3.2 EXERCISES

PRACTICE

Find the break-even point given the revenue and cost functions in Exercises 1–4.

1. $R(x) = 15x$
$C(x) = 5x + 30$

2. $R(x) = 27x$
$C(x) = 14x + 442$

3. $R(x) = 24x - 0.2x^2$
$C(x) = 8x + 300$

4. $R(x) = 9x - 0.7x^2$
$C(x) = 2x + 11.2$

Find the equilibrium point given the supply and demand functions in Exercises 5–8.

5. $S(x) = 2x + 3$
$D(x) = 15 - x$

6. $S(x) = 4x + 7$
$D(x) = 33 - 1.2x$

7. $S(x) = x^2 + x$
$D(x) = 35 - x$

8. $S(x) = x^2 + 3$
$D(x) = 51 - 2x$

In Exercises 9–18, the quantity represented by *y* is related to the quantity represented by *x* in one of the following ways:

(a) *y* is directly proportional to *x*
(b) *y* is inversely proportional to *x*
(c) *y* is directly proportional to the square of *x*
(d) *y* is inversely proportional to the square of *x*
(e) other

Match the given formula to the best choice of (a) through (e).

9. $y = 32x$

10. $y = \frac{32}{x}$

11. $y = 16x^2$

12. $y = \frac{-32}{x^2}$

13. $y = -x$

14. $y = 2x + 3$

15. $y = \pi x$

16. $y = (x-1)^2$

17. $y = \frac{x}{10}$

18. $y = \frac{wxv}{stu}$

APPLICATIONS

For Exercises 19–23, use the following situation:

Two students create a downloadable app which connects dots on a grid so that two players can play "Chase the Rabbit." They have developed a website on which to promote and sell the app for $5.00 and they pay an outside vendor $0.50 per purchase to manage the payments. They also pay another student $27/day (5 days a week) to monitor a customer service email box to answer questions and relay orders.

Let x denote the number of copies of the app sold, let $C(x)$ be the weekly total cost function (linear), and let $R(x)$ be the revenue function.

19. **a.** Write the expression for $C(x)$.
b. Determine the weekly cost of selling 500 copies of the app.

20. **a.** Write the revenue function.
b. How much revenue is produced by the sale of 500 copies of the app.

21. **a.** Write the profit function.
b. Determine the profit from the sale of 500 copies of the app.

22. How many copies of the app must be sold in order to break even?

23. A business professor estimates that the campus craze for the game could become national, and, therefore, the game could be marketed nationally. If 100 colleges were to become market sites, find a profit function for all 100 colleges together. Assume total profits and the number of colleges involved are directly proportional.

For Exercises 24–28, use the following information:

An ideal gas satisfies a law which may be stated as $\frac{PV}{T} = 0.821n$ where P is the pressure in atmospheres (atm), V is the volume in liters (L), T is the temperature in kelvins (K) ($K = 273 + C$, where C is the temperature in degrees Celsius), and n is the number of moles (gram molecular weights). Thus, for one mole of gas, pressure and volume are indirectly proportional for a constant temperature, pressure and temperature are directly proportional for a fixed volume, and volume and temperature are directly proportional for a fixed pressure.

Assume, if necessary, that there is 1 mole (6.023×10^{23} molecules) present.

24. What volume is occupied by 1 mole of gas at a temperature of 300 K and a pressure of 2 atm?

25. A fixed volume of gas is heated from a temperature of 200 K and 0.5 atm of pressure to 300 K. What is the new pressure?

26. A gas at a pressure of 2 atm expands, at constant temperature, from 10 L to 15 L. What is the new pressure?

27. One mole of gas occupies a volume of 2 L and has a temperature of 136.5 K. What is the pressure in atmospheres?

28. A gas has a volume of 2 liters, a temperature of 30°C and a pressure of 1 atm. When the gas is heated to 60°C and its volume is compressed to a volume of 1.25 liters, what is its new pressure? (**Hint:** For this problem, $n \neq 1$.)

29. Modeling in business: The manager of a pie shop sells his pies for $6.50. The overhead is $378 per day and each pie costs $1.10 to make.
a. Write the revenue function.
b. Write the cost function.
c. Write the profit function.
d. Find the break-even point.

30. Modeling in business: A certain style of athletic shoe costs $11.80 per pair to produce. The fixed costs are $864 per week. The shoes can be sold for $19.00 per pair.
a. Write the revenue function.
b. Write the cost function.
c. Write the profit function.
d. Find the break-even point.

31. Modeling in manufacturing: A manufacturer of golf clubs finds that the fixed costs are $5780 per week and the cost of producing each set of clubs is $73.00. Each set of clubs can be sold for $243.00.
a. Write the revenue function.
b. Write the cost function.
c. Write the profit function.
d. Find the break-even point.

32. Modeling in business: A soft drink company has fixed costs of $4000 per day. The variable costs are $2.75 per case of soda. Each case sells for $5.25.
a. Write the revenue function.
b. Write the cost function.
c. Write the profit function.
d. Find the break-even point.

33. Modeling in production: The cost of producing 200 pens is $290. Producing 250 pens would cost $297.50.
a. Find the average cost per pen for additional 50 pens over 200.
b. Assuming the total cost function is linear, write an equation for the cost of producing x pens.
c. What are the fixed costs?

34. Modeling in production: The Blue Umbrella Company can produce 500 umbrellas per week at a cost of $1800. It would cost $1950 to produce 600 umbrellas.
a. Find the average cost of each of the additional 100 umbrellas over 500.
b. Assuming the total cost is a linear function, write an equation for the cost of producing x umbrellas.
c. What are the fixed costs?

35. Revenue-profit: It has been determined that the cost of producing x units of a certain item is $11x + 500$. The demand function is given by $p = D(x) = 31 - 0.5x$.
a. Write the revenue function.
b. Write the profit function.

36. Modeling in sales: The manager of a men's store knows he can sell 60 pairs of a certain style of sock when the price is \$1.20 per pair. If the price is \$1.50, he can sell only 48 pairs of socks. The total cost function for x pairs of socks is $C(x) = 0.70x + 15$ dollars.

a. Assuming the demand function is linear, write an equation for $D(x)$.

b. Write the revenue function.

c. Write the profit function.

37. Modeling in manufacturing: A manufacturer of TVs can sell 800 TVs to his dealers at \$384 each. If the price is \$380, he can sell 1000 TVs. The total cost of producing x TVs is $C(x) = 3600 + 250x - 0.01x^2$ dollars.

a. Assuming the demand function is linear, write an equation for $D(x)$.

b. Write the revenue function.

c. Write the profit function.

38. Revenue: Suppose the revenue R from the sale of a product is directly proportional to the number of units x of the product that are sold. Suppose also that the revenue from the sale of 65 units of the product is \$1820.

a. Write a function for R in terms of x.

b. Find the revenue if 75 units are sold.

39. Interest: Suppose the annual interest I earned on an investment is directly proportional to the amount of money invested P. Suppose also that an investment of \$8200 earns an annual interest of \$512.50.

a. Write a function for I in terms of P.

b. Find the annual interest earned by \$6000.

40. Interest: What will \$6000 accumulate to if it is deposited in a bank for three years and earns 5% a year with annual compounding?

41. Price: Suppose that for a certain product, the price per item p is inversely proportional to the number of items sold x. Suppose also that the price per item is \$8.50 when 40 items are sold.

a. Write a function for p in terms of x.

b. Find the price if 34 items are sold.

42. Demand: Pat has decided to produce a limited number of prints from one of her paintings. She plans to issue x prints, where $0 < x \leq 50$. If she wants her revenue to be \$5000, write a function for the demand $D(x)$.

43. Number of orders: The owner of a camera shop expects to sell 800 cameras of a particular style during the year. How many orders will the dealer need to place with his distributor if each order is for x cameras?

44. Salary: A salesperson's weekly salary depends on the amount of her sales. Her salary is \$250 per week plus a commission of 8% of her weekly sales in excess of \$2500. Write a function for her salary if her sales were x dollars.

45. International calls: For an international call, the telephone company charges 65 cents for the first 3 minutes or less, plus 15 cents for each additional minute. Write a cost function for a call x minutes long.

46. Car rental: The rate for renting a car at a local agency is \$22.50 per day plus \$0.10 for each mile driven in excess of 100. If a car is rented for one day, write a function for the cost in terms of the number of miles driven.

47. Agriculture: A farmer cultivates bananas. They cost him 38 cents per bunch to produce. He is able to sell only 85% of those he produces. If he sells his bananas at 75 cents per bunch, find a function for his profit in terms of the number of bunches he produces.

48. Retail profit: A grocery store bought bags of frozen corn for 59 cents per bag and stored it in two freezers. During the night, one freezer defrosted and ruined 14 bags. If the remaining frozen corn was sold for 98 cents per bag, find a function for the profit in terms of the number of bags bought.

49. Retail profit: It costs Liz \$12 to build a picture frame. She estimates that, if she charges x dollars per frame, she can sell $60 - x$ frames per week. Write a function for her weekly profit.

50. Retail profit: A toy retailer pays \$3 each for a particular doll. He estimates that, if he charges x dollars for each doll, he will be able to sell $300 - 20x$ dolls. Write a function for his profit.

51. Area: The perimeter of a rectangle is 276 feet. If the rectangle is x feet long, write a function for the area $A(x)$.

52. Perimeter: The area of a rectangle is 426 cm^2. If the length of the rectangle is x centimeters, write a function for the perimeter $P(x)$.

53. Perimeter: The area of a rectangle is 288 ft^2. If the length of the rectangle is x feet, write a function for the perimeter $P(x)$.

54. Area: The perimeter of a rectangle is 197 inches. If the rectangle is x inches wide, write a function for the area $A(x)$.

55. Construction: The maintenance department at the city zoo wants to build a pen and divide it as shown in the diagram. If the department has a total of 720 feet of fencing, write a function for the area in terms of x.