Chief Reader Report on Student Responses:

2022 AP® Microeconomics Set 2 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, ʻIolani School; Exam Leader James Leady, University of Notre Dame; and Question Leaders Gerald Simons, Professor of Economics, Grand Valley State University; Jaymily Solano, Seminole High School; and Martha Rush, Mounds View High 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: Perfect Competition and Externalities
Max Score: 10
Mean Score: 5.15

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of how a firm in perfect competition would maximize profit in the short run, how the firm is affected by changes in the market, and the implication of, and policy to correct for, an externality.

The question stated that Frank Sugar Co. was a representative firm in a perfectly competitive market for sugar, currently earning zero economic profit. In part (a)(i) students were asked to draw a correctly labeled graph for the market, showing the equilibrium price (P_M) and quantity (Q_M). Part (a)(ii) asked students to show the profit-maximizing price (P_F) and quantity (Q_F) for Frank Sugar Co. These parts of the question tested students' knowledge of market conditions for perfect competition 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 an upward-sloping supply curve (S) for the market, a horizontal demand and marginal revenue curve (d = MR) for the firm, and the firm's marginal cost (MC) and average total cost (ATC) curves. Students were required to show that P_M and Q_M occur where demand and supply intersect, that d = MR is horizontal at $P_F = P_M$, and that Q_F is the quantity where MR = MC. These tasks required students to demonstrate marginal analysis in a graphical format. Students also had to draw ATC consistent with the given zero economic profit condition by having ATC tangent to d = MR at Q_F and having ATC's minimum where the rising MC curve and ATC curve intersect.

Part (b) of this question asked students to illustrate and analyze the impact of an increase in market demand, assuming a constant-cost industry. This part required students to demonstrate knowledge of how a change in market conditions influences the performance of a representative firm, and how that impacts the market in the long run. In part (b)(i) students were required to show that the new market equilibrium price (P_2) occurs where the increased market demand (D_2) intersects market supply, and that the firm's profit-maximizing quantity (Q_N) occurs where P_2=MC. In part (b)(ii) students were required to state that the firm's profits increase as a result of the increase in market demand. In part (b)(iii) students were required to state that the long-run equilibrium price would be lower than P_2, because more firms would enter the market, thereby increasing the market supply.

Part (c) of this question introduced the information that sugar consumption has a negative impact on public health that is underestimated by consumers. Students were asked to draw a correctly labeled graph of the market, demonstrating knowledge of externalities with marginal social benefit (MSB), marginal private benefit (MPB), marginal social cost (MSC), and marginal private cost (MPC) curves. In part (c)(i) students were asked to show the equilibrium quantity (Q_M). Students were required to draw a downward-sloping MPB and an upward-sloping MPC and to show that Q_M occurs where MPB equals MPC. In part (c)(ii) students were asked to show the socially optimal quantity (Q_S). Students were required to draw a downward-sloping MSB below the MPB, to label the MPC as equal to MSC, and to show that Q_S occurs where MSB equals MSC.

In part (d) of this question, students were told that the government decides to intervene in the market to address the negative impact of sugar consumption on public health. Students were asked to indicate whether a lump-sum tax, a per-unit tax, a lump-sum subsidy, or a per-unit subsidy would best achieve the

government's objective. This part required students to demonstrate knowledge of the impact of government taxes and subsidies on market outcomes. Students were required to state that a per-unit tax would be best and to explain that a per-unit tax would raise the price paid per unit and decrease the 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?

In part (a) students earned the point for drawing a correctly labeled graph of the market with a downward-sloping demand curve, an upward-sloping supply curve, P_M, and Q_M correctly on 82% of responses. Students earned the point for drawing the firm's demand (d = MR) curve horizontal at $P_F = P_M$ on 49% of responses. The point for drawing the MC curve with Q_F labeled was earned on 69% of responses. The point for drawing the ATC curve tangent to the firm's demand (d = MR) curve at Q_F, with the MC curve intersecting the ATC curve at the minimum point on the ATC curve, was earned on 61% of responses.

In part (b)(i) students correctly drew the increased market demand curve, P_2, and Q_N, on 53% of responses. The point in part (b)(ii) for stating that the firm's profit would increase was earned on 80% of responses. The point in part (b)(iii) for stating that the long-run market equilibrium price would be lower than P_2 and explaining that firms would enter the market causing market supply to increase (shift to the right) was earned on 36% of responses.

In part (c)(i) students drew a correctly labeled graph with a downward-sloping MPB curve, an upward-sloping MPC curve, and Q_M correctly on 40% of responses. In part (c)(ii) students drew a downward-sloping MSB curve below the MPB curve, and labeled MSC to be equal to MPC, and Q_S at the intersection of MSB and MSC correctly on 35% of responses.

The point in part (d) for stating that a per-unit tax would be best and explaining that a per-unit tax would raise the price paid per unit and decrease the equilibrium quantity, was earned on 14% of 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 downward-sloping demand curve for the firm. ● Not indicating that $P_F = P_M$, nor drawing P_F extended from P_M. ● Not labeling Q_F. ● Drawing ATC either above or below d = MR at Q_F. ● Omitting the ATC curve.	● Drawing a correctly labeled market graph with downward-sloping D, upward-sloping S, P_M, and Q_M, demonstrating an understanding of market equilibrium. ● Drawing a horizontal demand curve for the firm at $P_F = P_M$, demonstrating that the firm is a price-taker. ● Drawing Q_F at the quantity where MR = MC, demonstrating profit maximization. ● Drawing ATC tangent to d = MR at Q_F, demonstrating zero economic profit.

Part (b) • Not labeling Q_N. • Stating that the firm will earn a profit. • Providing an incomplete explanation by not connecting an increase in market supply to new firms entering the market.	• Drawing Q_N at the quantity where P_2 = MC, demonstrating the firm's adjustment to a new profit-maximizing quantity when market conditions change. • Stating that the firm's profit will increase when market demand increases. • Explaining that new firms will enter the market and connecting that to an increase in the market supply.
Part (c) • Drawing a downward-sloping MPC and upward-sloping MPB. • Drawing MSB above MPB. • Drawing MSC below MPC. • Drawing MSB ≠ MPB *and* drawing MSC ≠ MPC. • Not labeling MSC = MPC.	• Drawing an upward-sloping MPC and downward-sloping MPB, demonstrating that MPC is supply and MPB is demand. • Drawing MSB below MPB and MPC = MSC, demonstrating a negative consumption externality.
Part (d) • Stating that a lump-sum tax best addresses the externality. • Providing an incomplete explanation of the impact of a per-unit tax by not connecting an increase in the price paid per unit to a decrease in the equilibrium quantity.	• Stating that a per-unit tax best addresses the negative externality. • Explaining that a per-unit tax would raise the price paid per unit and connecting that to a decrease in the equilibrium quantity.

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?

The perfect competition model and its accompanying graphs are important for students to understand as many firms operate in highly competitive markets. Students were relatively successful at constructing the basic model, correctly drawing market demand and supply, and the firm's demand (d = MR), MC, and ATC curves. Students were also relatively successful in using these curves to identify the firm's profit-maximizing quantity. Students generally understood the basic mechanics of the price and quantity determination for a firm with no market power.

Although most students drew a horizontal demand (d = MR) for the perfectly competitive firm, students frequently failed to show that this horizontal curve represents a constant price equal to P_M, either by stating that $P_F = P_M$ or by drawing a dotted line going from P_M in the market graph to P_F in the firm's graph. Teachers should emphasize that because firms in perfect competition are price-takers, students should clearly indicate in their graphs and explanations that the profit-maximizing price for the firm is equal to the market equilibrium price.

Students were somewhat successful at incorporating changes in market conditions into the model. Many students correctly showed the impacts of the increase in demand in the market and firm graphs, and most demonstrated that they understood that an increase in market demand would cause an increase in the short-run profits of the firm. However, relatively few students fully explained what would happen to the market price in the long run. Most commonly, students explained that short-run profits would lead to more firms entering the market *or* they explained that short-run profits would lead to an increase in market supply. However, students frequently failed to connect more firms entering the market to an increase in the market supply.

Teachers should provide opportunities for students to practice explaining all of the steps in the movement from the short run to the long run—explaining (i) how a change in the market equilibrium price affects the profits of firms, (ii) how a change in profits causes firms to either enter or exit the market, (iii) how the resulting change in the number of firms affects the market supply, and (iv) how the change in supply affects the equilibrium price and/or quantity.

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. For this question, most students did not recognize that MPB was demand and MPC was supply. One suggestion is to provide students a preview of externalities by mentioning MPB and MPC concepts when introducing supply and demand analysis. External costs or benefits resulting from the consumption or production are reflected in the position of the MSB and MSC curves relative to the MPB and MPC curves. This question asked students to graph a market with a negative consumption externality. Graphical models of the market with each possible 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 graphing each of the possible externalities.

For the final part of the question, some students stated that a lump-sum tax would best achieve the government's objective of addressing the negative externality, failing to recognize that lump-sum taxes do not affect marginal costs or benefits and are thus ineffective at correcting for externalities. For those students who correctly stated that a per-unit tax would best address the externality, many failed to fully explain *why* such a tax would be best. Most students did not completely connect a per-unit tax to higher prices paid by consumers, which then results in a lower equilibrium quantity. A teaching recommendation is to provide opportunities for students to practice explaining how a tax would affect the price for buyers, the price for sellers and the equilibrium quantity in a market.

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. The elements of perfect competition reflected in this question are covered in Topics 3.2 and 3.4–3.7, externalities are covered in Topics 6.1 and 6.2, and the effects of government intervention in markets are addressed in 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 2

Task: Calculate, Perform Numerical Analysis, and Explain
Topic: Consumer Surplus, Producer Surplus Total Economic Surplus, and International Trade
Max Score: 5
Mean Score: 2.17

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of the effect of opening a domestic market to international trade. The question also assessed students' ability to identify consumer surplus and analyze changes in consumer surplus, producer surplus, and total economic surplus when a country decides to trade in the world market.

The question included a graph with the domestic supply and demand in the market for wool for New Zealand with price values of $0–$70 and quantities values 0–500 on a grid. Part (a) of this question asked students to calculate the domestic consumer surplus when New Zealand does not engage in international trade. The students were directed to show their work, and they were expected to set up the equation correctly (CS = ½ × 300 × ($70 – $40), or CS = ½ × 300 × $30, or CS = $9,000 / 2) and to calculate the domestic consumer surplus as $4,500.

In part (b) of this question, students were told that New Zealand decided to trade in the world market for wool, with the current world price at $60 per unit, and that New Zealand was a price taker. Part (b)(i) asked students to identify the number of units of wool to be exported as 400 units. Students needed to use given data to make the identification but were not required to explain or show calculations.

Part (b)(ii) required students to assert that domestic consumer surplus would decrease and explain that when the domestic price increased to the world price the domestic quantity demanded would decrease with the changes in both price and quantity demanded resulting in a smaller area of domestic consumer surplus. Students were not asked to use specific numbers or show calculations. Alternatively, students could assert that domestic consumer surplus decreased and explain the change in domestic consumer surplus with calculations showing that consumer surplus had decreased from $4,500 to $500 after New Zealand engaged in world trade.

Part (b)(iii) asked students to determine that total economic surplus in New Zealand would increase when the country traded in the world market. Additionally, students were expected to explain the change in surplus using appropriate values, such as by showing that producer surplus increased by $8,000, while domestic consumer surplus decreased by $4,000, and total economic surplus increased by $4,000. Students were required to explain using numbers but were not required to show calculations.

In part (c) of this question, students were given that demand for wool in New Zealand increases. Students were asked to indicate how New Zealand's exports would decrease after a shift in domestic demand.

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) 70% of students correctly calculated the domestic consumer surplus as $4,500 and showed the correct calculations.

In part (b)(i) 34% of students correctly asserted that New Zealand would export 400 units of wool. In part (b)(ii) 24% of students correctly stated that domestic consumer surplus would decrease and either explained

that the domestic price increased to the world market price and domestic quantity demanded decreased or explained that domestic consumer surplus decreased from $4,500 before trade to $500 after trade. In part (b)(iii) 20% of responses included the assertion that total economic surplus would increase with the explanation that domestic producer surplus increased from $4,500 before trade to $12,500 after trade (or increased by $8,000), domestic consumer surplus decreased from $4,500 before trade to $500 after trade (or decreased by $4,000), and that total economic surplus increased from $9,000 before trade to $13,000 after trade (or increased by $4,000).

In part (c) 66% of students correctly determined New Zealand exports decreased.

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) ● Asserting domestic consumer surplus as $4,500 without showing their calculation. ● Showing a calculation for domestic producer surplus instead of domestic consumer surplus. ● Calculating total economic surplus instead of consumer surplus. ● Calculating domestic consumer surplus as $9,000 instead of $4,500 (not dividing by 2 to get the area of the triangle). ● Setting up the calculation correctly but giving an incorrect value (i.e., $9,000 / 2 = $450).	● Calculating the area of consumer surplus as the area under the demand curve and above the equilibrium price, as ½ × 300 × ($70 − $40) = $4,500.
Part (b)(i) ● Asserting domestic quantity supplied (500 units) as the units to be exported. ● Asserting domestic quantity demanded (100 units) as the units to be exported.	● Identifying the difference between the domestic quantity supplied and the domestic quantity demanded as the number of units, 400, when the world price is greater than the market equilibrium price without international trade.

Part (b)(ii) • Asserting domestic consumer surplus decreased when price increased. • Asserting domestic consumer surplus decreased and explaining a decrease in the willingness to pay. • Asserting domestic consumer surplus decreased and explaining decrease in quantity supplied or decrease in supply. • Explaining domestic consumer surplus decreased due to fewer units domestically sold. • Explaining domestic consumer surplus decreased when domestic price increased to world market price and demand decreased. • Explaining domestic producer surplus increased causing a decrease in domestic consumer surplus.	• Stating domestic consumer surplus will decrease and explaining that it decreases both because price paid increases *and* because quantity consumed decreases.
Part (b)(iii) • Calculating domestic consumer surplus as \$500, domestic producer surplus as \$4,500, and asserting total economic surplus decreases by \$4,000 after trade. • Calculating total revenue and asserting total economic surplus will increase from \$12,000 before trade to \$30,000 after trade. • Calculating domestic producer surplus increases as \$12,500 and asserting total economic surplus increases from \$9,000 before trade to \$12,500 after trade. • Asserting that after trade a deadweight loss of \$4,000 exists and explaining total economic surplus decreases to \$5,000. • Asserting total economic surplus remains the same and calculating total economic surplus as \$9,000 before trade and after trade. • Asserting total economic surplus would decrease and explaining without using numbers. • Asserting total economic surplus would decrease, which results in deadweight loss of \$4,000.	• Demonstrating, with numbers, that there is an increase in the area of total economic surplus (\$9,000 to \$13,000) resulting from a smaller decrease in consumer surplus (\$4,500 to \$500) than the increase in producer surplus (\$4,500 to \$12,500).

Part (c) • Asserting exports increase. • Asserting exports remain the same.	• Identifying a decrease in exports since the increase in domestic demand would increase domestic consumption without affecting domestic production at the world price.

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?

Economic surplus is important for measuring market efficiency and understanding how international trade affects domestic consumers and producers. Students tend to get more practice with the case of imports in international trade models, because that is the more common case for evaluating trade policy, compared to the case of exports (when the world price is above the autarky price).

In part (a) students were given a graph of the domestic market for wool in New Zealand and asked to calculate domestic consumer surplus. Students were relatively successful in identifying the area needed to calculate domestic consumer surplus before trade. It may be helpful to encourage students to show their calculations, even when the math is straightforward.

In part (b)(i) students were asked to identify the number of units of wool New Zealand would export when it engages in trade at the world market price. Many students incorrectly identified the units of wool to be exported as the domestic quantity supplied or the domestic quantity demanded at the world price rather than the difference between the two. Some students identified the number of units to be *imported* when the world price is *below* the autarky price. It may be helpful to provide students with additional practice in the less common scenario of exports, and so ask them to identify units to be *exported* when the world price is *above* the autarky price.

In part (b)(ii) students were required to explain the reason for the decrease in domestic consumer surplus. Many students cited only the increase in price as an explanation for the decrease in domestic consumer surplus without also citing the decrease in domestic quantity demanded. Explaining the change in consumer surplus with the price effect only might be sufficient at the level of the individual consumer but explaining the change in consumer surplus at the market level requires both price and quantity effects because some consumers get priced out of the market. It would be beneficial for students to practice giving more complete explanations in terms of what occurs to both price and quantity on questions with tables and graphs.

In part (b)(iii) students were required to assert total economic surplus increases and use numbers to explain that domestic producer surplus increases by more than domestic consumer surplus decreases so that there is a net increase in total economic surplus. Although the questions did not require students to calculate the respective areas of consumer surplus and producer surplus, doing so was an efficient approach to completely articulating the change in total economic surplus. Some students used graphical illustrations with numbers to show the areas of the triangles and make the relevant comparison and completely articulate the change in total economic surplus. Students need to be provided with additional opportunities to practice identifying areas of consumer surplus and producer surplus before and after trade and making comparisons of those areas visually (by shading) and mathematically (by calculating values). Those opportunities to practice should include both importing and exporting scenarios.

In part (c) students were required to assert New Zealand's exports would decrease when the domestic demand increased. Students were relatively successful in asserting that exports would decrease. Additional practice in identifying imports or exports should be provided to students to help them understand how changes in domestic supply, domestic demand or the world price would affect a country's exports or imports.

Finally, students need practice using economic reasoning and terminology consistently through topics covered in the course. Teachers should encourage students to use proper phrasing by providing more opportunities to use the content-related vocabulary.

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. Market equilibrium, consumer surplus and producer surplus are covered in topic 2.6. International trade is covered in topic 2.8. 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: Explain, Identify and Calculate
Topic: Natural Monopoly and Regulation
Max Score: 5
Mean Score: 2.42

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of natural monopoly and regulation. The concepts in the question included economies of scale, zero economic profit, socially optimal quantity, price ceilings, total revenue, and lump-sum subsidies.

The question provided a graph showing a natural monopoly with a demand (D) curve, marginal revenue (MR) and marginal cost (MC) curves, and a long-run average total cost (LRATC) curve that is downward sloping through the relevant range of market demand. The graph is labeled to show quantities from 0 to 60 units and prices from 0 to $40.

In part (a) students were asked to identify whether the firm is experiencing economies of scale, diseconomies of scale, or constant returns to scale over the output range of 0 to 60 units, and they were asked to explain their response. Students were required to explain that the firm is experiencing economies of scale over the output range of 0 to 60 units because the LRATC curve is decreasing throughout this range.

Part (b) asked students to identify the price and quantity at which the monopolist earns zero economic profit, where the LRATC curve intersects the demand curve. Students were required to identify a price of $15 and a quantity of 50 units.

Part (c) introduced a price ceiling that results in the firm producing the socially optimal quantity in the short run. In part (c)(i) students were asked to calculate total revenue at the price ceiling, where the MC curve intersects the demand curve. Students were required to show their calculation of total revenue with a price of $10 and a quantity of 60 units. In part (c)(ii) students were asked to explain why the firm requires a subsidy to continue producing the socially optimal quantity in the long run. Students were asked to explain that the firm requires a subsidy because it is earning negative economic profit (loss), since the price is less than LRATC at the socially optimal quantity. In part (c)(iii) students were asked to calculate the lump-sum subsidy necessary for the monopoly to produce the socially optimal quantity in the long run. Students were required to calculate the lump-sum subsidy that would cover the economic loss incurred by the firm by multiplying the quantity by the difference between LRATC and the price ceiling.

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) 37% of students correctly identified that the firm was experiencing economies of scale and explained that this is due to decreasing LRATC over the output range of 0 to 60 units.

In part (b) 63% of students correctly identified a price of $15 and a quantity of 50 units as the point at which the monopolist earns zero economic profit.

In part (c)(i) 56% of students correctly calculated total revenue at the socially optimal quantity resulting from the price ceiling as $10 × 60 = $600 and showed their work. In part (c)(ii) 46% of students explained that the firm requires a subsidy to continue in the long run because at the price ceiling, the price is below

LRATC, and the firm is earning negative economic profit (loss). In part (c)(iii) 41% of students correctly calculated the required lump-sum subsidy as ($13 - $10) × 60 = $180 and showed their work.

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) ● Using short-run productivity gains to explain the long-run concept of economies of scale. ● Describing economies of scale as a change in price relative to a change in quantity. ● Providing a definition of economies of scale without referencing LRATC on the graph provided. ● Explaining that LRATC is decreasing but asserting diseconomies of scale. ● Explaining economies of scale by comparing LRATC to another curve, such as D or MR.	● Explaining that the firm's decreasing LRATC curve demonstrates that the firm is experiencing economies of scale.
Part (b) ● Identifying zero economic profit at a price of $6 and a quantity of 34 units, which is the intersection of MR and MC. ● Identifying zero economic profit at a price of $10 and a quantity of 60 units, which is the intersection of MC and demand.	● Identifying that a firm earns zero economic profit at the point where its LRATC curve intersects the demand curve, which occurs at a price of $15 and a quantity of 50.
Part (c)(i) ● Calculating total revenue of $15 × 50 = $750, based on a price ceiling of $15 which would result in zero economic profit for the monopoly. ● Calculating economic profit of −$180 when asked to calculate total revenue.	● Identifying that the socially optimal quantity of output occurs where the marginal cost of production is equal to the price, which is at a quantity of 60. ● Identifying the price ceiling that would result in the firm producing the socially optimal quantity of output, which is $10. ● Calculating total revenue at the price ceiling, $10 × 60 = $600.

Part (c)(ii) • Stating that the monopolist is "not earning profit" (which could imply zero economic profit) or "losing money" rather than stating that the monopolist is earning negative economic profit (or an economic loss). • Comparing a per-unit cost (LRATC) to total revenue. • Explaining that the monopoly requires a subsidy because marginal cost is less than LRATC. • Stating that LRATC is "above demand" without explicitly comparing LRATC to the price.	• Explaining that the monopoly requires a subsidy to continue producing in the long run because its LRATC is greater than price at the output level of 60, resulting in negative economic profit (loss).
Part (c)(iii) • Calculating only a per-unit subsidy of $3 by subtracting price ($10) from LRATC ($13) at an output level of 60. • Calculating a lump-sum subsidy of $150 by comparing the break-even price and quantity ($15 × 50 = $750) to the socially optimal price and quantity ($10 × 60 = $600). • Calculating a lump-sum subsidy of $250 by subtracting the price ceiling of $10 from the break-even price of $15, then multiplying by the break-even output level of 50.	• Identifying the firm's average total cost of production at the socially optimal output level, which is $13. • Calculating the value of the required lump-sum subsidy by showing the difference between the firm's ATC and the price ceiling and multiplying by the quantity: ($13 − $10) × 60 = $180.

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 the concepts of natural monopoly, economies of scale, and regulation, students need to learn how to correctly interpret a graph and identify a variety of key points on the graph, including the profit-maximizing quantity, the socially optimal quantity, and the price that yields zero economic profit. Teachers should provide students with a variety of graphs, so that students have the opportunity to practice identifying each of these points, and calculating total revenue, total cost, and profit, in different scenarios. Teachers should require students to explain how they identified each point using economic reasoning and terminology; for example, the monopolist earns zero economic profit at a price of $10 and quantity of 50 because at this point, price and average total cost are equal.

Students also need practice distinguishing between short-run and long-run production and costs. A production simulation that begins in the short-run with fixed capital, then transitions to the long-run with variable capital, may be a helpful exercise.

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 3.3: Long-Run Production Costs 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.