the intersection of the Demand and Supply + Tax lines.
Part (a)(ii) • Incorrectly identifying the area of total tax revenue as P_2P_4XW or P_2P_3ST.	• Identifying the area representing the total tax revenue as P_1P_3SZ; $(P_3\text{-}P_1) \times Q_2$; or $(P_3 \times Q_2) - (P_1 \times Q_2)$
Part (b)(i) • Stating that the price paid by consumers will be the same or lower after the imposition of a per-unit sales tax.	• Stating that the price paid by consumers will be higher.
Part (b)(ii) • Stating that the tax revenue will be higher with no explanation given. • Stating that the tax revenue will be lower because price is increasing. • Stating that the tax revenue will remain the same because producers bear the full burden of the tax.	• Stating that the tax revenue will be higher because a per-unit tax does not change quantity given perfectly inelastic demand, while it does change quantity given relatively inelastic demand (Q_3 is higher than Q_2).
Part (c) • Stating that producer surplus will remain the same with no explanation given • Stating that producer surplus will decrease	• Producer surplus will remain the same because there is no change in price or quantity or because the consumer bears all the burden of the tax.

• Stating that producer surplus will increase	

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?

Students should be reminded to avoid internal labeling on graphing points, instead labeling price and quantity values on their respective axes. Students missing the first point in (a)(i) frequently did so because they used the internal point S rather than P_3 and Q_2.

Students would also benefit from additional practice calculating the area of tax revenue from a graph. Additionally, assigning tax assessment problems, such as FRQs that use numbers instead of labels (P_2, Q_2, etc.), would allow students to practice calculating tax revenues.

The introduction of an inelastic demand curve in part (b) changed the burden of the tax from being shared to being borne completely by the consumer. Exercises where students identify the tax burden for different combinations of elasticities would improve this skill.

Careful reading of the question is also suggested to be certain that the response given goes beyond a restatement of the prompt. Frequently, explanations given in (b)(ii) and (c) simply repeated parts of the question stem without using or interpreting that information to reach the correct conclusion.

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

Teachers may log in to AP Classroom to access formative questions and past AP questions on the content and skills addressed in this question.

Question #3	**Task:** Perform numerical analysis, explain, create a visual representation	**Topic:** Oligopoly and Game Theory
	Max. Points: 6	**Mean Score:** 4.23

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of two-player (Boulevard and Jackpot) strategic games. In parts (a) through (d) of the question, the students were expected to identify a player's dominant strategy, identify the payoff for a player, explain why an alternative pair of actions was not profit maximizing, and identify the collective best result. In part (e), the students were expected to construct a new payoff matrix based on a proposal given by Jackpot. Students were expected to determine if Boulevard would agree to the proposal by comparing the Nash equilibrium of the original matrix with the Nash equilibrium of the new matrix.

Part (a) assessed students' understanding of a dominant strategy. Students needed to state that Jackpot's dominant strategy is to choose a closing time of 6 p.m.

In part (b) students were asked to determine whether an action is profit maximizing and to explain their answer using values from the matrix. Students needed to state that the proposed choice is not profit-maximizing and explain that Boulevard would earn more by choosing Delivery rather than No Delivery ($30>$20).

Part (c) tested students' ability to identify Nash equilibrium outcomes and to correctly identify the payoff for the player. Students needed to state that Boulevard would earn $30 in the Nash Equilibrium.

Students were told in part (d) the two firms merged to form one company with two locations while still facing the same choices. This part of the question tested students' ability to understand profit-maximizing behavior and the effect of a change in market conditions in the context of a given payoff matrix. Students needed to recognize the new, best outcome maximized the sum of the two profits in each cell and state the actions associated with the profit maximizing outcome (9 p.m. and No Delivery).

In part (e) students needed to construct a new payoff matrix based on a proposal given by Jackpot. Students were expected to determine if Boulevard would agree to the proposal by comparing the Nash equilibrium of the original matrix with the Nash equilibrium of the new matrix. Part (e)(i) tested students' ability to construct a payoff matrix given new strategic considerations. The second part, (e)(ii), tested students' ability to compare two separate Nash equilibria in order to explain that the optimal choice is for Boulevard to agree to Jackpot's proposal because it will be better off in the new game ($40 > $30).

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 students' understanding of the concept of a dominant strategy, asking them whether Jackpot has a dominant strategy, and if so, which strategy is dominant. Students earned the point in 86.6% of responses.

In part (b) students were required to identify and explain the $30 associated with Delivery and closing at 6 p.m. to the $20 associated with No Delivery and closing at 6 p.m. Students earned the point in 73.5% of the responses. Common mistakes included omitting values from the matrix in the explanation and using the wrong values from the matrix.

For part (c) the Nash equilibrium and payoff (profit) for Boulevard were correctly identified by most, with students earning the point in 64.9% of the responses. A common mistake was focusing on achieving the highest payoff available to one of the players in the matrix (either $50 or $55).

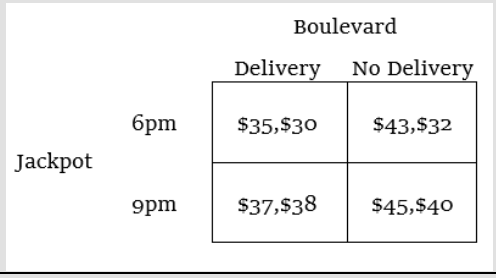
Part (d) tested students' ability to recognize the joint nature of an optimal outcome when the players (companies) merge but still face the previous choices. Most students (80.4%) earned the point.

Part (e)(i) tested students' ability to draw a two player game after altering a condition. Most students were able to correctly redraw the payoff matrix with the players and actions, but many were unable to calculate the correct values for each cell. The students were able to redraw the matrix correctly with all players, actions, and values in 51.8% of the responses. Some students restructured the game in a way that was inconsistent with the new condition, or left off players or actions off their redrawn matrix.

Part (e)(ii) tested students' ability to compare two Nash equilibria and explain which strategy Boulevard would choose. Students earned the point in 46.4% 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) • Adding the payouts and basing the player's decision on the collective best.	• Stating that Jackpot's dominant strategy is to close at 6pm.
Part (b) • Not using values from the payoff matrix to explain why this is not the profit-maximizing action by Boulevard. • Comparing the wrong values from the payoff matrix when explaining why this is not the profit-maximizing action by Boulevard.	• Stating that this is not the profit-maximizing action by Boulevard and explaining that Boulevard will earn $30 by choosing Delivery instead of $20 by choosing No Delivery.
Part (c) • Adding the profits of the two players in the Nash equilibrium rather than providing the profit of just Boulevard in the Nash equilibrium • Stating that the profit is $55 (likely because that is the largest number in the payoff matrix)	• Identifying the profit for Boulevard Gardens in the Nash equilibrium as $30.
Part (d) • Using the individual firms' profits rather than their combined profits.	• Stating that the combined company would maximize its profit by choosing to close at 9pm and offer No Delivery.

Part (e)(i) • Leaving off players or actions on the redrawn payoff matrix. • Calculating incorrect values in the cells of the payoff matrix.	Part (e)(i) • Correctly redrawing the payoff matrix with the players, actions, and payoffs that shows how the enforced agreement would affect the payoffs: 
Part (e)(i) • Only uses the new matrix to answer the question and does not consider the previous Nash equilibrium.	• Stating that Boulevard would agree to Jackpot's proposal because it would be better off with the payoff increasing from $30 to $40.

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?

To master oligopoly and game theoretic analyses, students need to be able to read and interpret a payoff matrix. Teachers can support student learning by providing variations of these games as practice. Having students take the roles of decision-makers and practice explaining their decisions will help them understand the concepts. Similarly, students should be given written descriptions of changes to the environment, which they should then use to modify the initial payoff matrix. This will provide opportunities for students to understand the effects of economic policies and changes on player incentives.

In parts (b) and (e)(ii), students sometimes provided the correct answer to the initial question but then didn't explain their answer at all or didn't explain their answer using numbers from the payoff matrix. Encourage students to read the prompts carefully and to address the tasks required in each question. If a question asks students to "explain," it is not sufficient to simply assert the answer; students must fully support their assertion with an explanation. Additionally, if a question specifically asks students to use values in their explanation, then they must use values in order to earn the point.

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

Teachers may log in to AP Classroom to access formative questions and past AP questions on the content and skills addressed in this question. There is also a lesson titled "Teaching About Game Theory" in the *Mastering Economic Thinking Skills* module that's available in the Classroom Resources section of the AP Microeconomics course page.