Chapter 12

Use the following table to work Problems 2 to 4.

Pat's Pizza Kitchen is a price taker and the table shows its costs of production.

Output (pizzas per hour)	Total cost (dollars per hour)
0	10
1	21
2	30
3	41
4	54
5	69

2. Calculate Pat's profit-maximizing output and economic profit if the market price is
   (i) $14 a pizza,
   (ii) $12 a pizza,
   (iii) $10 a pizza.

   (i) At $14 a pizza, Pat's profit-maximizing output is 4 pizzas an hour and economic profit is $2 an hour. Pat's maximizes its profit by producing the quantity at which marginal revenue equals marginal cost. In perfect competition, marginal revenue equals price, which is $14 a pizza. The marginal cost is the change in total cost when output is increased by 1 pizza an hour. The marginal cost of increasing output from 3 to 4 pizzas an hour is $13 ($54 minus $41). The marginal cost of increasing output from 4 to 5 pizzas an hour is $15 ($69 minus $54). So the marginal cost of the fourth pizza is half-way between $13 and $15, which is $14. Marginal cost equals marginal revenue when Pat produces 4 pizzas an hour. Economic profit equals total revenue minus total cost. Total revenue equals $56 ($14 multiplied by 4). Total cost is $54, so economic profit is $2.

   (ii) At $12 a pizza, Pat's profit-maximizing output is 3 pizzas an hour and economic profit is ☐$5. Pat's maximizes its profit by producing the quantity at which marginal revenue equals marginal cost. Marginal revenue equals price, which is $12 a pizza. The marginal cost of increasing output from 2 to 3 pizzas an hour is $11 ($41 minus $30). The marginal cost of increasing output from 3 to 4 pizzas an hour is $13. So the marginal cost of the third pizza is half-way between $11 and $13, which is $12. Marginal cost equals marginal revenue when Pat produces 3 pizzas an hour. Economic profit equals total revenue minus total cost. Total revenue equals $36 ($12 multiplied by 3). Total cost is $41, so economic profit is ☐$5.

   (iii) At $10 a pizza, Pat's profit-maximizing output is 2 pizzas an hour and economic profit is ☐$10. Pat's maximizes its profit by producing the quantity at which marginal revenue equals marginal cost. Marginal revenue equals price, which is $10 a pizza. The marginal cost of increasing output from 1 to 2 pizzas an hour is $9 ($30 minus $21). The marginal cost of increasing output from 2 to 3 pizzas an hour is $11. So the marginal cost of the second pizza is half-way between $9 and $11, which is $10. Marginal cost equals marginal revenue when Pat produces 2 pizzas an hour. Economic profit equals total revenue minus total cost. Total revenue equals $20 ($10 multiplied by 2). Total cost is $30, so economic profit is ☐$10.

3. What is Pat's shutdown point and what is Pat's economic profit if it shuts down temporarily?

   The shutdown point is the price that equals minimum average variable cost. To calculate total variable cost, subtract total fixed cost ($10—when output is zero, total variable cost is $0, so total cost at zero output equals total fixed cost) from total cost. Average variable cost equals total variable cost divided by the quantity produced. The average variable cost of producing 2 pizzas is $10 a pizza. Average variable cost is a minimum when marginal cost equals average variable cost. The marginal cost of producing 2 pizzas is $10. So Pat's shutdown point is a price of $10 a pizza. When Pat shuts down the economic "profit" is actually an economic loss equal to Pat's fixed cost. In particular Pat's economic loss is $10.

4. Derive Pat's supply curve.

   Pat's supply curve is the same as the marginal cost curve at prices equal to or above $10 a pizza. The supply curve is the *y*-axis (0 pizzas) at prices below $10 a pizza.

5. The market for paper is perfectly competitive and 1,000 firms produce paper. The first table sets out the market demand schedule for paper. The second table sets out the costs of each producer of paper. Calculate the market price, the market output, the quantity produced by each firm, and the firm's economic profit or loss.

Price (dollars per box)	Quantity demanded (thousands of boxes per week)
3.65	500
5.20	450
6.80	400
8.40	350
10.00	300
11.60	250
13.20	200

Output (boxes per week)	Marginal cost (dollars per additional box)	Average variable cost	Average total cost
		(dollars per box)	
200	6.40	7.80	12.80
250	7.00	7.00	11.00
300	7.65	7.10	10.43
350	8.40	7.20	10.06
400	10.00	7.50	10.00
450	12.40	8.00	10.22
500	20.70	9.00	11.00

The market price is $8.40 per box of paper. The market price is the price at which the quantity demanded equals the quantity supplied. The firm's supply curve is the same as its marginal cost curve at prices above minimum average variable cost. Average variable cost is at its minimum when marginal cost equals average variable cost. Marginal cost equals average variable cost at the quantity 250 boxes a week. So the firm's supply curve is the same as the marginal cost curve for the outputs equal to 250 boxes or more. When the price is $8.40 a box, each firm produces 350 boxes and the quantity supplied by the 1,000 firms is 350,000 boxes a week. The quantity demanded at $8.40 is 350,000 a week. The market output is 350,000 boxes a week. Each firm produces 350 boxes a week.

Each firm incurs an economic loss of $581 a week. Each firm produces 350 boxes at an average total cost of $10.06 a box. The firm sells the 350 boxes for $8.40 a box. The firm incurs a loss on each box of $1.66 and incurs a total economic loss of $581 a week.

6 In Problem 5, the market demand and the demand schedule becomes the schedule shown in the table. If firms have the same costs set out in Problem 5, what is the market price and the firm's economic profit or loss in the short run?

Price (dollars per box)	Quantity demanded (thousands of boxes per week)
2.95	500
4.13	450
5.30	400
6.48	350
7.65	300
8.83	250
10.00	200
11.18	150

The market price is $7.65 a box, the equilibrium market quantity is 300,000 boxes a week, and each firm incurs an economic loss of $834 a week. When the price is $7.65 a box, each firm produces 300 boxes and the total quantity supplied by the 1,000 firms is 300,000 boxes a week. The market quantity demanded at $7.65 is 300,000 boxes a week. Each firm produces 300 boxes at an average total cost of $10.43 a box. The firm sells the 300 boxes for $7.65 a box. At this price and quantity the firm incurs a loss on each box of $2.78 and incurs an economic loss of $834 a week.

7. In Problem 5, in the long run, what is the market price and the quantity of paper produced? What is the number of firms in the market?

In the long run, the price equals the minimum average total cost, $10 a box. The number of firms in the long run is 750. In the long run, as firms exit the industry, the price rises. In the long-run equilibrium the price will equal the minimum average total cost. When output is 400 boxes a week, marginal cost equals average total cost and average total cost is a minimum at $10 a box. In the long run, the price is $10 a box. Each firm remaining in the industry produces 400 boxes a week. The quantity demanded at $10 a box is 300,000 boxes a week. The number of firms is 300,000 boxes divided by 400 boxes per firm, which is 750 firms. In the long run, the 750 firms together produce the equilibrium quantity of 300,000 boxes.

8. If the market demand for paper remains the same as in Problem 6, calculate the market price, market output, and the economic profit or loss of each firm.

In the long run, the price equals the minimum average total cost, which is $10.00 a box, the equilibrium industry quantity is 200,000 boxes a week, and each firm makes zero economic profit.

9. In perfect competition in the long-run equilibrium, can consumer surplus or producer surplus be increased? Explain your answer.

Once at the competitive equilibrium quantity, which is the same as the efficient quantity, the sum of consumer surplus plus producer surplus is as large as possible. If the price is lowered, consumer surplus increases but only at the expense of a larger decrease in producer surplus. And the lower price is not the long-run equilibrium price.

If the price is raised, producer surplus increases but only at the expense of a larger decrease in consumer surplus. And the higher price is not the long-run equilibrium price.

14. The market for smoothies is perfectly competitive and the market demand schedule is in the first table. Each of the 100 producers of smoothies has the costs given in the second table when it uses its least-cost plant.

Output (smoothies per hour)	Marginal cost (dollars per additional smoothie)	Average variable cost (dollars per smoothie)	Average total cost (dollars per smoothie)
3	2.50	4.00	7.33
4	2.20	3.53	6.03
5	1.90	3.24	5.24
6	2.00	3.00	4.67
7	2.91	2.91	4.34
8	4.25	3.00	4.25
9	8.00	3.33	4.44

a. What is the market price of a smoothie?

The market price is the price at which the market quantity demanded equals the market quantity supplied. The firm's supply curve is the same as its marginal cost curve at prices above minimum average variable cost. Average variable cost is a minimum when marginal cost equals average variable cost. Marginal cost equals average variable cost at the quantity 7 smoothies an hour. So the firm's supply curve is the same as the marginal cost curve for outputs greater than and equal to 7 smoothies. When the price is $2.91 a smoothie, each firm produces 7 smoothies and the market quantity supplied by the 100 firms is 700 smoothies an hour. The market quantity demanded at $2.91 is 700 smoothies an hour so the market price is $2.91

b. What is the market quantity of smoothies?
   The market quantity of smoothies is 700 smoothies an hour.
c. How many smoothies does each firm sell?
   Each firm sells 7 smoothies an hour.
d. What is the economic profit made or economic loss incurred by each firm?
   Each firm incurs an economic loss. Each firm produces 7 smoothies at an average total cost of $4.34 a smoothie. The firm sells the 7 smoothies for $2.91 each. The firm incurs a loss on each smoothie of $1.43 and incurs a total economic loss of $10.01 an hour.

15. **Chevy Volt Production Temporarily Shut Down**

GM will temporarily lay off 1,300 employees as the company stops production of the electric car, Chevy Volt, for five weeks. GM had hoped to sell 10,000 Volts last year, but ended up selling just 7,671. It plans to maintain inventory levels by adjusting production to match demand.

Source: *Politico*, March 2, 2012

a. Explain how the shutdown decision will affect GM Chevy Volt's *TFC*, *TVC*, and *TC*.
   The shutdown decision has no effect on GM's *TFC*. It will lower GM's *TVC* and *TC*.
b. Under what conditions would this shutdown decision maximize Chevy Volt's economic profit (or minimize its loss)? Explain your answer.
   GM will shut down its plant when the price of a Volt is less than its average variable cost, that is, when $P < AVC$. By shutting down, GM incurs an economic loss equal to its total fixed cost, which is the minimum loss that it can incur in this situation.
c. Under what conditions will GM start producing the Chevy Volt again? Explain your answer.
   GM will start producing the Chevy Volt again when the price of Volt exceeds its average variable cost, that is, when $P > AVC$. In this case, even if GM is still incurring an economic loss, its loss will be less if it produces than if it shuts down.

17. In Problem 14, do firms enter or exit the market in the long run? What is the market price and the equilibrium quantity in the long run?
   The firms are incurring economic losses, so some firms exit the market. As firms exit the market, the market supply decreases so that in the long run the price rises to equal the minimum average total cost, $4.25 per smoothie. When the price is $4.25 for a smoothie, the equilibrium quantity is 550 smoothies per hour.
18. In Problem 15, under what conditions would GM stop producing the Chevy Volt and exit the market for electric cars. Explain your answer.
   GM will permanently shut down and exit the market in the long run if the price of a Volt is less than GM's average total cost. In this situation, if it remained open GM would incur an economic loss but if it exited the market it would no longer incur an economic loss.

Chapter 13

Price (dollars per bottle)	Quantity demanded (bottles per hour)	Total revenue (dollars)	Marginal revenue (dollars per bottle)
10	0	0	
			8
8	1	8	
			4
6	2	12	
			0
4	3	12	
			−4
2	4	8	
			−8
0	5	0	

Use the following table to work Problems 2 to 4.

Minnie's Mineral Springs is a single-price monopoly. Columns 1 and 2 of the table set out the market demand schedule for Minnie's water and columns 2 and 3 set out Minnie's total cost schedule.

2. Calculate Minnie's marginal revenue schedule and draw a graph of the market demand curve and Minnie's marginal revenue curve. Explain why Minnie's marginal revenue is less than the price.

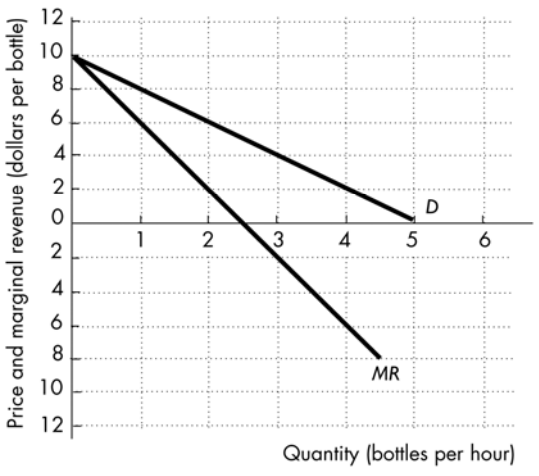
To calculate Minnie's marginal revenue, we first need to calculate the total revenue. Minnie's total revenue schedule lists the total revenue at each quantity sold. For example, Minnie's can sell 1 bottle for $8 a bottle, which is $8 of total revenue at the quantity 1 bottle. Minnie's entire total revenue schedule is in the table on the next page.

The marginal revenue schedule lists the marginal revenue that results from increasing the quantity sold by 1 bottle. For example, Minnie's can sell 1 bottle for total revenue of $8. Minnie's can sell 2 bottles for $6 each, for total revenue of $12. So by increasing the quantity sold from 1 bottle to 2 bottles, marginal revenue is $4 a bottle ($12 minus $8). In the table on the next page, this marginal revenue is placed midway between the quantities 1 bottle and 2 bottles.

Minnie's demand curve and marginal revenue curve are in Figure 13.1 The demand curve intersects the vertical axis at a price of $10 and intersects the horizontal axis at a quantity of 5. The marginal revenue curve intersects the vertical axis at a price of $10 and intersects the horizontal axis at a quantity of 2.5.

Minnie's marginal revenue is less than her price because to sell an additional unit of output, Minnie must lower her price on all units sold. So when Minnie sells an additional unit of output, her revenue consists of the price she receives for this extra unit minus what she loses on *all* previous units she sells now at the new, lower price.

FIGURE **13.1**
Problem 2



3. At what price is Minnie's total revenue maximized and over what range of prices is the demand for water elastic? Why will Minnie not produce a quantity at which the market demand is inelastic?

   Interpolating along the demand curve, Minnie's total revenue is maximized at a price of $5. At this price she sells 2.5 bottles an hour for total revenue of $12.50.

   The demand for Minnie's Mineral Springs water is elastic between $5 per bottle and $10 per bottle. Minnie will not produce a quantity at which the demand for her water is inelastic because producing at such a price does not maximize her profit. If Minnie is producing where her demand is inelastic, she can decrease the quantity she produces and 1) increase her total revenue, and 2) decrease her total cost. Because her total revenue increases and her total cost decreases, Minnie's total profit increases. Anytime Minnie's production is at a quantity at which demand is inelastic, she can always increase her total profit by decreasing her production.

4. Calculate Minnie's profit-maximizing output and price and economic profit.

   Minnie's profit-maximizing output is 1.5 bottles and her profit-maximizing price is $7a bottle.

   To maximize profit Minnie's needs to produce the quantity at which marginal revenue equals marginal cost. The marginal cost of increasing the quantity from 1 bottle to 2 bottles is $4 a bottle ($7 minus $3). That is, the marginal cost at 1.5 bottles of water is $4 a bottle. The marginal revenue of increasing the quantity sold from 1 bottle to 2 bottles is $4 ($12 minus $8). So the marginal revenue from 1.5 bottles is $4 a bottle. The profit-maximizing output is 1.5 bottles. The profit-maximizing price is the highest price that Minnie's can sell the profit-maximizing output of 1.5 bottles. Minnie's can sell 1 bottle for $8 and 2 bottles for $6, so it can sell 1.5 bottles for $7 a bottle.

   Economic profit equals total revenue minus total cost. Total revenue equals price ($7 a bottle) multiplied by quantity (1.5 bottles), which is $10.50. Total cost of producing 1 bottle is $3 and the total cost of producing 2 bottles is $7, so the total cost of producing 1.5 bottles is $5. Minnie's economic profit equals $10.50 minus $5, which is $5.50.

5. Use the data in Problem 2 to work Problem 5.

   a. Use a graph to illustrate the producer surplus generated from Minnie's Mineral Springs' water production and consumption.

      Figure 13.2 shows Minnie's producer surplus. The producer surplus equals the area of the grey polygon on the figure.

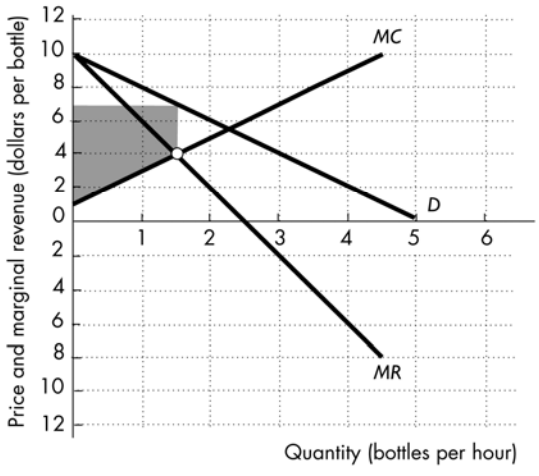
   b. Is Minnie's an efficient producer of water? Explain your answer.

      Minnie's is not an efficient producer of water. Efficiency requires that the amount of production sets the marginal cost of water equal to its marginal benefit. The marginal benefit is measured by the demand curve, so in Figure 13.2 the efficient quantity of water to produce is the quantity where the marginal cost curve intersects the demand curve, which is 2 1/9 bottles per hour.

   c. Suppose that new wells were discovered nearby to Minnie's and Minnie's faced competition from new producers. Explain what would happen to Minnie's output, price, and profit.

      Competition would force Minnie's to lower its price. Minnie's output would decrease as would its economic profit.

FIGURE **13.2**
Problem 5



6. LaBella Pizza can produce a pizza for a marginal cost of $2. Its price of a pizza is $15.

a. Could La Bella Pizza make a larger economic profit by offering a second pizza for $5? Use a graph to illustrate your answer.

La Bella Pizza is price discriminating, which increases its profit. It is charging consumers a second price for the second pizza they buy. This sort of price discrimination essentially is moving downward along a consumer's demand curve and increasing the quantity the consumer purchases. On both counts, La Bella is increasing its sales and, because its marginal revenue from these additional sales, $5 per pizza, exceeds its marginal cost of $2, the additional sales increase La Bella's profit.

FIGURE **13.3**
Problem 6a

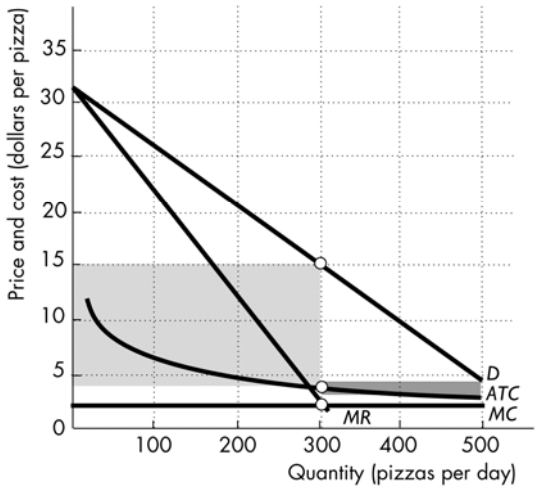


Figure 13.3 illustrates La Bella Pizza's situation. With no price discrimination La Bella produces 300 pizzas and sells them at a price of $15 a pizza. With the price discrimination, La Bella still sells 300 pizzas at a price of $15 and also sells an additional 200 pizzas at a price of $5. The economic profit when La Bella sells at one price is equal to the large, light grey area. When La Bella price discriminates, it makes additional economic profit equal to the darker grey rectangle.

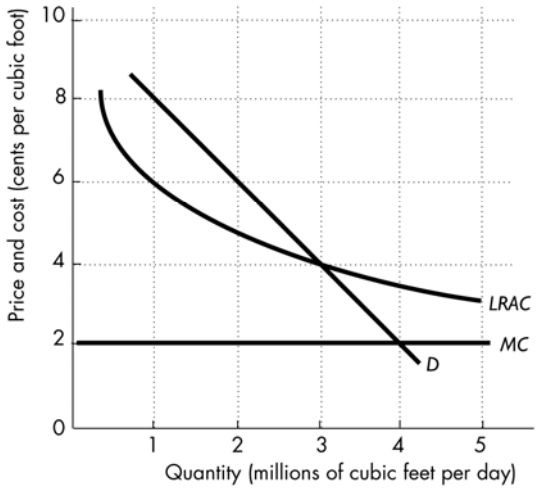
b. How might La Bella Pizza make even more economic profit? Would La Bella Pizza then be more efficient than it would be if it charged $15 for each pizza?

La Bella could further price discriminate. For instance, it might sell a third pizza for $4, which, given the marginal cost of $2, would still increase economic profit. A firm that can price discriminate increases its production relative to what it would produce if it could not price discriminate. So the quantity of pizza La Bella produces is closer to the efficient quantity with the price discrimination that it would be if La Bella did not price discriminate.

Use the following figure to work Problems 7 to 9.

The figure shows Calypso, a U.S. natural gas distributor. It is a natural monopoly that cannot price discriminate. What quantity will Calypso produce, what price will it charge, and what will be the total surplus and deadweight loss if Calypso is:

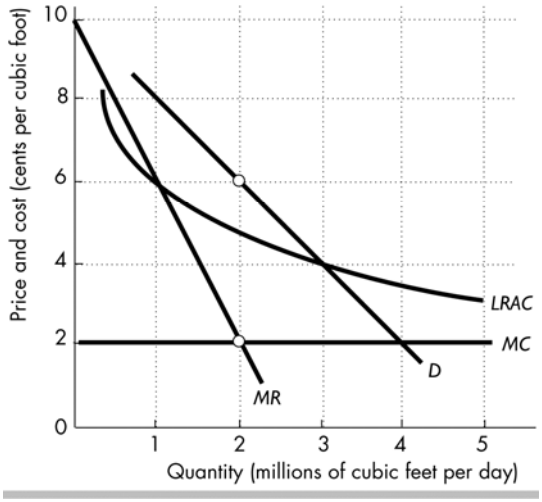
FIGURE **13.4**
Problems 7 to 9



7. An unregulated profit-maximizing firm?

   As shown in Figure 13.5, Calypso will produce 2 million cubic feet a day and sell it for 6 cents a cubic foot. The marginal revenue curve will run from 10 cents on the *y*-axis to 2.5 cubic feet on the *x*-axis. The profit-maximizing output is 2 million cubic feet at which marginal revenue equals marginal cost. The price charged is the highest that people will pay for 2 million cubic feet a day, which is 6 cents a cubic foot. The consumer surplus is $40,000, the producer surplus is $80,000, and the deadweight loss is $40,000. The consumer surplus is the triangular area under the demand curve and above the price. The price is 6 cents, so consumer surplus equals (10 cents minus 6 cents) multiplied by 2 million cubic feet/2, which is $40,000. The producer surplus is the rectangular area under the price and above the *MC* curve. The price is 6 cents, so producer surplus equals (6 cents minus 2 cents) multiplied by 2 million cubic feet a day, which is $80,000. The efficient output is 4 cubic feet, at which marginal cost equals price (marginal benefit). The deadweight loss is the triangular area between the demand (or marginal social benefit) curve and the marginal cost curve between the equilibrium quantity and the efficient quantity. So the deadweight loss equals (4 million cubic feet minus 2 million cubic feet) multiplied by (6 cents minus 2 cents)/2, which is $40,000 a day.

FIGURE **13.5**
Problems 7



8. Regulated to make zero economic profit?

If Calypso is regulated to make zero economic profit, it produces the output at which price equals average total cost—at the intersection of the demand curve and the *LRAC* curve. Calypso will produce 3 million cubic feet a day and charge 4 cents a cubic foot. The consumer surplus is $90,000, the producer surplus is $60,000, and the deadweight loss is $10,000. The consumer surplus is the triangular area under the demand curve and above the price. The price is 4 cents, so consumer surplus equals (10 cents minus 4 cents) multiplied by 3 million cubic feet/2, which is $90,000. The producer surplus is the rectangular area under the price and above the *MC* curve. The price is 4 cents, so producer surplus equals (4 cents minus 2 cents) multiplied by 3 million cubic feet, which is $60,000. The efficient output is 4 million cubic feet, at which marginal cost equals price (marginal benefit). The deadweight loss is the triangular area between the demand (or marginal social benefit) curve and the marginal cost curve between the equilibrium quantity and the efficient quantity. So the deadweight loss equals (4 million cubic feet minus 3 million cubic feet) multiplied by (4 cents minus 2 cents)/2, which is $10,000 a day.

9. Regulated to be efficient?

If the firm is regulated to be efficient, it will produce the quantity at which price (marginal social benefit) equals marginal social cost—at the intersection of the demand curve and the marginal cost curve. Calypso will produce 4 million cubic feet a day and charge 2 cents a cubic foot. The consumer surplus is $160,000, the producer surplus is $0, and the deadweight loss is $0. The consumer surplus is the triangular area under the demand curve and above the price. The price is 2 cents, so consumer surplus equals (10 cents minus 2 cents) multiplied by 4 million cubic feet/2, which is $160,000. There is no producer surplus because the price equals the marginal cost. And there is no deadweight loss because the quantity produced is the efficient quantity.

Use the following information to work Problems 12 to 16.

Hot Air Balloon Rides is a single-price monopoly. Columns 1 and 2 of the table set out the market demand schedule and columns 2 and 3 set out the total cost schedule.

12. Construct Hot Air's total revenue and marginal revenue schedules.

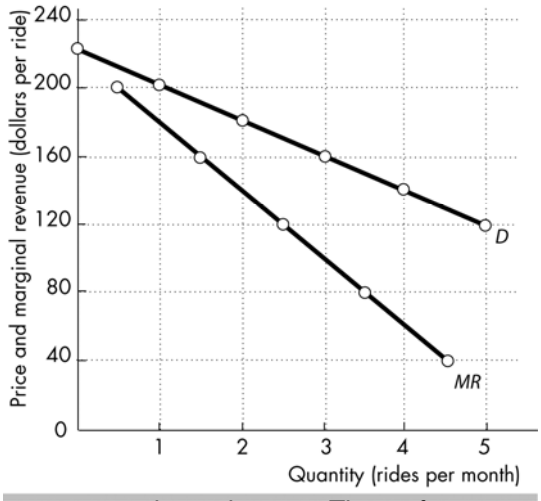
The table showing Hot Air's total revenue schedule and marginal revenue schedule is on the next page. Total revenue equals price multiplied by quantity. Marginal revenue equals the change in total revenue divided by the change in quantity. For example, between 1 ride and 2 rides the total revenue increases by $160 and the quantity increases by 1 ride, so the marginal revenue equals $160/1, which is $160. This marginal revenue is placed midway between the 1 ride and 2 rides rows.

Price (dollars per ride)	Quantity demanded (rides per month)	Total revenue (dollars per month)	Marginal revenue (dollars per ride)
220	0	0	
			200
200	1	200	
			160
180	2	360	
			120
160	3	480	
			80
140	4	560	
			40
120	5	600	

13. Draw a graph of the market demand curve and Hot Air's marginal revenue curve.

    Figure 13.6 illustrates Hot Air's demand curve and marginal revenue curve.

FIGURE **13.6**
Problem 13



14. Find Hot Air's profit-maximizing output and price and calculate the firm's economic profit.

    Hot Air's marginal cost equals marginal revenue at 2 1/2 rides a month, where both equal $120. From the demand curve, the price is $170 a ride. Economic profit equals total revenue minus total cost. The total cost of 2 1/2 rides a month is $320. Hot Air's total revenue equals the number of rides multiplied by the price per ride, which is (2 1/2 rides per month) × ($170) = $425. So the economic profit is total revenue minus total cost, which is $425 − $320 = $105.

15. If the government imposes a tax on Hot Air's profit, how do its output and price change?

    As a result of the tax, Hot Air's fixed cost changes, but its marginal cost does not. The profit-maximizing level of output is still 2 1/2 rides a month and the price still equals $170. The tax decreases Hot Air's economic profit but does not change its output or price.

16. If instead of taxing Hot Air's profit, the government imposes a sales tax on balloon rides of $30 a ride, what are the new profit-maximizing quantity, price, and economic profit?

    A $30-a-ride tax increases Hot Air's marginal cost by $30 at every level of output. With the increase in the marginal cost, Hot Air now sells 2 rides a month because this is the level at which the new marginal cost equals the marginal revenue (both equal $140). From the demand curve, Hot Air sets a price of $180 a ride. Economic profit equals total revenue minus total cost. The total revenue is 2 rides × $180 which is $360. The total cost is $260 plus the tax of $60, which is $320. So the new economic profit is $360 − $320 = $40.