Chief Reader Report on Student Responses:

2023 AP® Microeconomics Set 2
Free-Response Questions

• Number of Students Scored	94,772		
• Number of Readers	135		
• Score Distribution	Exam Score	N	%At
	5	20,225	21.34
	4	24,625	25.98
	3	19,566	20.65
	2	18,860	19.90
	1	11,496	12.13
• Global Mean	3.25		

The following comments on the 2023 free-response questions for AP® Microeconomics examination were written by the Chief Reader Aaron Lowen, Professor of Economics, Grand Valley State University; Chief Reader Designate James Leady, University of Notre Dame; Assistant Chief Reader Peter Duffer, Buffalo Grove High School; Exam Leader Lee Ann Fuller, John Carroll Catholic High School; and Question Leaders Eric Dodge, Hanover College; Brian Heggood, Stanton College Preparatory School; and Mary Kohelis, Madonna 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: 4.00

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of how a firm in a perfectly competitive market would maximize profit in the short run, how the firm adjusts to the long-run equilibrium, and the implication of, and policy to correct for, an externality.

The question stated that Anderson Company was a typical firm in a constant-cost, perfectly competitive market for Good G, currently earning positive economic profit. In part (a) students were asked what must be true about the relationship between accounting profit and economic profit if Anderson Company incurs both explicit and implicit production costs. This part assessed students' knowledge about the difference between accounting profit and economic profit. Because economic profit subtracts implicit and explicit costs from total revenue while accounting profit only subtracts explicit costs, accounting profit will be greater than economic profit.

In part (b) students were asked to draw correctly labeled side-by-side graphs for the market and Anderson Company. In the graph for the market, students were asked to show the equilibrium price (P_M) and quantity (Q_M). Part (b)(ii) asked students to show the profit-maximizing price (P_F) and quantity (Q_F) for Anderson Company. These parts of the question assessed 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 (d) and marginal revenue (MR) curve for the firm where d = MR, and the firm's rising marginal cost (MC) curve and U-shaped average total cost (ATC) curve. Students were required to show that P_M and Q_M occur where market demand and market supply curves 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. Part (b)(iii) asked students to completely shade Anderson Company's area of positive economic profit. This task required students to draw ATC consistent with the given positive economic profit condition by having ATC below P_F at Q_F, MC curve passing through the minimum of ATC curve, and shading the rectangle of economic profit.

In part (c) students were asked to show in the graph what happens in the market in the long run and how this affects the firm's price and quantity. Students were required to demonstrate knowledge of how a perfectly competitive market adjusts to positive short-run profits and how this adjustment influences the production decisions of a representative firm. Part (c)(i) asked students to show the new lower market equilibrium price, P_2, and greater market equilibrium quantity, Q_2, occurring where the increased market supply, S_2, intersects market demand. Part (c)(ii) asked students to show that Anderson Company's profit-maximizing price, P^*, represents the new $d_2 = MR_2$ curve and the profit-maximizing quantity, Q^*, where the new $MR_2 = MC = min$ ATC.

In part (d) students were given the information that the production of Good G creates benefits for third parties. Part (d)(i) asked students to determine if the market equilibrium quantity would be greater than, less than, or equal to the allocatively efficient quantity and explain their response. Students were required to recognize that a positive externality in production causes marginal private cost (MPC) to be greater than the marginal social cost (MSC). When this happens, the market equilibrium quantity will be less than the allocatively efficient quantity. Part (d)(ii) introduced a government intervention to correct the externality. Students were asked to determine whether total economic surplus will increase, decrease, or stay the same because of this action and explain their response. Students had to demonstrate an understanding that the government action taken to correct the positive externality in production would increase total economic surplus, since it would increase the quantity of Good G produced to the allocatively efficient quantity and reduce deadweight loss.

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) 46% of students earned the point for asserting that accounting profit is greater than economic profit.

In part (b) 74% of 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. Additionally, 49% of students earned the point for drawing the firm's demand (d = MR) curve horizontal at $P_F = P_M$. The point for drawing a rising MC curve with Q_F labeled at the point where MR = MC was earned 61% of the time. The point for drawing the ATC curve below the firm's demand (d = MR) curve at Q_F and showing the MC curve intersecting the ATC curve at the minimum point on the ATC curve was earned 52% of the time. The point associated for completely shading the area of economic profit was earned on 40% of the responses.

In part (c)(i) 45% of students earned the point for correctly drawing the increased market supply curve and correctly labeling the new market equilibrium with P_2 and Q_2. In part (c)(ii) 38% of students earned the point for correctly drawing the firm's new demand ($d_2 = MR_2$) curve at the lower price ($P^* = P_2$) from the market and labeling the profit-maximizing quantity (Q^*) at the minimum of the ATC curve.

In part (d)(i) 11% of students earned the point for correctly stating that the equilibrium market quantity was less than the allocatively efficient quantity because MPC > MSC. In part (d)(ii) 21% of students earned the point for asserting that total economic surplus would increase because the government intervention decreased deadweight loss.

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) • Incorrectly stating the relationship between accounting and economic profit. • Asserting that implicit costs are subtracted from total revenue to calculate accounting profit.	 • Because economic profit subtracts both explicit and implicit costs, while accounting profit subtracts only explicit costs, accounting profit exceeds economic profit. • Economic profit = accounting profit – implicit costs.
Part (b) • Not indicating that $P_F = P_M$, nor drawing P_F extended from P_M. • Not adding the d = MR label to the firm's price. • Drawing a downward-sloping demand curve for the firm. • Not labeling Q_F. • Drawing ATC either above or at d = MR at Q_F. • Omitting the ATC curve. • Not shading the correct area of economic profit.	 • 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 an ATC curve below d = MR at Q_F, demonstrating positive economic profit.
Part (c) • Shifting the demand curve leftward, rather than shifting the supply curve rightward, to produce a lower market price (P_2). • Not indicating that $P^* = P_2$, nor drawing P^* extended from P_2. • Not shifting the supply curve and asserting that in the long run $P_M = P_2$. • Omitting or using incorrect labels for P_2 and/or Q_2.	 • Drawing a rightward shift of supply to demonstrate that positive short-run profits will attract entry. • Indicating in the graph that the market price (P_2) is lower and market quantity (Q_2) is higher in the long run. • Drawing a horizontal demand curve for the firm extended from the market graph at P_2 where $P^* = P_2$, demonstrating that the firm is a price-taker. • Indicating that the firm's profit-maximizing quantity (Q^*) in the long run is at the point where $P^* = MC = min$ ATC.

Part (d)

- Not recognizing a positive externality in production when instructed that the production of a good creates benefits for third parties.
- Not indicating that the equilibrium market quantity is less than the allocatively efficient quantity when a positive externality exists.
- Recognizing a positive externality but explaining it as a consumption (demand side) positive externality rather than as a production (supply side) positive externality.
- Mistaking total economic surplus with a surplus of a product in the market (excess supply).
- Not recognizing that a correction of an externality reduces the deadweight loss and therefore increases total economic surplus.

- Stating that the market equilibrium quantity is less than the allocatively efficient quantity when a positive externality exists.
- Stating that a positive externality in production creates a condition in which the marginal social cost (MSC) is less than the marginal private cost (MPC).
- Stating that when the government acts to correct an externality that total economic surplus increases.
- Explaining that economic surplus increases when the market quantity increases and gets closer to the allocatively efficient 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 recognizing that accounting profit exceeds economic profit, constructing the basic model, and correctly drawing market demand and supply curves 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 price-taking firm.

Students who failed to earn the point in part (a) often simply stated that if economic profit was positive (from the prompt) that accounting profit was also positive. While true, this response does not fully explain the relationship between economic profit and accounting profit. Many student responses placed the subtraction of implicit costs on accounting profit, not economic profit.

Although almost half of students drew a horizontal demand (d = MR) for the perfectly competitive firm, students also needed to show that this horizontal curve represents a constant price equal to P_M, which is demonstrated by either 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. The primary struggle for students in part (b) was correctly shading the area of economic profit. This difficulty is often the result of how the ATC curve is drawn. A U-shaped ATC curve that has a very shallow (or nearly horizontal) approach to the minimum point makes finding the rectangle more difficult. Teachers could emphasize drawing a steeper U-shaped ATC curve with a single, clear minimum point to demonstrate this graphing point.

Students were relatively successful at graphically showing the long-run adjustment to positive short-run profits. The most common error was shifting the market demand curve to the left rather than shifting the market supply curve to the right. While this creates the necessary lower price, it does not describe the long-term adjustment and how the entry of new firms affects the market. Once again, students needed to show that this horizontal curve represents a constant price equal to P_2, either by stating that $P^* = P_2$ or by drawing a dotted line going from P_2 in the market graph to P^* in the firm's graph.

Teachers should provide opportunities for students to practice explaining market adjustment to long-run equilibrium, which includes 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 quantity.

Externalities are important in fully understanding market inefficiencies. In part (d)(i) of this question, most students recognized the situation as a positive externality and knew that this meant that market equilibrium quantity was less than the allocatively efficient quantity. The primary difficulty in earning that point was in providing an explanation consistent with a positive externality in production, not consumption. Positive externalities are almost always taught as coming from the consumption side of a transaction. In that case, the market fails to produce the allocatively efficient quantity because MSB is greater than MPB. But when the positive externality comes from production, it becomes a market failure because the MPC is greater than the MSC. One suggestion is to provide students with 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. 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 externality scenarios.

To a lesser degree, students struggled with explaining how a government correction to the externality would increase total economic surplus. We suspect that many students were unfamiliar with the term "economic surplus," though they have learned about consumer and producer surplus. Students who were most successful with earning the point in part (d)(ii) were those who knew that correcting an externality would decrease deadweight loss and therefore increase economic surplus. We suggest that teachers introduce this concept alongside consumer and producer surplus and return to economic surplus whenever discussing deadweight loss.

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 utilize 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, State, and Explain
Topic: Profit-Maximizing Behavior in Factor Markets, Production Function, Profit
Max Score: 5
Mean Score: 2.41

What were the responses to this question expected to demonstrate?

The question assessed students' understanding of how firms make decisions to maximize profits in a labor market and how firms decide to hire labor in a perfectly competitive labor market.

The question stated that Keepdry sold rain jackets in a perfectly competitive market for a price of $5 each and hired labor from a perfectly competitive labor market at a wage rate of $15. A table was provided indicating the total production of rain jackets for each number of workers hired by the firm.

In part (a) students were asked to calculate the marginal revenue product of the second worker. Students were expected to calculate the marginal product of the second worker as the difference in total production between employing two workers and employing one worker and to multiply the difference by the marginal revenue for the rain jackets.

In part (b) students were asked to state the number of workers with which diminishing marginal returns began. Students were expected to calculate the marginal product of each worker and to recognize that diminishing marginal returns begins when the addition of another unit of an input, labor in this case, resulting in less marginal product than the unit before it.

In part (c) students were asked to identify the profit-maximizing number of workers Keepdry should hire and to explain the profit-maximizing behavior of this firm using marginal analysis. Students were expected to identify how many units of labor Keepdry would hire in a perfectly competitive labor market and explain how Keepdry would determine this number of workers to maximize profits.

In part (d) students were asked to calculate Keepdry's economic profit at its profit-maximizing level of employment given a particular fixed cost. Students were expected to state Keepdry's economic profit as the difference between the total revenue generated by a particular number of workers for the firm and the sum of the provided fixed cost and variable cost (the labor costs for that number of workers).

In part (e) students were asked to explain if Keepdry's decision to hire its profit-maximizing number of workers would be affected by a change to the firm's fixed costs. Students were expected to recognize a firm's hiring decisions are only affected by changes to worker productivity, output price, or labor cost.

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) 53% of students earned the point for correctly calculating the marginal revenue product of the second worker.

In part (b) 73% of students earned the point for correctly stating that diminishing marginal returns begin with the hiring of the third worker.

In part (c) 37% of students earned the point for correctly stating the profit-maximizing number of workers is 4, and explaining that the MRP of the fourth worker is greater than the marginal factor cost of the fourth worker and the MRP of the fifth worker is less than the marginal factor cost of the fifth worker.

In part (d) 62% of students earned the point for correctly calculating the economic profit for the profit-maximizing number of workers identified in part (c).

In part (e) 27% of students earned the point for correctly stating that the number of workers will stay the same and explaining that the increase in fixed cost does not affect the marginal factor cost.

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) • Identifying the MP of the second worker as the MRP. • Subtracting the MFC from the MRP.	• Calculating the MRP as MRP = MP × MR = (20 − 9) × \$5 = \$55.
Part (b) • Identifying diminishing marginal returns as when marginal product is negative. • Identifying profit-maximizing condition in the factor market as MR = MP. • Identifying profit-maximizing condition as MP at its highest value. • Identifying profit-maximizing condition as MP = 0. • Using total profit values rather than marginal analysis. • Repeating profit-maximizing rule for employing labor rather than applying the rule to the specific situation in question.	• Identifying that diminishing marginal returns begin with the hiring of the third worker as MP started to decrease from 11 to 7 units, and before that MP increased from 9 to 11 units. • Stating the fourth worker maximizes profits because the MRP (\$25) is greater than the MFC (\$15) **AND** hiring the fifth worker decreases profits because the MRP (\$10) is less than the MFC (\$15).
Part (c) • Not stating economic profit = total revenue minus total cost. • Subtracting total revenue from total cost.	• Calculating the economic profit for 4 workers as economic profit = total revenue − total cost = (32 × \$5) − [\$40 + (4 × \$15)] = \$60.
Part (d) • Not explaining firms' decisions to hire based on productivity, output price, or factor cost (wage). • Using total profit values rather than marginal analysis.	• Stating the number of workers hired will not change because fixed cost does not affect the marginal factor cost (wage) of producing rain jackets.

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 production function and profit-maximizing behavior of firms that buy production inputs from perfectly competitive factor markets are topics assessed on each exam. In general, student responses indicated they were familiar with the topics and understood the questions asked. Teachers are encouraged to spend more time having students explain decisions made by agents who participate in factor markets. While assessments of student understanding of the production function and profit-maximizing behavior in factor markets often emphasize calculation and identification, students should also be able to articulate how marginal analysis is used in a particular decision or to arrive at a result. Additional practice may help students articulate their reasoning more clearly.

Teachers are also encouraged to have students support their responses with numbers from the question when requested. In this question, students were asked to explain how decisions are made by firms to maximize profits in factor markets. Many responses referenced the essential knowledge that typical firms hire labor as long as the marginal revenue product of labor is greater than the market wage. However, students were less successful in demonstrating that they could apply this rule to the information provided in the question. Similarly, prompts requesting marginal analysis often provide data that are critical in answering the question presented, and students should be encouraged to use that data in their responses.

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 3.1 The Production Function, 3.4 Types of Profit, and 5.3 Profit-Maximizing Behavior in Perfectly Competitive Factor Markets can be assigned to students as warm-ups, lectures, or reviews, and Topic Questions can be assigned to assess student understanding.

Question 3

Task: Identify, Assert, and Explain
Topic: Natural Monopoly
Max Score: 5
Mean Score: 1.83

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 decreasing average total costs over the entire effective demand, deadweight loss, socially optimal quantity, and economic profit.

The question provided a graph showing a natural monopoly with a demand (D) curve, marginal revenue (MR) and marginal cost (MC) curves, and an average total cost (ATC) curve that is downward sloping through the relevant range of market demand.

In part (a) students were asked to assert whether the firm shown in this graph is a natural monopoly and to explain their assertion. Students were required to state yes and explain that the firm is experiencing decreasing average total costs over the entire effective demand for its product.

In part (b) students were asked to identify the area representing the deadweight loss for this profit-maximizing monopoly. Students were required to identify the area of deadweight loss as bfg.

In part (c) a government regulation on price was introduced that resulted in the firm earning zero economic profits. Part (c)(i) required students to identify the price and resulting quantity the firm would produce in order to improve resource allocation. Students were required to state the regulated price is P_3, and the regulated quantity is Q_3. In part (c)(ii) students were asked if this government policy eliminates the deadweight loss and to explain using labeling from the graph. Students were required to answer no and explain that the area cjg is the remaining deadweight loss.

In part (d) students were asked to state whether the firm will earn positive, negative, or zero economic profit if the government decides to set a price that results in the socially optimal quantity of output, and then to explain using labeling from the graph. Students were required to state that the firm will earn negative economic profit and explain that at the socially optimal quantity (Q_4), average total cost is greater than price (P_1).

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) 30% of students earned the point for correctly identifying that the firm was a natural monopoly and explaining that this is due to decreasing ATC over the entire effective demand for its product.

In part (b) 47% of students earned the point for correctly identifying the area representing the deadweight loss for the profit maximizing monopoly as bfg.

In part (c)(i) 49% of students earned the point for correctly identifying that when the government sets a price that results in the firm earning zero economic profit, the regulated price is P_3 and the regulated quantity is Q_3. In part (c)(ii) 30% of students earned the point for explaining that the regulated price did not eliminate

the deadweight loss and identifying the remaining area of deadweight loss as cjg. Alternatively, students could have stated P_3 is greater than (or not equal to) marginal cost at Q_3, or Q_3 is less than the socially optimal quantity Q_4.

In part (d) 33% of students earned the point for correctly stating negative economic profit and explaining that at the socially optimal quantity, Q_4, average total cost is greater than price (P_1). Alternatively, students could have explained that at the socially optimal quantity, Q_4, the area of negative economic profit is P_1P_2dg or $(P_2 - P_1) \times Q_4$.

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 that the firm is not a natural monopoly. • Explaining that the horizontal marginal cost curve describes a natural monopoly without referencing the ATC. • Describing the ATC without referencing the entire effective demand for the product.	• Recognizing that this firm is a natural monopoly because the firm experiences decreasing average total costs over the entire effective demand for its product.
Part (b) • Identifying the incorrect area of deadweight loss.	• Identifying area bfg as the deadweight loss. Alternatively, identifying the area of deadweight loss as $\frac{1}{2} \times (P_5 - P_1) \times (Q_4 - Q_2)$.
Part (c)(i) • Identifying the regulated price as P_1 or P_4 at the profit-maximizing quantity. • Identifying the regulated price as P_1 and the corresponding quantity as Q_4, the socially optimal price and quantity.	• Identifying the regulated price and quantity combination associated with zero economic profit as P_3 and Q_3.
Part (c)(ii) • Stating no and explaining that the remaining deadweight loss is bec, an area associated with ATC at the profit-maximizing level. • Stating yes and explaining that zero economic profit has been achieved at quantity Q_4 and price P_1.	• Stating no and explaining that the area cjg is the remaining deadweight loss. Alternatively, explaining P_3 is greater than (or not equal to) marginal cost at Q_3, or explaining that Q_3 is less than the socially optimal quantity Q_4.
Part (d) • Stating the firm will earn negative economic profit but explaining the answer with incorrect price and/or quantity. • Stating the firm will earn positive economic profit at the socially optimal quantity. • Stating the firm will earn zero economic profit at the socially optimal quantity.	• Stating the firm will earn negative economic profit and explaining at the socially optimal quantity, Q_4, the average total cost is greater than price P_1. Alternatively, explaining at the socially optimal quantity, Q_4, the area of negative economic profit is P_1P_2dg or the area of negative economic profit is $(P_2 - P_1) \times Q_4$.

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?

When presenting the concepts of natural monopoly and regulation, teachers should help students understand the differences between a natural monopoly, a non-price-discriminating (single-price) monopoly, and a price-discriminating monopoly.

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 and price, the quantity and price that yield zero economic profit, and the socially optimal quantity and corresponding price. Teachers should provide students with a variety of graphs, so that students have the opportunity to practice identifying each of these points. Teachers are encouraged to provide students with opportunities to explain how they identified each point using economic reasoning and terminology. Teachers should also require students to label the price and quantity axes and only use external labels when indicating price and quantity. However, if a question concerns areas such as deadweight loss or economic profit, as in this question, Question 3, then utilizing the provided internal labeling (letters) is necessary.

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 utilize the resources available in AP Classroom for the topics and skills covered in this question. AP Daily videos on Topics 4.1: Introduction to Imperfectly Competitive Markets 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.