Past-paper walk-through

Profit Maximization ▪ 3.5

eXercise

Questions in this set

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Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 2

2026 ▪ Q2

The table shows Protecto's short-run cost schedule of producing helmets.

Quantity of Helmets	Total Cost ($)	Marginal Cost ($)
4	200	30
5	235	35
6	275	40
7	320	45
8	375	55
9	440	65
10	520	80

Question 2

Protecto produces and sells as many helmets as it wants at a market price of $60 each, and Protecto's fixed cost is $80.

(a) Identify the market structure in which Protecto sells helmets.

(b) Calculate Protecto's average variable cost when it produces 4 helmets. Show your work.

(c) Calculate Protecto's economic profit when it sells 5 helmets. Show your work.

(d) Identify Protecto's profit-maximizing quantity of helmets. Explain your answer using marginal analysis and numbers.

(e) Protecto is earning positive economic profit in the short run. As the market for helmets adjusts to long-run equilibrium, will the market price of helmets increase, decrease, or remain the same? Explain.

Question 2

Quantity of Helmets	Total Cost ($)	Marginal Cost ($)
4	200	30
5	235	35
6	275	40
7	320	45
8	375	55
9	440	65
10	520	80

Question 1

2025 Set 1 ▪ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

(a)(i) Draw a correctly labeled graph for Voda Reservoir and show each of the following. The profit-maximizing quantity, labeled Q_M.

(a)(ii) The profit-maximizing price, labeled P_M.

(a)(iii) The average total cost curve consistent with Voda Reservoir earning negative economic profit, labeled ATC.

(a)(iv) The area of deadweight loss, shaded completely.

Question 1

2025 Set 1 ▪ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

(b) Suppose the government requires Voda Reservoir to produce the socially optimal quantity of bottled water. On your graph in part A, show the socially optimal quantity of bottled water, labeled Q_S.

Question 1

2025 Set 1 ▪ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

(c) Suppose instead the government grants a per-unit subsidy to Voda Reservoir. What will happen to Voda Reservoir's profit-maximizing quantity of bottled water? Explain.

Question 1

2025 Set 1 ▪ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

(d) Suppose new producers have entered the bottled-water market and Voda Reservoir continues to operate in the bottled-water market. Will the demand for Voda Reservoir's bottled water become more elastic, become less elastic, or stay the same as new producers enter the market?

Question 1

2025 Set 1 ▪ Q1

Voda Reservoir is a profit-maximizing firm and the only producer of bottled water in a country. Currently, Voda Reservoir is earning negative economic profit.

(e)(i) Voda Reservoir hires workers in a perfectly competitive labor market. If the demand for bottled water increases, what will happen to Voda Reservoir's demand for labor? Explain.

(e)(ii) The government implements a new regulation that increases the minimum age required for a worker to be employed in a bottled-water factory. What will happen to the market wage in the short run? Explain.

Solution 1

(a)(i)

Mark scheme

- Draw a correctly labeled graph for Voda Reservoir (a monopolist) with Price/Cost on the vertical axis and Quantity on the horizontal axis. Show a downward-sloping demand curve (D) and a downward-sloping marginal revenue curve (MR) lying below D, plus a rising marginal cost curve (MC). Label the profit-maximizing quantity Q_M at the intersection of MR and MC (where MR = MC). Points: 1 point for the correctly drawn D and MR curves (D downward-sloping, MR downward-sloping and below D); 1 point for the rising MC curve and Q_M correctly labeled where MR = MC.

Solution 1

(a)(ii)

Mark scheme

- From Q_M, draw a vertical line up to the demand curve D; the corresponding price on the vertical axis is the profit-maximizing price, labeled P_M. The graph must show P_M read off the D curve directly above Q_M.

Solution 1

(a)(iii)

Mark scheme

- Draw the average total cost (ATC) curve so that it lies ABOVE the demand curve D at Q_M (i.e., $ATC > P_M$ at Q_M), which is consistent with Voda Reservoir earning negative economic profit (a loss). The MC curve must pass through the minimum point of the ATC curve.

Solution 1

(a)(iv)

Mark scheme

- Shade the deadweight loss completely: the triangular area bounded between the demand curve (D) and the marginal cost curve (MC), from Q_M out to the quantity where D intersects MC (the allocatively efficient quantity). This region represents the value lost to society because the monopolist produces less than the efficient quantity.

Solution 1

(b)

Mark scheme

- On the same graph, label the socially optimal quantity Q_S at the intersection of the demand curve (D) and the marginal cost curve (MC) — the allocatively efficient quantity where price equals marginal cost. Q_S must lie to the right of Q_M.

Solution 1

(c)

Mark scheme

- Voda Reservoir's profit-maximizing quantity of bottled water will INCREASE. Explain with ONE of: (1) the per-unit subsidy decreases the firm's marginal cost, shifting the MC curve to the right (down), so it intersects the MR curve at a greater quantity; OR (2) the per-unit subsidy increases the firm's marginal revenue, shifting the MR curve to the right, so it intersects the MC curve at a greater quantity.

Solution 1

(d)

Mark scheme

- The demand for Voda Reservoir's bottled water will become MORE ELASTIC. As new producers enter the bottled-water market, more substitutes become available for Voda Reservoir's product, making its individual demand more sensitive to price changes (more elastic).

Solution 1

(e)(i)

Mark scheme

- Voda Reservoir's demand for labor will INCREASE. Explanation: the increase in demand for bottled water increases the price and marginal revenue of bottled water, which increases the marginal revenue product of labor (MRP = MR $\times$ MPL), shifting the labor demand curve to the right.

Solution 1

(e)(ii)

Mark scheme

- The market wage will INCREASE in the short run. Explanation: raising the minimum age required to work in a bottled-water factory decreases the supply of workers, shifting the labor supply curve to the left, which raises the equilibrium market wage.

Question 1

2025 Set 2 ▪ Q1

Deskward is a typical profit-maximizing firm that produces and sells wooden desks in a constant-cost, perfectly competitive market that is in long-run equilibrium.

(a)(i) Draw correctly labeled side-by-side graphs for the wooden desk market and for Deskward and show each of the following. The market equilibrium price and quantity, labeled P_M and Q_M, respectively.

(a)(ii) Draw correctly labeled side-by-side graphs for the wooden desk market and for Deskward and show each of the following. Deskward's profit-maximizing price and quantity, labeled P_F and Q_F, respectively.

(a)(iii) Draw correctly labeled side-by-side graphs for the wooden desk market and for Deskward and show each of the following. Deskward's average total cost curve consistent with long-run equilibrium, labeled ATC.

Question 1

2025 Set 2 ▪ Q1

Deskward is a typical profit-maximizing firm that produces and sells wooden desks in a constant-cost, perfectly competitive market that is in long-run equilibrium.

(b) If the monthly rent, a fixed cost, on Deskward's factory building increases, what will happen to the firm's profit-maximizing quantity in the short run? Explain.

Question 1

2025 Set 2 ▪ Q1

Deskward is a typical profit-maximizing firm that produces and sells wooden desks in a constant-cost, perfectly competitive market that is in long-run equilibrium.

(c)(i) Suppose the government is considering granting a per-unit subsidy to producers of wooden desks. On your market graph in part A, show the short-run effect of a per-unit subsidy on each of the following. The new market equilibrium price and quantity of wooden desks, labeled P^* and Q^*, respectively.

(c)(ii) Suppose the government is considering granting a per-unit subsidy to producers of wooden desks. On your market graph in part A, show the short-run effect of a per-unit subsidy on each of the following. The area representing the total cost of the subsidy to the government, shaded completely.

Question 1

2025 Set 2 ▪ Q1

Deskward is a typical profit-maximizing firm that produces and sells wooden desks in a constant-cost, perfectly competitive market that is in long-run equilibrium.

(d) Instead of the per-unit subsidy, suppose the government imposes a binding price floor in the market for wooden desks. Will the price floor result in a shortage of wooden desks, a surplus of wooden desks, or neither? Explain.

Question 1

2025 Set 2 ▪ Q1

Deskward is a typical profit-maximizing firm that produces and sells wooden desks in a constant-cost, perfectly competitive market that is in long-run equilibrium.

(e)(i) Deskward also produces chairs. Deskward increases its production from 500 chairs to 600 chairs, and its long-run total cost increases from \$80,000 to \$108,000. Calculate Deskward's long-run average total cost of producing 500 chairs. Show your work.

(e)(ii) As Deskward increases production from 500 chairs to 600 chairs, is Deskward experiencing economies of scale, diseconomies of scale, or the efficient scale? Explain using numbers.

Solution 1

(a)(i)

Mark scheme

- Draw a correctly labeled graph of the market for wooden desks with a downward-sloping demand (D) curve and an upward-sloping supply (S_1) curve. Label the market equilibrium price (where D and S_1 intersect) as P_M and the market equilibrium quantity as Q_M.

Solution 1

(a)(ii)

Mark scheme

- Draw Deskward's graph with the firm's horizontal demand and marginal revenue curve (d = MR) extended from the market equilibrium price P_M, and label the firm's price as P_F (= P_M, since the firm is a price taker) (1 point). Also draw a rising marginal cost (MC) curve and show the firm's profit-maximizing quantity, labeled Q_F, at the point where MR = MC (1 point).

Solution 1

(a)(iii)

Mark scheme

- Show the average total cost (ATC) curve tangent to the firm's d = MR curve at Q_F, and show the MC curve passing through the minimum point of the ATC curve. Tangency of ATC to price (zero economic profit) with MC crossing ATC at its minimum indicates Deskward's ATC curve is consistent with long-run competitive equilibrium.

Solution 1

(b)

Mark scheme

- Deskward's profit-maximizing quantity will NOT change in the short run. An increase in a fixed cost (like rent) does not affect the firm's marginal cost or marginal revenue; since profit maximization occurs where MR = MC and neither curve shifts, the profit-maximizing quantity is unchanged (only the firm's economic profit falls).

Solution 1

(c)(i)

Mark scheme

- On the market graph from part A, show the supply curve shifting right, from S_1 to S_2 (a per-unit subsidy lowers producers' effective cost of production, increasing supply). Label the new, lower market equilibrium price as P^* and the new, higher market equilibrium quantity as Q^*, at the intersection of D and S_2.

Solution 1

(c)(ii)

Mark scheme

- Shade completely the rectangle bounded by the vertical gap between S_1 and S_2 (the per-unit subsidy) at the new equilibrium quantity Q^* — i.e., the area between S_1 and S_2 from quantity 0 to Q^*, spanning from P^* up to the price on S_1 at Q^*. This area equals the per-unit subsidy times Q^*, the total cost of the subsidy to the government.

Solution 1

(d)

Mark scheme

- The price floor will result in a surplus of wooden desks. Because the price floor is binding, it is set above the market equilibrium price; at this higher price, the quantity of wooden desks supplied is greater than the quantity demanded, creating a surplus.

Solution 1

(e)(i)

Mark scheme

- Long-run average total cost (LRATC) at 500 chairs = Total Cost / Quantity = \$80{,}000 / 500 = \$160 per chair. Show the division as work.

Solution 1

(e)(ii)

Mark scheme

- Deskward is experiencing diseconomies of scale. As output increases from 500 to 600 chairs, LRATC increases from \$160 (= \$80{,}000/500) to \$180 (= \$108{,}000/600) per chair. Because LRATC rises as output increases, this is diseconomies of scale (economies of scale would require falling LRATC; efficient scale requires LRATC to be at its minimum).

Question 1

2024 Set 1 ▪ Q1

1. Soja Farm is a typical profit-maximizing firm that produces and sells soybeans in a constant-cost, perfectly competitive market that is in long-run equilibrium. The market equilibrium price of soybeans is \$14 per bushel.

   (a) Draw correctly labeled side-by-side graphs for the soybean market and for Soja Farm, and show each of the following.

   (i) The market equilibrium price and quantity, labeled \$14 and Q_M, respectively
   (ii) Soja Farm's profit-maximizing price and quantity, labeled P_F and Q_F, respectively
   (iii) Soja Farm's average total cost curve consistent with a long-run equilibrium, labeled ATC

   (b) If Soja Farm is the only firm in the market that chooses to increase its price of soybeans to \$15 per bushel, will Soja Farm's total revenue increase by \$1, remain the same, or decrease to \$0 ? Explain.

   (c) Soybeans are used as an input in the production of tofu. Tofu now becomes a more popular food option among consumers. On your graphs in part (a), show the short-run effect of the increased popularity of tofu on each of the following.

   (i) The new market equilibrium price and quantity of soybeans, labeled P_2 and Q_2, respectively
   (ii) Soja Farm's new profit-maximizing quantity, labeled Q*

Question 1

(d) Given the increase in popularity of tofu in part (c), what will happen to the number of firms in the soybean market in the long run? Explain.

(e) Suppose a 25% increase in the market price of quinoa causes a 5% decrease in the quantity demanded of quinoa and a 10% increase in the quantity demanded for tofu.

(i) Is the demand for quinoa elastic, inelastic, or unit elastic? Explain using numbers.
(ii) Calculate the cross-price elasticity of demand between quinoa and tofu. Show your work.

Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

Solution 1

(a) Mark scheme

- Draw side-by-side graphs (4 points, 1 each): (1) Market graph: downward-sloping demand D_1 and upward-sloping supply S, with the equilibrium labeled at price $14 and quantity Q_M. (2) Firm graph: Soja Farm (a price-taking, perfectly competitive firm) has a horizontal demand/marginal-revenue curve d_1 = MR_1 drawn at the market price, labeled P_F (=14, the height carried over from the market graph). (3) A rising marginal cost (MC) curve is added to the firm graph, crossing $d_1 = MR_1$ at the profit-maximizing quantity Q_F (where $MR = MC$). (4) An average total cost (ATC) curve is added, drawn tangent to the firm's demand curve exactly at Q_F (zero long-run economic profit),

Solution 1

with the MC curve passing through the minimum point of ATC. Each of the four elements earns its own point; grade holistically against these four labeled features.

Solution 1

(b)

Mark scheme

- Soja Farm's total revenue would decrease to $0(notmerelyfallby1)$. Because Soja Farm is one price-taking firm among many in a perfectly competitive market, it faces a perfectly elastic (horizontal) demand curve at the market price of $14.Ifitaloneraisesitspriceto15$, all of its customers would simply buy soybeans from the many other sellers still charging the market price of $14, soSojaFarmwouldsellzerounitsandearn0$ in revenue.

Solution 1

(c)

Mark scheme

- Two points, one per graph: (i) On the market graph, demand shifts rightward from D_1 to D_2 (tofu's rising popularity raises demand for its input, soybeans), producing a new, higher equilibrium price labeled P_2 and a new, higher equilibrium quantity labeled Q_2 (both to the right/above the original 14/Q_M point). (ii) On the firm's graph, the higher market price shifts the firm's horizontal demand/MR curve upward to $d_2 = MR_2$ at P_2, and the new profit-maximizing quantity is labeled Q^*, found where $MR_2 = MC$ (to the right of the original Q_F).

Solution 1

(d)

Mark scheme

- The number of firms in the soybean market will increase in the long run. At the new higher price P_2, existing firms like Soja Farm earn positive (above-normal) economic profits (price exceeds ATC at Q^*). These economic profits attract new firms to enter the soybean market, which is characteristic of long-run adjustment in a perfectly competitive industry.

Solution 1

(e)(i)

Mark scheme

- Demand for quinoa is inelastic. Explanation (either is sufficient): the price elasticity of demand for quinoa has an absolute value of $|\%\Delta Q\_d \ / \ \%\Delta P| = 5\% \ / \ 25\% = 0.2$, which is less than 1, so demand is inelastic; equivalently, the 5% decrease in quantity demanded of quinoa is smaller (proportionally) than the 25% increase in the price of quinoa, meaning quantity demanded responds less than proportionally to the price change.

Solution 1

(e)(ii)

Mark scheme

- Cross-price elasticity of demand between quinoa and tofu = (% change in quantity demanded of tofu) / (% change in price of quinoa) = 10% / 25% = 0.4. (The positive value confirms quinoa and tofu are substitutes.)

Question 3

2023 Set 1 ▪ Q3

The graph provided shows the demand (d), marginal revenue (MR), average total cost (ATC), average variable cost (AVC), and marginal cost (MC) curves for Hansel Hangout, a typical profit-maximizing firm in a perfectly competitive market producing Good X.

[Graph with y-axis "Price, Cost ()"*showinggridlinevalues*$8, 9, 11, 14, 20, 21, 26$*and*$x-$*axis*"*Quantity*"*showinggridlinevalues*$4, 6, 8, 10$.*Curvesshown*, *labeledlefttorightalongtherightside*
MC(*risingmarginalcostcurve*), *ATC*(*averagetotalcostcurve*, $U-$
shaped, *intersectingMCatapproximatelyquantity*8, *price*$20-$
21), *AVC*(*averagevariablecostcurve*, $U-$
shaped, *lyingbelowATC*, *withitsminimumnearquantity*$4-$
6*aroundprice*$8-9$), *andahorizontallin*ed $=$ MR*drawnatprice*14.*Dashedguidelinesconnect* :
price26*uptotheMCcurvenearquantity*10; *price*21*and*20*nearquantity*8*whereMCcrossesATC*; *price*

Question 3

= MR$ crosses MC (near quantity 8) and also down to where it crosses AVC (near quantity 10); price 11 and 9 and 8 down near quantity 4 where AVC has its minimum.]

(a) Calculate Hansel Hangout's total fixed cost. Show your work.

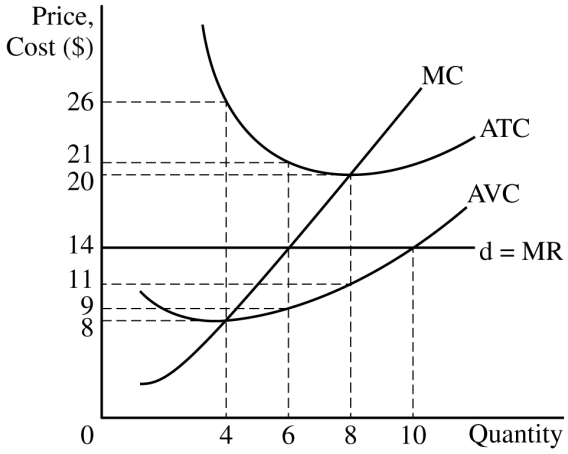
(b) Identify the price and Hansel Hangout's profit-maximizing quantity of Good X.

(c) Calculate Hansel Hangout's economic profit at the quantity identified in part (b). Show your work.

(d) As the market for Good X adjusts to the long-run equilibrium, what will happen to the price of Good X? Explain.

(e) Assume the cross-price elasticity of demand between Good X and Good C is positive. Given the change in the long-run price of Good X in part (d), will the quantity demanded of Good C increase, decrease, or remain the same? Explain.

Question 3



Solution 3

(a)

Mark scheme

- Total Fixed Cost = (Average Total Cost − Average Variable Cost) × Quantity. Using the $Q = 4$ row: TFC = $(26{-}8) \times 4 = 18{\times}4 =$72. (Equivalently, from $Q = 6$: $(21{-}9) \times 6 = 72$; *orfrom*Q=8: $(20 - 11){\times}8 =$72.)

Solution 3

(b)

Mark scheme

- Price = \$14 and Hansel Hangout's profit-maximizing quantity of Good X is 6 units (the quantity from the data table where marginal revenue equals marginal cost, i.e., price equals marginal cost for this price-taking firm).

Solution 3

(c)

Mark scheme

- Economic Profit = (Price − Average Total Cost) × Quantity = (\$14 − \$21) × 6 = (−\$7) × 6 = −\$42. (Equivalently, Total Revenue − Total Cost = (\$14 × 6) − (\$21 × 6) = \$84 − \$126 = −\$42.)

Solution 3

(d)

Mark scheme

- The market price of Good X will increase in the long run. Explanation: because firms are earning negative economic profit (a loss) at the current price, some firms will exit the market, shifting the market supply curve to the left (decrease in supply), which raises the market equilibrium price toward the zero-economic-profit long-run equilibrium.

Solution 3

(e)

Mark scheme

- The quantity demanded of Good C will increase. Explanation: a positive cross-price elasticity of demand between Good X and Good C indicates the two goods are substitutes in consumption; since the long-run price of Good X increases (from part (d)), demand for Good C increases (the demand curve for C shifts right), causing an increase in the quantity demanded of Good C.

Question 1

2023 Set 2 ▪ Q1

Anderson Company is a typical firm that manufactures Good G in a constant-cost, perfectly competitive market. Anderson Company is currently earning positive economic profit.

(a) What must be true about the relationship between accounting profit and economic profit if Anderson Company currently incurs both explicit and implicit costs in production?

Question 1

2023 Set 2 ▪ Q1

Anderson Company is a typical firm that manufactures Good G in a constant-cost, perfectly competitive market. Anderson Company is currently earning positive economic profit.

(b) Draw correctly labeled side-by-side graphs for the market and Anderson Company and show each of the following.

(i) The market equilibrium price and quantity, labeled P_M and Q_M, respectively (ii) The profit-maximizing price and quantity for Anderson Company, labeled P_F and Q_F, respectively (iii) The area representing Anderson Company's positive economic profit, shaded completely

Question 1

2023 Set 2 ▪ Q1

Anderson Company is a typical firm that manufactures Good G in a constant-cost, perfectly competitive market. Anderson Company is currently earning positive economic profit.

(c) On your graphs in part (b), show what will happen to each of the following if the market for Good G adjusts to long-run equilibrium.

(i) The market equilibrium price and quantity, labeled P_2 and Q_2, respectively (ii) Anderson Company's profit-maximizing price and quantity, labeled $P*$ and $Q*$, respectively

Question 1

2023 Set 2 ▪ Q1

Anderson Company is a typical firm that manufactures Good G in a constant-cost, perfectly competitive market. Anderson Company is currently earning positive economic profit.

(d)(i) Assume the production of Good G creates benefits for third parties. Given this situation, will the market equilibrium quantity be greater than, less than, or equal to the allocatively efficient quantity? Explain.

(d)(ii) The government takes an action that corrects the externality in the market for Good G. As a result of the government's action, does total economic surplus increase, decrease, or stay the same? Explain.

Solution 1

(a)

Mark scheme

- Anderson Company's accounting profit must be greater than its economic profit. Accounting profit = total revenue − explicit costs, while economic profit = total revenue − (explicit costs + implicit costs). Because implicit costs are positive, subtracting them further reduces the total, so economic profit is lower than accounting profit.

Solution 1

(b) Mark scheme

- Draw correctly labeled side-by-side graphs for the market and for Anderson Company. Market graph: downward-sloping demand (D) and upward-sloping supply (S), with their intersection labeled market equilibrium price P_M and quantity Q_M [1 point]. Firm graph: a horizontal demand/marginal-revenue curve (d = MR) extended from P_M, with the firm's price labeled P_F ($= P_M$) [1 point]. Add a rising marginal cost (MC) curve intersecting d = MR at the profit-maximizing quantity, labeled Q_F, where MR = MC [1 point]. Add an average total cost (ATC) curve that sits below the d = MR curve at Q_F, with the MC curve passing through the minimum point of ATC [1 point]. Shade completely the rectangle bounded above by P_F (d = MR) and below by ATC at

Solution 1

Q_F to represent Anderson Company's positive economic profit [1 point]. Total: 5 points for the five required graph elements.

Solution 1

(c) Mark scheme

- On the graphs from part (b), show the long-run adjustment: (i) On the market graph, draw a rightward shift of the supply curve (S to S_2), producing a lower market equilibrium price, labeled P_2, and a greater market equilibrium quantity, labeled Q_2 [1 point]. (ii) On the firm's graph, show the new lower price P^* extended from the new market equilibrium price P_2 (giving the firm a new demand/MR curve $d_2 = MR_2$), and a lower profit-maximizing quantity, labeled Q^*, at the new equilibrium where $P^* = MR_2 = MC =$ minimum ATC (zero economic profit in the long run) [1 point]. Total: 2 points.

Solution 1

(d)(i)

Mark scheme

- The market equilibrium quantity will be less than the allocatively efficient quantity. Because production of Good G creates benefits for third parties (a positive production externality), the marginal social cost (MSC) is less than the marginal private cost (MPC) at the market equilibrium. Since the market only reflects MPC (not MSC), it under-produces relative to the allocatively efficient output level where price equals MSC.

Solution 1

(d)(ii)

Mark scheme

- Total economic surplus will increase. Accept an explanation using ONE of the following: the quantity produced will increase toward the allocatively efficient quantity; the deadweight loss will decrease to $0; the marginal private cost will rise to equal the marginal social cost, internalizing the externality (e.g., via a per-unit subsidy).

Question 1

2022 Set 1 ▪ Q1

A firm has a patent on a new carbon-capture technology, making it the only producer of that device. The firm is currently earning a positive economic profit and is producing the profit-maximizing level of output.

(a) Draw a correctly labeled graph for the firm and show each of the following. (i) The quantity of carbon-capture devices produced by the firm, labeled Q_M (ii) The price charged by the firm, labeled P_M (iii) The area representing consumer surplus, shaded completely

Question 1

2022 Set 1 ▪ Q1

A firm has a patent on a new carbon-capture technology, making it the only producer of that device. The firm is currently earning a positive economic profit and is producing the profit-maximizing level of output.

(b)(i) The government is considering different options to regulate the firm. Suppose the government is considering taxing the firm. Could using a per-unit tax change the firm's output to the socially optimal quantity? Explain.

(b)(ii) Instead, suppose the government imposes a price ceiling so that the firm produces the socially optimal quantity. On your graph in part (a), label the quantity and price after the price ceiling is imposed as Q_C and P_C.

(b)(iii) At the price and the quantity identified in part (b)(ii), is the firm earning positive economic profit? Explain.

Question 1

2022 Set 1 ▪ Q1

A firm has a patent on a new carbon-capture technology, making it the only producer of that device. The firm is currently earning a positive economic profit and is producing the profit-maximizing level of output.

(c)(i) Assume the government decides not to regulate the firm and instead the firm produces the quantity of output that maximizes total revenue.
If the firm now increases its output by one unit, would marginal revenue be positive, negative, or zero? Explain.

(c)(ii) Starting at the total-revenue-maximizing quantity, if the firm reduces the price by 10%, would quantity demanded increase by less than 10%, by more than 10%, or by exactly 10%?

Solution 1

(a) Mark scheme

- Monopoly graph for the firm, 5 points total (1 point each): (1) Correctly labeled downward-sloping demand curve D and marginal-revenue curve MR, with MR below D. (2) Marginal-cost curve MC added, intersecting MR at the profit-maximizing quantity labeled Q_M (where $MR = MC$). (3) Profit-maximizing price P_M read up from Q_M to the demand curve. (4) Average-total-cost curve ATC drawn below the demand curve at Q_M, with the MC curve passing through the minimum point of ATC. (5) Consumer surplus – the area bounded above by D, below by the price P_M, from the price axis out to Q_M – shaded completely.

Solution 1

(b)(i)

Mark scheme

- No. A per-unit tax raises the firm's marginal cost, shifting MC upward. The new MC intersects MR at a LOWER quantity than Q_M, so the tax decreases the firm's profit-maximizing output – it moves output further away from (not toward) the socially optimal quantity, which is higher than Q_M (found where $MC = D$).

Solution 1

(b)(ii)

Mark scheme

- The socially optimal quantity Q_C is where the (original, untaxed) MC curve crosses the demand curve D (i.e. $MC = D$); this lies to the right of Q_M. The corresponding price ceiling P_C is the price on the demand curve at Q_C (equivalently, the height of D and MC where they cross). Both Q_C (on the quantity axis, right of Q_M) and P_C (on the price axis, below P_M) should be labeled on the part (a) graph.

Solution 1

(b)(iii)

Mark scheme

- Yes, the firm earns positive economic profit at Q_C, because $ATC < P_C$ at that quantity – profit per unit is $P_C - ATC > 0$. Scoring note: grade for internal consistency with the student's own graph – accept 'no economic profit' only if their ATC curve is drawn at or above P_C at Q_C; the standard graph has ATC below P_C at Q_C, giving positive profit.

Solution 1

(c)(i)

Mark scheme

- Marginal revenue would be negative. At the total-revenue-maximizing quantity, $MR = 0$ (TR is at its peak). Increasing output by one more unit pushes the firm onto the inelastic portion of the demand curve, where selling more requires a price cut large enough that total revenue falls, i.e. $MR < 0$ for that extra unit.

Solution 1

(c)(ii)

Mark scheme

- Less than 10%. At the revenue-maximizing quantity, demand is unit elastic ($|E_d| = 1$). Cutting price further moves the firm onto the inelastic portion of the demand curve, where $|E_d| < 1$, so the percentage increase in quantity demanded is smaller than the 10% percentage decrease in price.

Question 1

2022 Set 2 ▪ Q1

Sugar is produced in a perfectly competitive market using inputs from perfectly competitive factor markets. Frank Sugar Co. is a representative firm in the sugar market.

(a) Assume Frank Sugar Co. is earning zero economic profit. Draw correctly labeled side-by-side graphs for the sugar market and Frank Sugar Co. and show each of the following.

(i) The market equilibrium price and quantity, labeled P_M and Q_M, respectively (ii) The profit-maximizing price and quantity for Frank Sugar Co., labeled P_F and Q_F, respectively

Question 1

2022 Set 2 ▪ Q1

Sugar is produced in a perfectly competitive market using inputs from perfectly competitive factor markets. Frank Sugar Co. is a representative firm in the sugar market.

(b)(i) Assume the demand for sugar increases and sugar is produced in a constant-cost industry.

On your graph in part (a), show the short-run effect of the increased demand for sugar on the market price, labeled P_2, and the quantity sold by Frank Sugar Co., labeled Q_N.

(b)(ii) Compared to the equilibrium identified in part (a)(ii), what will happen to the short-run profit earned by Frank Sugar Co. as a result of the increased demand for sugar?

(b)(iii) When the market adjusts to long-run equilibrium, how will the market price of sugar in the long run compare to P_2 ? Explain.

Question 1

2022 Set 2 ▪ Q1

Sugar is produced in a perfectly competitive market using inputs from perfectly competitive factor markets. Frank Sugar Co. is a representative firm in the sugar market.

(c) Instead, assume sugar consumption has a negative impact on public health over time and the negative impact of sugar on health is underestimated by consumers. Draw a correctly labeled graph of the market, with the marginal social benefit (MSB), marginal private benefit (MPB), marginal social cost (MSC), and marginal private cost (MPC) curves, and show each of the following.
(i) The market equilibrium quantity, labeled Q_M (ii) The socially optimal quantity, labeled Q_S

Question 1

2022 Set 2 ▪ Q1

Sugar is produced in a perfectly competitive market using inputs from perfectly competitive factor markets. Frank Sugar Co. is a representative firm in the sugar market.

(d) Assume the government decides to intervene in the market to affect consumers' incentives and to address the negative impact of sugar consumption on public health. Which of the following policies would best achieve that objective in the short run: a lump-sum tax, a per-unit tax, a lump-sum subsidy, or a per-unit subsidy? Explain.

Solution 1

(a) Mark scheme

- Draw two side-by-side graphs. Market graph: upward-sloping supply (S) and downward-sloping demand (D) curves crossing at the equilibrium price P_M and quantity Q_M (1 pt — correctly labeled axes/curves/P_M/Q_M). Firm graph: a horizontal line at $P_F = P_M$ labeled d = MR, representing the price-taking firm's demand/marginal-revenue curve (1 pt). An upward-sloping MC curve crossing d = MR at quantity Q_F, the profit-maximizing output where MR = MC (1 pt). A U-shaped ATC curve drawn tangent to (just touching) the d = MR line at Q_F, with the MC curve passing through ATC's minimum point — this shows P_F = ATC, i.e. the firm earns zero economic profit (1 pt).

Solution 1

(b)(i)

Mark scheme

- On the market graph, shift the demand curve rightward from D to D , raising the equilibrium price from P_M to a higher price labeled P_2 (equilibrium quantity rises from Q_M to Q_2). On the firm's graph, shift the horizontal d = MR line upward to the new price P_2 (labeled d = MR); the firm's profit-maximizing quantity, where MR = MC, rises from Q_F to a higher quantity labeled Q_N.

Solution 1

(b)(ii)

Mark scheme

- The short-run profit earned by Frank Sugar Co. will increase. At the new price P_2, price exceeds ATC at Q_N (whereas at P_F price equaled ATC, i.e. zero economic profit), so the firm now earns positive economic profit.

Solution 1

(b)(iii)

Mark scheme

- The long-run market price will be lower than P_2 (it will fall back to P_M). Explanation: the positive economic profit earned at P_2 attracts new firms to enter the sugar market; entry increases market supply, shifting the supply curve rightward and driving the market price back down until it reaches P_M, where firms again earn zero economic profit.

Solution 1

(c)

Mark scheme

- Draw a graph with an upward-sloping marginal private cost curve (MPC) and a downward-sloping marginal private benefit curve (MPB); their intersection gives the market equilibrium quantity Q_M (1 pt). Add a marginal social benefit curve (MSB) drawn below/to the left of MPB (since consumers underestimate sugar's harm to health, so MSB $<$ MPB at each quantity), label the upward-sloping cost curve MPC $=$ MSC (no production externality), and mark the socially optimal quantity Q_S at the intersection of MSB and MSC, with $Q_S < Q_M$ (1 pt).

Solution 1

(d)

Mark scheme

- A per-unit tax would best achieve the objective in the short run. Explanation: a per-unit tax raises the effective price consumers pay per unit of sugar, directly changing consumers' marginal incentives and reducing the quantity consumed toward the socially optimal quantity Q_S — unlike a lump-sum tax (which does not change the per-unit price/marginal incentive) or a subsidy (which would increase, not decrease, consumption).

Question 1

2019 Set 1 ▪ Q1

As the only gas station in a small town, FillUp has a local monopoly on the sale of gasoline. FillUp is currently earning positive economic profit.

(a)(i) Draw a correctly labeled graph for FillUp and show each of the following. FillUp's profit-maximizing quantity, labeled Q_F

(a)(ii) FillUp's profit-maximizing price, labeled P_F

(a)(iii) The deadweight loss associated with FillUp's profit-maximizing quantity, shaded completely

(a)(iv) The maximum quantity at which FillUp would earn zero economic profit, labeled Q_Z

Question 1

2019 Set 1 ▪ Q1

As the only gas station in a small town, FillUp has a local monopoly on the sale of gasoline. FillUp is currently earning positive economic profit.

(b)(i) Assume that FillUp's fixed costs increase because of a new lease on its property and FillUp stays in business. Will each of the following increase, decrease, or remain unchanged at FillUp's profit-maximizing quantity?

The deadweight loss. Explain.

(b)(ii) FillUp's economic profit

Question 1

2019 Set 1 ▪ Q1

As the only gas station in a small town, FillUp has a local monopoly on the sale of gasoline. FillUp is currently earning positive economic profit.

(c)(i) Assume the demand for gasoline decreases because people bike to work more often.

What must be true for FillUp to continue to operate in the short run?

(c)(ii) What happens to FillUp's profit-maximizing quantity and price in the short run assuming the firm continues to operate?

Solution 1

(a)(i)

Mark scheme

- Two points bundled here: (1) draw a correctly labeled graph of the monopoly showing a downward-sloping demand (D) curve and a marginal revenue (MR) curve that lies below D, with axes labeled Price/Cost (vertical) and Quantity (horizontal); (2) add an upward-sloping MC curve and show FillUp's profit-maximizing quantity, labeled Q_F, at the point where MR = MC, with Q_F dropped down to the quantity axis.

Solution 1

(a)(ii)

Mark scheme

- FillUp's profit-maximizing price, labeled P_F, is found by going straight up from Q_F to the demand curve (D) and reading the price on the vertical axis. P_F must be shown above the average total cost curve (ATC) at Q_F, since the monopolist is earning a positive economic profit.

Solution 1

(a)(iii)

Mark scheme

- The deadweight loss is the triangular region between Q_F and the socially efficient (allocatively efficient) quantity where MC intersects the demand curve, bounded above by D and below by MC. This entire triangle must be shaded completely to earn the point.

Solution 1

(a)(iv)

Mark scheme

- Q_Z, the maximum quantity at which FillUp earns zero economic profit, is the quantity where the ATC curve intersects the demand curve (D), i.e. where P = ATC. Q_Z lies to the right of Q_F on the quantity axis.

Solution 1

(b)(i)

Mark scheme

- The deadweight loss remains unchanged. A fixed-cost increase (e.g. a new lease) does not affect marginal cost (MC), so it does not shift the MR = MC intersection; the profit-maximizing quantity Q_F is unchanged, and since the DWL triangle depends only on Q_F, MC, and D, its size stays the same.

Solution 1

(b)(ii)

Mark scheme

- FillUp's economic profit will decrease. Higher fixed costs raise total cost and therefore average total cost (ATC), while price and quantity are unaffected, so profit $= (\text{P} - \text{ATC}) \times \text{Q}$ falls.

Solution 1

(c)(i)

Mark scheme

- For FillUp to continue operating in the short run, price must be greater than average variable cost (AVC) at the profit-maximizing level of output ($P >$ AVC) — the firm must at least cover its variable costs (the short-run shutdown rule).

Solution 1

(c)(ii)

Mark scheme

- Both FillUp's profit-maximizing quantity and price will decrease. A fall in the demand for gasoline shifts D (and MR) to the left; the new MR = MC intersection occurs at a lower quantity, and reading up to the new, lower demand curve at that quantity gives a lower price.

Question 1

2018 ▪ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

(a)(i) Draw a correctly labeled graph for Single Cinema, and show the following: The profit-maximizing price and quantity of tickets, labeled as P_m and Q_m, respectively.

(a)(ii) Draw a correctly labeled graph for Single Cinema, and show the following: The area representing the negative economic profit, shaded completely.

Question 1

2018 ▪ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

(b) Explain why Single Cinema continues to operate in the short run despite earning negative economic profit in the short run.

Question 1

2018 ▪ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

(c) Would Single Cinema's total revenue increase, decrease, or stay the same if it decides to sell one fewer ticket than Q_m? Explain.

Question 1

2018 ▪ Q1

In the early twentieth century, limited transportation options and the lack of effective substitutes gave Single Cinema monopoly power in a small town. Assume that Single Cinema is a profit-maximizing firm and currently operates at a negative economic profit in the short run.

(d)(i) Single Cinema hires workers in a perfectly competitive labor market with a downward-sloping demand curve. Suppose the number of workers available in the market decreases. What will happen to the wage rate? Explain.

(d)(ii) Single Cinema hires workers in a perfectly competitive labor market with a downward-sloping demand curve. Suppose the number of workers available in the market decreases. What will happen to the marginal revenue product of the last worker hired? Explain.

Solution 1

(a)(i)

Mark scheme

- Draw a correctly labeled monopoly graph for Single Cinema. Points earned: (1) a correctly labeled graph with a downward-sloping demand (D) curve and a marginal revenue (MR) curve drawn below/steeper than D; (2) a rising marginal cost (MC) curve that passes through the minimum point of the average total cost (ATC) curve; (3) the profit-maximizing quantity Qm shown where MR = MC (MC crosses MR); (4) the profit-maximizing price Pm read off the demand curve directly above Qm (go up from Qm to D, then across to the price axis).

Solution 1

(a)(ii)

Mark scheme

- On the same monopoly graph, completely shade the rectangle representing negative economic profit: it lies between the ATC curve and price Pm, at quantity Qm, with the ATC curve drawn above the demand curve (and thus above Pm) at Qm — since ATC $>$ Pm at Qm, the firm is making a loss. The shaded loss area = (ATC - Pm) x Qm.

Solution 1

(b)

Mark scheme

- Single Cinema keeps operating in the short run because price is greater than average variable cost (P $>$ AVC) — equivalently, total revenue exceeds total variable cost (TR $>$ TVC), or the firm's current economic loss is smaller than its fixed cost, which is what its loss would be if it shut down. Since operating produces a smaller loss than shutting down, the firm continues to operate despite the negative economic profit.

Solution 1

(c)

Mark scheme

- Total revenue will decrease if Single Cinema sells one fewer ticket than Qm. Explanation (any one of): the monopolist is operating on the elastic portion of the demand curve at Qm; the quantity effect of losing a ticket sale is greater than the price effect of the higher price; the percentage change in quantity demanded is greater than the percentage change in price; or MR is positive at Qm (since Qm is where $MR = MC > 0$), meaning revenue is still rising with quantity, so cutting quantity lowers revenue.

Solution 1

(d)(i)

Mark scheme

- The wage rate will increase. Because the number of workers available in the perfectly competitive labor market decreases, the market labor supply curve S shifts left to S'. With labor demand D unchanged, the new market equilibrium wage W' is higher than the original wage W (quantity of labor falls from Q to Q').

Solution 1

(d)(ii) Mark scheme

- The marginal revenue product (MRP) of the last worker hired will increase. Explanation (any one of): the firm now hires fewer workers, so the marginal product of the last worker hired is higher (diminishing marginal product means fewer workers implies a higher marginal product); the market wage (marginal factor cost, MFC) increased, and a profit-maximizing firm hires where MRP = MFC, so at the new higher wage MRP must also be higher; or graphically, there is an upward movement along the firm's downward-sloping MRP curve as the wage/MFC rises from W to W' (quantity of labor hired falls from q to q').

Question 1

2017 ▪ Q1

Corn is used as food and as an input in the production of ethanol, an alternative fuel. Assume corn is produced in a perfectly competitive market.

(a) Draw correctly labeled side-by-side graphs for the corn market and a representative corn farmer. On your graphs show each of the following.

(i) The equilibrium price and quantity in the corn market, labeled P_M and Q_M, respectively

(ii) The profit-maximizing quantity of corn produced by the representative farmer earning zero economic profit, labeled Q_F

Question 1

2017 ▪ Q1

Corn is used as food and as an input in the production of ethanol, an alternative fuel. Assume corn is produced in a perfectly competitive market.

(b)(i) Assume the demand for ethanol increases. On your graphs in part (a) show what will happen to each of the following in the short run.

The market price and quantity of corn, labeled P^* and Q^*

(b)(ii) The area of the profit or loss earned by the representative corn farmer, shaded completely

Question 1

2017 ▪ Q1

Corn is used as food and as an input in the production of ethanol, an alternative fuel. Assume corn is produced in a perfectly competitive market.

(c) Relative to your answer in part (b), state what will happen to the market equilibrium price and quantity of corn in the long run. Explain.

Question 1

2017 ▪ Q1

Corn is used as food and as an input in the production of ethanol, an alternative fuel. Assume corn is produced in a perfectly competitive market.

(d) Soybeans are produced in a perfectly competitive market. Assume farmers can grow either corn or soybeans on the same land. What happens to the price of soybeans in the next planting season if the price of corn increases? Explain.

Question 1

2017 ▪ Q1

Corn is used as food and as an input in the production of ethanol, an alternative fuel. Assume corn is produced in a perfectly competitive market.

(e)(i) Assume instead that the government sets a binding price ceiling in the corn market. Draw a new correctly labeled graph for the corn market and show each of the following.

The binding price ceiling, labeled P_c

(e)(ii) The quantity purchased by consumers in the corn market, labeled Q_p

Solution 1

(a) Mark scheme

- Draw side-by-side graphs. Corn MARKET graph: downward-sloping demand D_1 and upward-sloping supply S intersecting at equilibrium price P_M and quantity Q_M (both labeled on the axes with dashed lines to the intersection). FIRM graph: a horizontal demand/marginal-revenue curve $d_1 = MR_1$ drawn at the market price P_M; the firm's profit-maximizing quantity Q_F is where $MC = MR_1$; the firm's ATC and MC curves are drawn with MC passing through the minimum point of ATC, and $P_M = ATC = MC$ at Q_F (the representative farmer earns zero economic profit). Points earned for: (1) correctly labeled corn-market graph with P_M, Q_M (downward demand, upward supply); (2) horizontal demand curve on the

Solution 1

firm graph extended from P_M; (3) Q_F identified at $MC = MR_1$; (4) ATC/MC shown with MC passing through minimum ATC and $P = ATC = MC$ at Q_F.

Solution 1

(b)(i)

Mark scheme

- An increase in ethanol demand raises the demand for corn, shifting the market demand curve rightward from D_1 to D_2. This raises the market equilibrium price and quantity of corn in the short run, labeled P^* and Q^* (both greater than P_M and Q_M).

Solution 1

(b)(ii)

Mark scheme

- On the firm's graph, with price now at P^* (above ATC) and the firm producing where $MC = MR_2 = d_2$ at quantity Q_{F2}, the profit earned is the rectangle bounded above by P^* and below by ATC, over the output range from 0 to Q_{F2}. This rectangle must be shown completely shaded to earn the point.

Solution 1

(c)

Mark scheme

- In the long run the market quantity of corn will increase and the market price will decrease (moving back down). Because the representative farmer is earning positive economic profit in the short run (part b), new farmers are attracted into the corn market; their entry shifts the market supply curve rightward, which increases quantity and decreases price until economic profit returns to zero.

Solution 1

(d)

Mark scheme

- The price of soybeans will increase in the next planting season. Since farmers can grow either corn or soybeans on the same land, a higher price of corn makes growing corn relatively more profitable, so farmers substitute land away from soybeans and into corn. This decreases the supply of soybeans, raising the equilibrium price of soybeans.

Solution 1

(e)(i)

Mark scheme

- Draw a new, correctly labeled graph of the corn market (same upward-sloping supply and downward-sloping demand) showing a binding price ceiling P_C set below the market equilibrium price.

Solution 1

(e)(ii)

Mark scheme

- The quantity purchased by consumers, Q_P, is the quantity at which the price ceiling P_C intersects the supply curve – i.e. the quantity that sellers are willing to supply at the ceiling price, which is the actual (constrained) quantity transacted in the market.