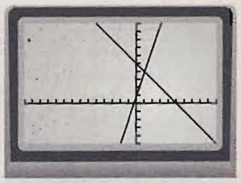
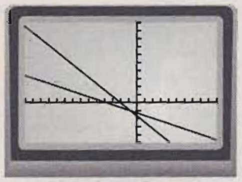
5.



$(1, 4)$

6.



$(-1, -1)$

7. infinitely many solutions **8.** 1 **9.** no solution **10.** 1
11. 1 **12.** infinitely many solutions

13.
$$-2(-5 - y) + 2y = -5$$
$$10 + 2y + 2y = -5$$
$$4y = -15$$
$$y = -\frac{15}{4}$$
$$x = -5 + \frac{15}{4}$$
$$x = -\frac{5}{4}$$
$$\left(-\frac{5}{4}, -\frac{15}{4}\right)$$

14.
$$-3x + 2y = -6$$
$$\underline{5x - 2y = 18}$$
$$2x = 12$$
$$x = 6$$
$$-3(6) + 2y = -6$$
$$2y = 12$$
$$y = 6$$
$$(6, 6)$$

15.
$$-12x - 3y = -3$$
$$\underline{12x + 3y = 3}$$
$$0 = 0$$
infinitely many solutions

16.
$$-3(3 - 2y) - 4y = -2$$
$$-9 + 6y - 4y = -2$$
$$2y = 7$$
$$y = \frac{7}{2}$$
$$x = 3 - 2\left(\frac{7}{2}\right)$$
$$x = -4$$
$$\left(-4, \frac{7}{2}\right)$$

17.
$$6x - 16y = 22$$
$$\underline{-6x + 16y = -5}$$
$$0 \neq 17$$
no solution

18.
$$15x - 40y = -35$$
$$\underline{-15x - 18y = 9}$$
$$-58y = -26$$
$$y = \frac{13}{29}$$
$$3x - 8\left(\frac{13}{29}\right) = -7$$
$$3x = -\frac{99}{29}$$
$$x = -\frac{33}{29}$$
$$\left(\frac{-33}{29}, \frac{13}{29}\right)$$

19.
$$3s + 5n = 3943$$
$$s + n = 937$$
$$3(937 - n) + 5n = 3943$$
$$2811 - 3n + 5n = 3943$$
$$2n = 1132$$
$$n = 566$$
$$s = 937 - 566$$
$$s = 371$$
371 tickets sold to students
566 tickets sold to non-students

Lesson 3.3

Activity (p. 156)

a. Region 1
b. Region 3
c. Region 4
d. Region 2

3.3 Guided Practice (p. 159)

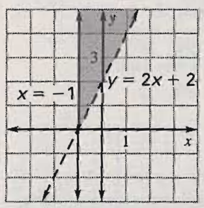
1 It must satisfy every inequality in the system.

2. It is not a solution because it does not satisfy inequality 1; $-5 \not\geq 2$.

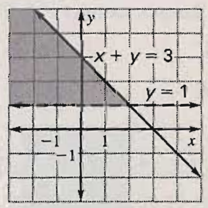
3. The line $y = 3$ should be solid, and the region above the line $x + y = 5$ should be shaded, not the region below.

4. $-1 \geq -1; 2 > -2 + 2$; yes **5.** $0 \geq -1; 0 \not> 0 + 2$; no **6.** $1 \geq -1; 4 \not> 2 + 2$; no **7.** $2 \geq -1; 7 > 2(2) + 2$; yes

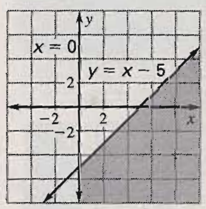
8.



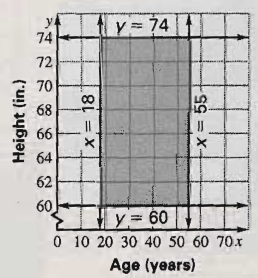
9.



10.



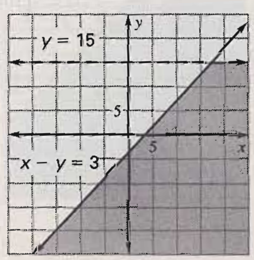
11. $18 \leq x \leq 55$
$60 \leq y \leq 74$



3.3 Practice and Applications (pp. 159-162)

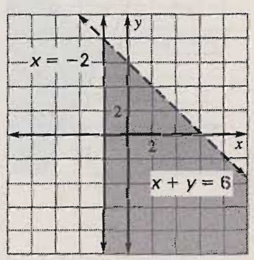
12. yes **13.** no **14.** yes

15.



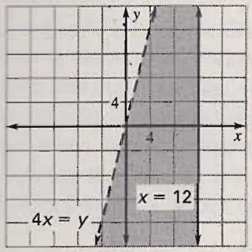
Sample answer: (13, 10)

16.



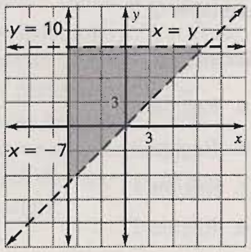
Sample answer: (0, 0)

17.



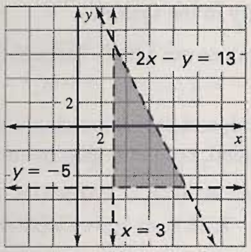
Sample answer: (−2, −10)

18.



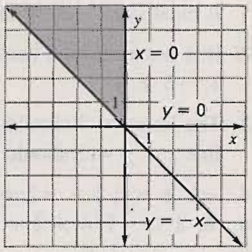
Sample answer: (0, 2)

19.



Sample answer: (4, 2)

20.

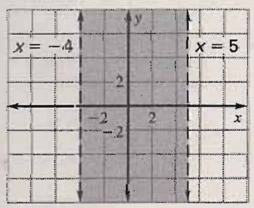


Sample answer: (−3, 5)

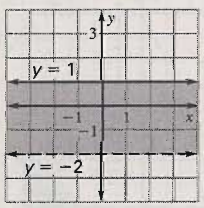
21. C **22.** B **23.** F

24. E **25.** A **26.** D

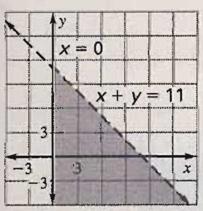
27.



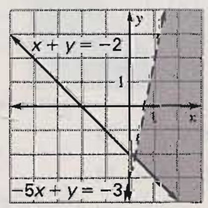
28.



29.



30.



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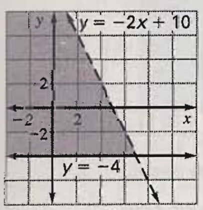
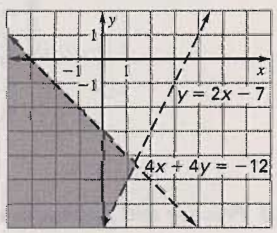
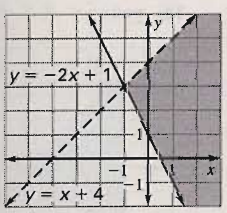


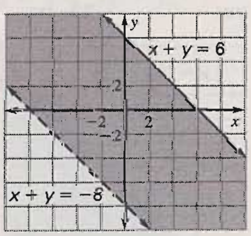
32.



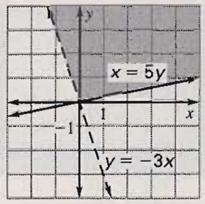
33.



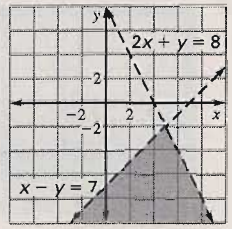
34.



35.



36.



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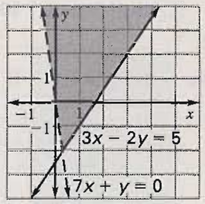
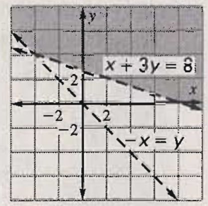
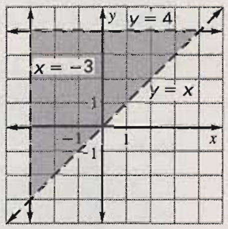


38.



39.



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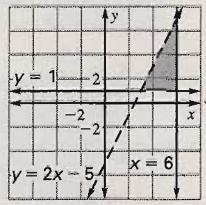

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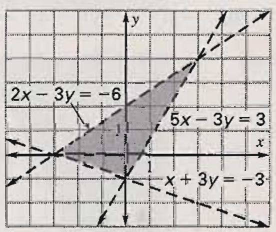

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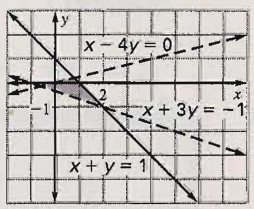

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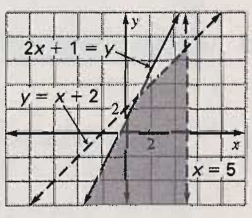

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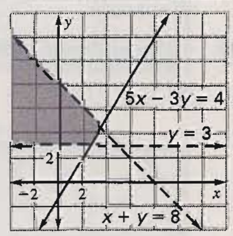

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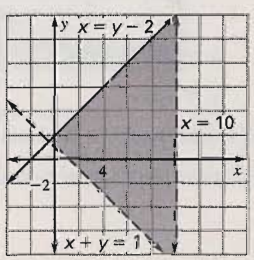

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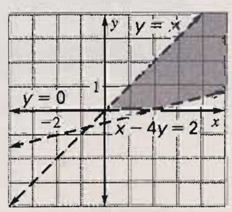
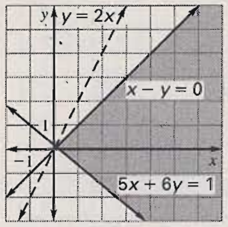
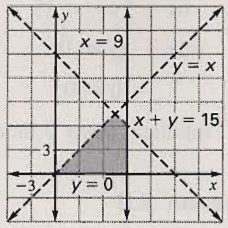


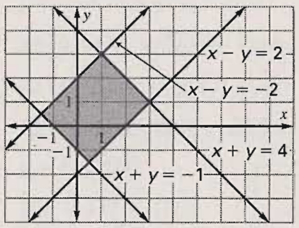
47.



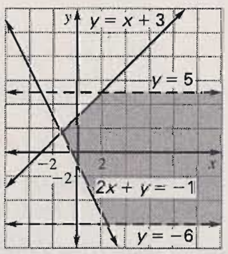
48.



49.

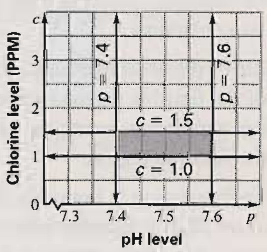


50.



51. $7.4 \le p \le 7.6$

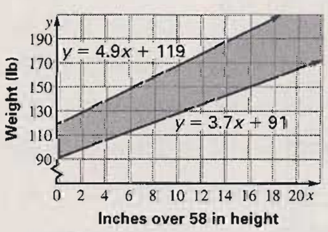
$1.0 \le c \le 1.5$



52. $y \ge 3.7x + 91$

$y \le 4.9x + 119$

53.

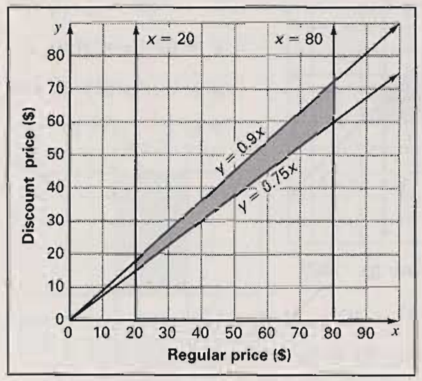


54. $y \ge 3.7(14) + 91$ $\quad y \le 4.9(14) + 119$

$y \ge 142.8$ lbs. $\quad y \le 187.6$ lbs.

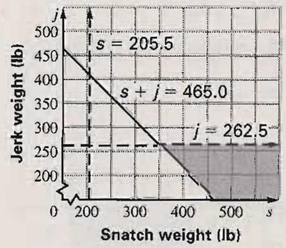
55. $20 \le x \le 80;\ y \le 0.9x$ or $0.75x \le y$

56.



$48.75 to $58.50

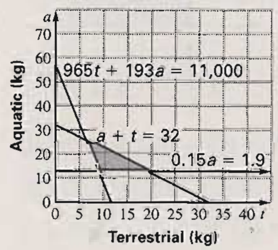
57.



$s > 205.5;\ j \le 262.5;$

$s + j > 465.0$

58.



$0.15a \ge 1.9;$

$965t + 193a \ge 11{,}000;$

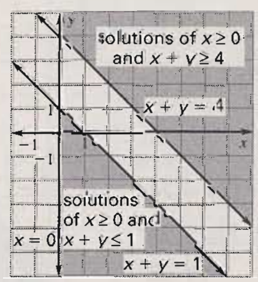
$a + t \le 32$

59. *Sample answer:*

$x + y \le 1$

$x + y \ge 4$

$x \ge 0$



60. A

61. C

62. $x \ge 1;\ x \le 8$

$y \ge -5;\ y \le 3$

63. $y \le x + 3;$

$y \le 3$

$y \ge x - 6;$

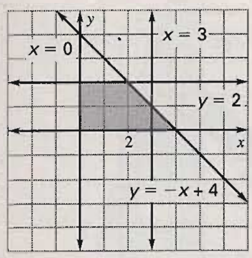
$y \ge -1$

64. $y \le 4x + 27;$

$y \le -x + 12$

$y \ge \frac{2}{3}x + 7$

65.



$x \ge 0 \quad x \le 3$

$y \ge 0 \quad y \le -x + 4$

$y \le 2$

3.3 Mixed Review (p. 162)

66. $2(5) + 7(-3) = 10 - 21 = -11$

67. $-4(-6) - 3(-1) = 24 + 3 = 27$

68. $10(-4) - 3(2) = -40 - 6 = -46$

69. $-(-3) + 8(-2) = 3 - 16 = -13$

70. positive correlation

71. relatively no correlation

72. negative correlation

73. $13(10 + 4y) + 5y = 2$

$130 + 52y + 5y = 2$

$57y = -128$

$y = -\frac{128}{57}$

$x = \frac{570}{57} + 4\left(-\frac{128}{57}\right)$

$x = \frac{58}{57}$

$\left(\frac{58}{57}, -\frac{128}{57}\right)$

74. $-2(3y - 3) + 7y = 10$

$-6y + 6 + 7y = 10$

$y = 4$

$x = 3(4) - 3$

$x = 9$

$(9, 4)$

75. $-10x - 12y = 24$

$\underline{10x + 12y = 24}$

$0 \ne 48$

no solution

76. $-14x + 10y = 0$

$\underline{14x - 8y = 2}$

$2y = 2$

$y = 1$

$14x - 8(1) = 2$

$14x = 10$

$x = \frac{5}{7}$

$\left(\frac{5}{7}, 1\right)$

77. $-4(2 - 5y) - 10y = 12$

$-8 + 20y - 10y = 12$

$10y = 20$

$y = 2$

$x = 2 - 5(2)$

$x = -8$

$(-8, 2)$

78. $6x - 8y = -18$

$-6x + 8y = 18$

$0 = 0$

infinitely many solutions

Lesson 3.4

Activity (p. 163)

1. at O, $C = 0$;

at P, $C = 20$;

at R, $C = 30$;

at S, $C = 18$;

at T, $C = 8$;

at U, $C = 18$;

at V, $C = 12$;

2. R; O

3. 30; 0; can't be done

3.4 Guided Practice (p. 166)

1. Linear programming is the process of optimizing a linear objective function subject to a set of linear inequalities known as constraints.

2. The value of the objective function is tested at various points of the feasible region to determine where it is a maximum and/or minimum; the system of constraints define the feasible region.

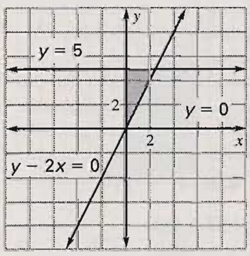
3. If the feasible region is bounded, the maximum and minimum values of the objective function must occur at a vertex, so the value of the objective function is checked at each vertex.

4. (0, 0), (0, 3), (2, 4), (4, 0)

5. minimum $C = 5(0) + 7(0) = 0$

maximum $C = 5(2) + 7(4) = 38$

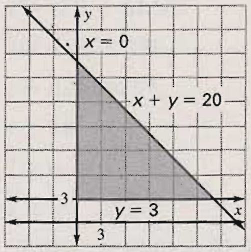
6.



At (0, 0): $C = 0 + 0 = 0$ ← minimum

At (0, 5): $C = 0 + 5 = 5$

At $\left(\frac{5}{2}, 5\right)$: $C = \frac{5}{2} + 5 = \frac{15}{2}$ ← maximum

7. 

At (0, 3): $C = 2(0) - (3) = -3$

At (17, 3): $C = 2(17) - (3) = 31$ ⟵ maximum

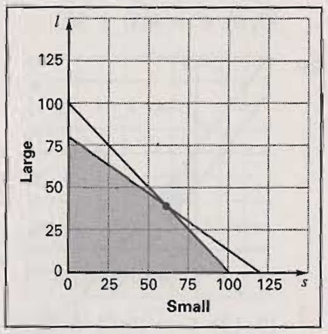
At (0, 20): C: $2(0) - (20) = -20$ ⟵ minimum

8. $s + l \le 100$

$10s + 15l \le 1200$

$C = 6s + 10l$

At (0, 80) = 6(0) + 10(800)



Buy 80 large baskets and sell them for a profit of $800.00.

3.4 Practice and Applications (pp. 166-167)

9. (0, 40): $C = 0 - 40 = -40$ ⟵ minimum

(30, 30): $C = 30 - 30 = 0$

(40, 0): $C = 40 - 0 = 40$ ⟵ maximum

(0, 0); $C = 0 - 0 = 0$

10. $(-6, -3)$: $C = 2(-6) + 5(-3) = -27$

$(-2, -6)$: $C = 2(-2) + 5(-6) = -34$ ⟵ minimum

$(6, -6)$: $C = 2(6) + 5(-6) = -18$

(1, 5): $C = 2(1) + 5(5) = 27$ ⟵ maximum

(8, 1): $C = 2(8) + 5(1) = 21$

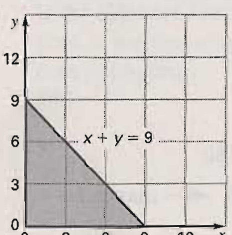
11. (3, 5): $C = 4(3) + 2(5) = 22$

(1, 4): $C = 4(1) + 2(4) = 12$

(2, 1): $C = 4(2) + 2(1) = 10$ ⟵ minimum

(4, 0): $C = 4(4) + 2(0) = 16$

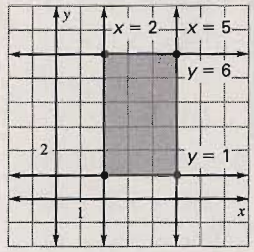
no maximum; feasible region unbounded

12. 

(0, 0): $C = 2(0) + 3(0) = 0$ ⟵ minimum

(9, 0): $C = 2(9) + 3(0) = 18$

(0, 9): $C = 2(0) + 3(9) = 27$ ⟵ maximum

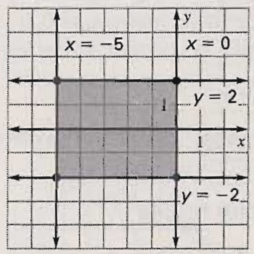
13. 

(2, 1): $C = 2 + 4(1) = 6$ ⟵ minimum

(5, 1): $C = 5 + 4(1) = 9$

(2, 6): $C = 2 + 4(6) = 26$

(5, 6): $C = 5 + 4(6) = 29$ ⟵ maximum

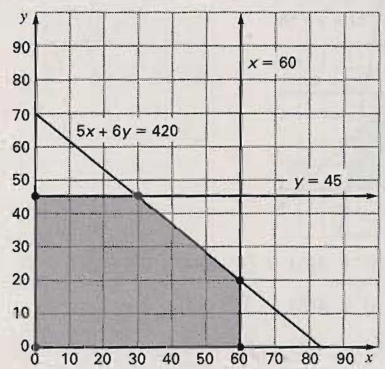
14. 

(0, 2): $C = 2(0) + (2) = 2$ ⟵ maximum

(0, –2): $C = 2(0) + (-2) = -2$

(–5, 2): $C = 2(-5) + (2) = -8$

(–5, –2): $C = 2(-5) + (-2) = -12$ ⟵ minimum

15. 

(0, 0): $C = 10(0) + 7(0) = 0$ ⟵ minimum

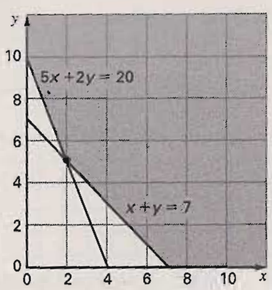
(0, 45): $C = 10(0) + 7(45) = 315$

(30, 45): $C = 10(30) + 7(45) = 615$

(60, 20): $C = 10(60) + 7(20) = 740$ ⟵ maximum

(60, 0): $C = 10(60) + 7(0) = 600$

16.



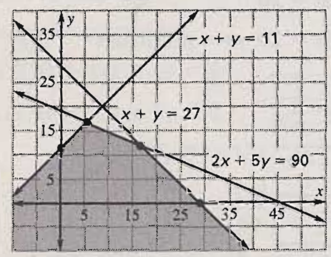
(0, 10): $C = -2(0) + 10 = 10$

(2, 5): $C = -2(2) + 5 = 1$

(7, 0): $C = -2(7) + 0 = -14$

no minimum or maximum; feasible region is unbounded

17.



(−11, 0): $C = 4(-11) + 6(0) = -44$

(0, 11): $C = 4(0) + 6(11) = 66$

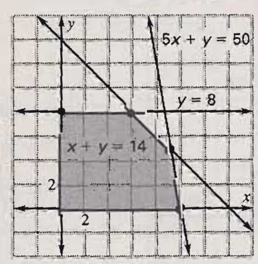
(5, 16): $C = 4(5) + 6(16) = 116$

(15, 12): $C = 4(15) + 6(12) = 132$ ← maximum

(27, 0): $C = 4(27) + 6(0) = 108$

no minimum; feasible region is unbounded

18.



(0, 0): $C = 5(0) + 4(0) = 0$ ← minimum

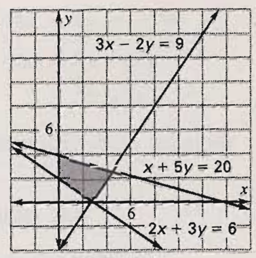
(0, 8): $C = 5(0) + 4(8) = 32$

(6, 8): $C = 5(6) + 4(8) = 62$

(9, 5): $C = 5(9) + 4(5) = 65$ ← maximum

(10, 0): $C = 5(10) + 4(0) = 50$

19.



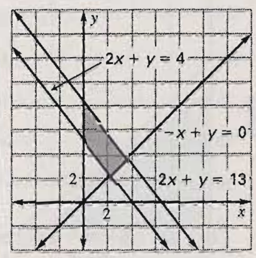
(0, 4): $C = 4(0) + 3(4) = 12$

(0, 2): $C = 4(0) + 3(2) = 6$ ← minimum

(5, 3): $C = 4(5) + 3(3) = 29$ ← maximum

(3, 0): $C = 4(3) + 3(0) = 12$

20.



(0, 13): $C = 10(0) + 3(13) = 39$

(0, 4): $C = 10(0) + 3(4) = 12$ ← minimum

$\left(\frac{4}{3}, \frac{4}{3}\right)$: $C = 10\left(\frac{4}{3}\right) + 3\left(\frac{4}{3}\right) = 17\frac{1}{3}$

$\left(\frac{13}{3}, \frac{13}{3}\right)$: $C = 10\left(\frac{13}{3}\right) + 3\left(\frac{13}{3}\right) = 56\frac{1}{3}$ ← maximum

21. $C = 0.5O + 0.4B$

$2.5O + B \le 500$ (1 gal = 4 quarts)

$1.5O + 3B \le 600$

$B \ge 0$

$O \ge 0$

(0, 200): $C = 0.5(0) + 0.4(200) = 80$

(150, 125): $C = 0.5(150) + 0.4(125) = 125$ ← maximum

(200, 0): $C = 0.5(200) + 0.4(0) = 100$

(0, 0): $C = 0.5(0) + 0.4(0) = 0$

150 gal of Orangeade and 125 gal of Berry-fruity for a profit of $125

22. $C = 12x + 18y$

$75x + 50y \le 600$

$3x + 6y \le 60$

$x \ge 0$

$y \ge 0$

(0, 10): $C = 12(0) + 18(10) = 180$

(2, 9): $C = 12(2) + 18(9) = 186$ ← maximum

(8, 0): $C = 12(8) + 18(0) = 96$

(0, 0): $C = 12(0) + 18(0) = 0$

Purchase 2 of type A and 9 of type B for a total storage capacity of 186 ft^3.

Chapter 3 *continued*

23. $C = \$2t + \$1.50s$

$10t + 5s \le 180$

$t + 0.25s \le 15$

$t \ge 3s$

$t \ge 0$

$s \ge 0$

$(0, 0)$: $C = \$2(0) + \$1.5(0) = 0$

$(14, 4)$: $C = \$2(14) + \$1.5(4) = \$34$ ← maximum

$(15, 0)$: $C = \$2(15) + \$1.5(0) = 30$

Make 14 jars of tomato sauce and 4 jars of salsa for a profit of \$34.

24. $C = 0.57p + 0.78b$

$265p + 230b \ge 500$

$15p + 5b \ge 20$

$3p + 10b \le 30$

$p + b \le 8$

$(8, 0)$: $C = 0.57(8) + 0.78(0) = 4.56$

$\left(\frac{100}{53}, 0\right)$: $C = 0.57\left(\frac{100}{53}\right) + 0.78(0) \approx 1.08$

$\left(\frac{84}{85}, \frac{88}{85}\right)$: $C = 0.57\left(\frac{84}{85}\right) + 0.78\left(\frac{88}{85}\right) \approx 1.37$

$\left(\frac{10}{27}, \frac{26}{9}\right)$: $C = 0.57\left(\frac{10}{27}\right) + 0.78\left(\frac{26}{9}\right) \approx 2.46$

$\left(\frac{50}{7}, \frac{6}{7}\right)$: $C = 0.57\left(\frac{50}{7}\right) + 0.78\left(\frac{6}{7}\right) = 4.74$

Eat about 1.887 cups of pinto beans and no rice for a total cost of \$1.08.

25. $C = 2(0) + 6(46) = 276$

D

26. $C = -2(0) - (8)$

A

27. a. $C = 2x + 2y$

vertices

$(5, 1)$; $2(5) + 2(1) = 12$ ← maximum

$(2, 4)$; $2(2) + 2(4) = 12$ ← maximum

$(5, 0)$; $2(5) + 2(0) = 10$

$(0, 4)$; $2(0) + 2(4) = 8$

$(0, 0)$; $2(0) + 2(0) = 0$

two points

$(3, 3)$; $2(3) + 2(3) = 12$

$(4, 2)$; $2(3) + 2(3) = 12$

If the objective function has a certain value at two vertices, it has that same value at each point of the edge connecting them.

b. $C = 5x - y$

vertices

$(-1, -1)$; $C = 5(-1) - (-1) = -4$

$(3, 19)$; $C = 5(3) - 19 = -4$

$(3, -1)$; $C = 5(3) - (-1) = 16$ ← maximum

two points

$(3, 15)$; $C = 5(3) - 15 = 0$

$(3, 0)$; $C = 5(3) - 0 = 15$

$(2, -1)$; $C = 5(2) + 1 = 11$

$(0, -1)$; $C = 5(0) + 1 = 1$

$(0, 4)$; $C = 5(0) - 4 = -4$

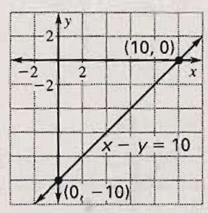
$(2, 14)$; $C = 5(2) - 14 = -4$

The closer to the point $(3, -1)$ on the line segment, the closer the maximum value.

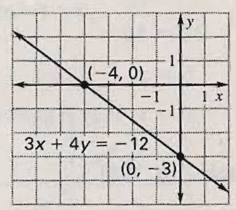
If an edge is parallel to the objective function, the value of C is constant all along that edge. The value of the objective function at points along an edge is between the values at the vertices at its endpoints.

3.4 Mixed Review (p. 168)

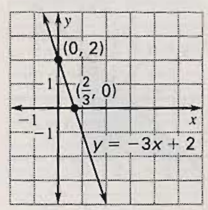
28.



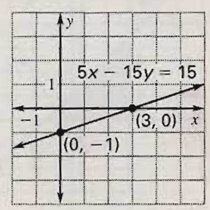
29.



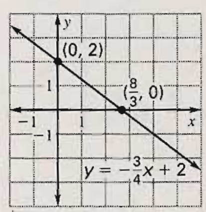
30.



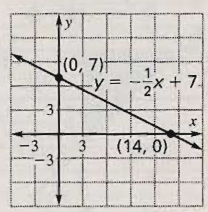
31.



32.



33.



34. $f(0) = 0 - 5 = -5$

35. $f(-2) = -2 - 5 = -7$

36. $f(-10) = 3(-10) - 1 = -31$

37. $f(-1) = -1 - 5 = -6$

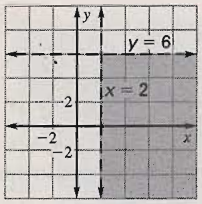
38. $g(1) = 2(1) + 1 = 3$

39. $g(-5) = -7(-5) = 35$

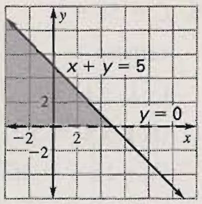
40. $g(-1) = -7(-1) = 7$

41. $g(7) = 2(7) + 1 = 15$

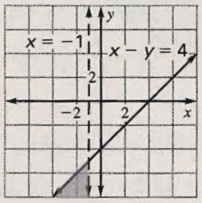
42.



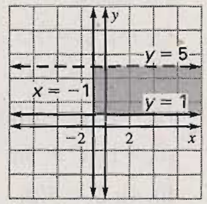
43.



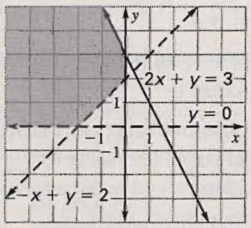
44.



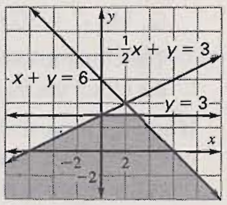
45.



46.



47.



48. $30 = 3v + 2p$

$v = p$

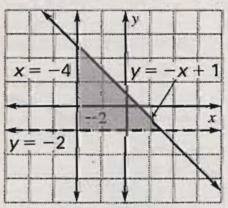
$30 = 5p$

$6 = p$

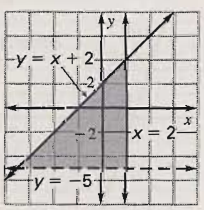
$6 = v$; Play 6 games of each.

Quiz 2 (p. 169)

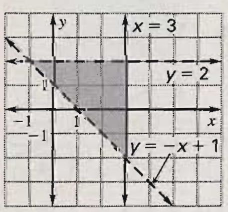
1.



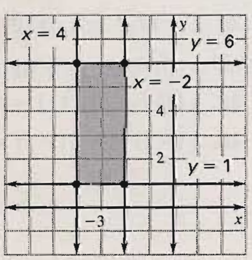
2.



3.



4.



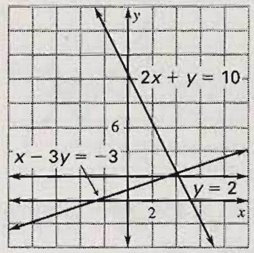
$(-4, 6)$: $C = 5(-4) + 2(6) = -8$

$(-2, 6)$: $C = 5(-2) + 2(6) = 2$ ⟵ maximum

$(-4, 1)$: $C = 5(-4) + 2(1) = -18$ ⟵ minimum

$(-2, 1)$: $C = 5(-2) + 2(1) = -8$

5.

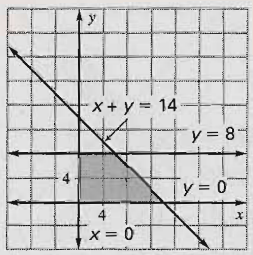


$(3, 2)$: $C = 5(3) + 2(2) = 19$ ⟵ minimum

$(4, 2)$: $C = 5(4) + 2(2) = 24$ ⟵ maximum

$\left(\frac{27}{7}, \frac{16}{7}\right)$: $C = 5\left(\frac{27}{7}\right) + 2\left(\frac{16}{7}\right) = 23\frac{6}{7}$

6.



$(0, 8)$: $C = 5(0) + 2(8) = 16$

$(6, 8)$: $C = 5(6) + 2(8) = 46$

$(14, 0)$; $C = 5(14) + 2(0) = 70$ ⟵ maximum

$(0, 0)$: $C = 5(0) + 2(0) = 0$ ⟵ minimum

7. $C = 10S + 20L$

	vertices
$2S + 3L \le 30$	$(12, 0)$; $10(12) + 20(0) = 120$
$S + L \ge 12$	$(6, 6)$; $10(6) + 20(6) = 180$
$S \ge 0$	$(15, 0)$; $10(15) + 20(0) = 150$
$L \ge 0$	6 small boxes and 6 large boxes

Math and History (p. 169)

1. $\frac{500 \text{ ton}}{25 \text{ ton}} = 20$ tanks

2. $33 + 27 = 60$ trucks

3. $C = r + t$

$581 \ge 3r + 25t$

$60 \ge r$

$20 \ge t$

$r \ge 3t$

$r \ge 0$

$t \ge 0$

$(0, 60)$: $C = 0 + 60 = 60$

$(16, 60)$: $C = 16 + 60 = 76$ ⟵ maximum

$(17, 51)$: $C = 17 + 51 = 68$

$(0, 0)$: $C = 0 + 0 = 0$

16 tanks, 60 trucks