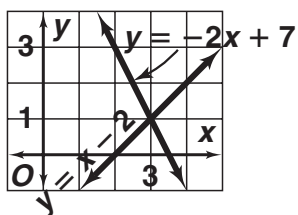# Answers for Lesson 3-1   Exercises
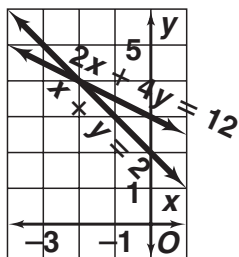
**1.** $(3, 1)$
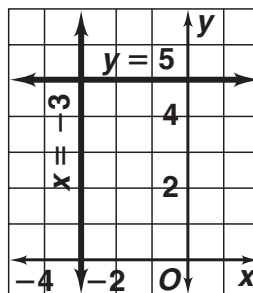


**2.** $(2, 1)$
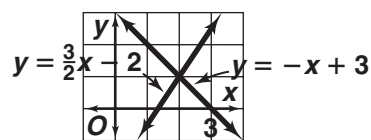


**3.** $(-2, 4)$



**4.** $(-3, 5)$



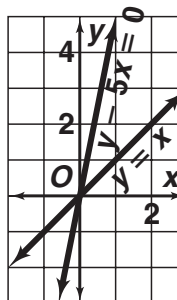**5.** no solution
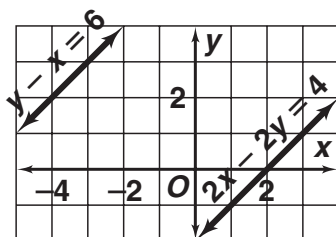


**6.** $(3, -4)$
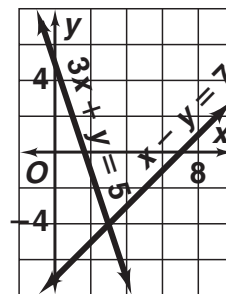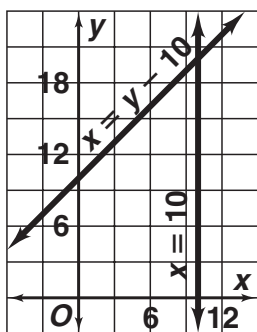


**7.** $(3, 6)$
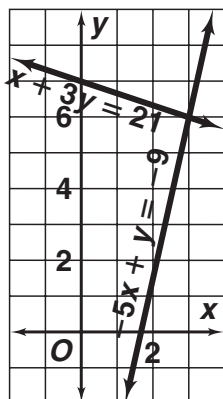


**8.** $(0, 0)$

# Answers for Lesson 3-1   Exercises (cont.)

**9.** $(10, 20)$



**10.** Use 0 for 1980.

$$\begin{cases} y = 0.232x + 1.328 \\ y = 0.145x + 3.673 \end{cases}$$

about 2007

**11.** Use 0 for 1970.

$$\begin{cases} y = 0.22x + 67.5 \\ y = 0.15x + 75.507 \end{cases}$$

about 2085

**12. a.** $\begin{cases} y = 3000x + 5200 \\ y = -900x + 35{,}700 \end{cases}$

**b.** If Feb $= 1$, the revenue will equal expenses in the 7.82 month, or late August.

**13.** dependent     **14.** inconsistent     **15.** inconsistent

**16.** independent     **17.** inconsistent     **18.** inconsistent

**19.** dependent     **20.** independent     **21.** dependent
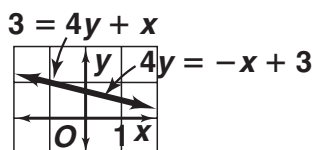
**22.** inconsistent     **23.** independent     **24.** inconsistent
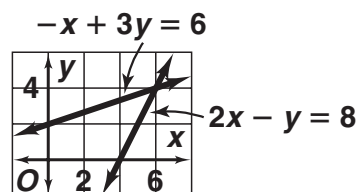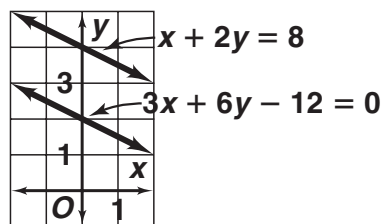
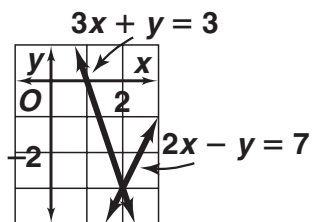**25.** infinite solutions     **26.** $\left(\frac{4}{3}, \frac{7}{6}\right) \approx (1.5, 1)$
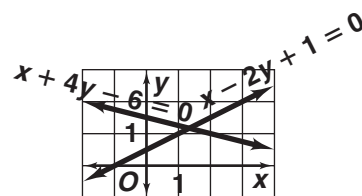




**27.** no solution     **28.** $(6, 4)$

# Answers for Lesson 3-1   Exercises (cont.)

**29.** $(2, -3)$

$3x + y = 3$



$2x - y = 7$

**30.** $(1.875, 0.75) \approx (2, 1)$

$20x + 30y = 60$

$40x = 60y + 30$



**31.** $\left( \frac{16}{9}, -\frac{14}{9} \right) \approx (1.5, -1.5)$

$2 = 2x + y$

$10 - 3x = 3y$



**32.** $\left( \frac{1}{3}, \frac{3}{5} \right)$

$x = \frac{1}{3}$

$3x = -5y + 4$
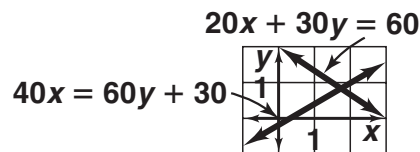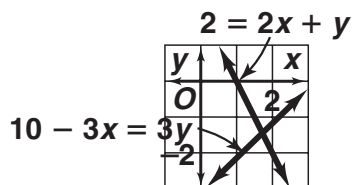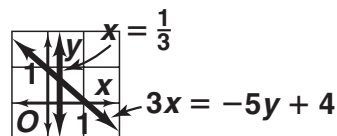


**33.** infinite solutions

$x + 3y = 6$

$6y + 2x = 12$



**34.** $(4, 2)$

$2y + x = 8$

$y - 2x = -6$



**35.** $\left( \frac{12}{7}, \frac{18}{7} \right) \approx (1.7, 2.6)$

$x - 3y = -6$

$y = -2x + 6$



**36.** no solution

$y - 2 = -2y$

$-x - 2$

$2x - 4y = 0$

$-4$
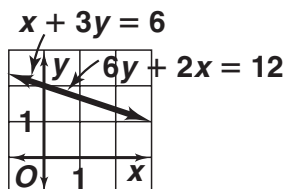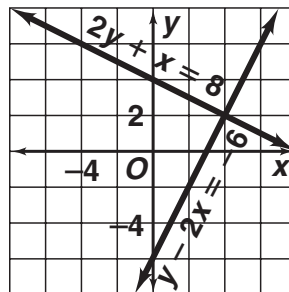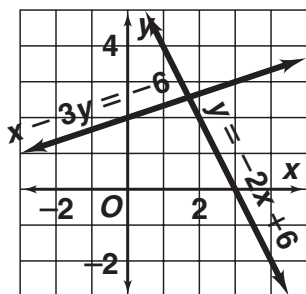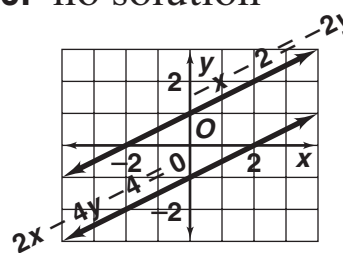
**37. a.** $\begin{cases} c = 3 + 0.40b \\ c = 9.00 \end{cases}$
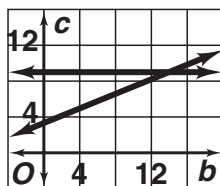


**b.** (15, 9); the point represents where the cost of using the bank or online service would be the same.

**c.** The local bank would be cheaper if you only have 12 bills to pay per month.

**38.** inconsistent    **39.** dependent    **40.** independent

**41.** inconsistent    **42.** inconsistent    **43.** dependent

**44. a.** $\begin{cases} c = 20d + 30 \\ c = 25d \end{cases}$

**b.** The cost would be the same for a 6-day stay.

**c.** The Pooch Pad would be cheaper for a 7-day stay.

**45.** $x$ = minutes, $y$ = flyers;
$\begin{cases} y = 6x + 80 \\ y = 4x + 100 \end{cases}$
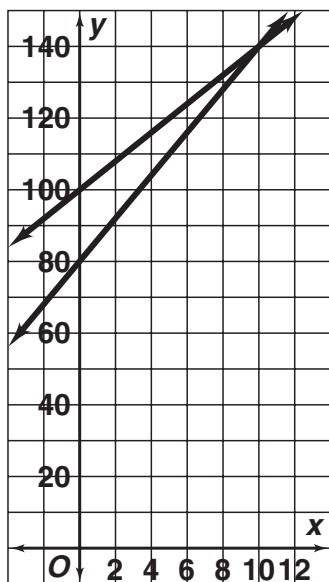


After 10 minutes the numbers of flyers will be equal.

**46.** Answers may vary. Sample: $y = x + 3$

**47.** Answers may vary. Sample: $y = -4x + 8$

# Answers for Lesson 3-1   Exercises (cont.)

**48.** Answers may vary. Sample: $y = 2x + \frac{7}{3}$

**49.** No; they would be the same line, and the system would be dependent and consistent.

**50.** An independent system has one solution. The slopes are different, but the $y$-intercepts could be the same. An inconsistent system has no solution. The slopes are the same, and the $y$-intercepts are different. A dependent system has an infinite number of solutions. The slopes and $y$-intercepts are the same.

**51.** Answers may vary. Sample: $3x + 4y = 12$

**52.** Answers may vary. Sample: $y = -\frac{5x}{2} + 7$

**53.** Answers may vary. Sample: $\begin{cases} -10x + 2y = 4 \\ 5x - y = -2 \end{cases}$

**54.** They are the same equation written in different forms.

**55. a.** $p$: independent, $n$: dependent

  **b.** $n = -1600p + 14{,}800$

  **c.** $n = -6000 + 32{,}000$

  **d.** About $(3.91, 8545)$; profits are maximized if about 8545 widgets are sold for about \$3.91 each.

# Answers for Lesson 3-2    Exercises

**1.** $(0.5, 2.5)$

**2.** $(c, d) = (-2, 4)$

**3.** $(20, 4)$

**4.** $(p, q) = (0.75, 2.5)$

**5.** $(10, -1)$

**6.** $(8, -1)$

**7.** $(a, b) = (0, 3)$

**8.** $(r, t) = (-6, -9)$

**9.** $(-2, -5)$

**10.** $(m, n) = (-3, 4)$

**11.** $(6, 4)$

**12.** $(r, s) = (-6, -6)$

**13. a.** $\begin{cases} d = 0.50m \\ d = 15 \end{cases}$

    **b.** 30 miles

**14.** 3 vans and 2 sedans, or 4 vans and 1 sedan, or 5 vans and 0 sedans

**15. a.** $\begin{cases} p = 28 \\ p = 8 + 0.35d \end{cases}$

    **b.** 58

**16.** 2 mi/h, 6 mi/h

**17.** $20°, 70°, 90°$

**18.** $(7, 5)$

**19.** $(2, 4)$

**20.** $(a, b) = (-1, 3)$

**21.** $(2, -2)$

**22.** $(w, y) = (-2, -4)$

**23.** $(u, v) = (4, 1)$

**24.** $(2, 3)$

**25.** $(6, 0)$

**26.** $(8, 6)$

**27.** $(0, 3)$

**28.** $(1, 1)$

**29.** $(r, s) = (2, -1)$

**30.** $\{(x, y)| -2x + 3y = 13\}$

**31.** $\{(a, d)| -3a + d = -1\}$

**32.** $(a, b) = (3, 2)$

**33.** no solution

**34.** $(5, 4)$

**35.** no solution

**36.** $\left(\frac{20}{17}, \frac{19}{17}\right)$

**37.** $(-3, 2)$

# Answers for Lesson 3-2   Exercises (cont.)

**38.** $(r, s) = (4, 1)$          **39.** $(1, 3)$

**40.** no solution          **41.** $(m, n) = (1, -4)$

**42.** 2875 votes

**43.** In determining whether to use substitution or elimination to solve an equation, look at the equations to determine if one is solved or can be easily solved for a particular variable. If that is the case, substitution can easily be used. Otherwise, elimination might be easier.

**44.** $(-6, 30)$          **45.** $(m, n) = (4, -3)$

**46.** $(-1, -\frac{1}{2})$          **47.** $(t, v) = (50, 750)$

**48.** $(0.5, 0.75)$          **49.** $(\frac{3}{11}, -\frac{2}{11})$

**50.** $(300, 150)$          **51.** $(a, b) = (-235, -5.8)$

**52.** $(0.5, 0.25)$          **53.** A

**54.** Elimination; substitution would be difficult since no coefficient is 1.

**55.** Substitution; the first equation is solved for $y$.

**56.** Substitution; the second equation is easily solved for $n$.

**57.** Substitution; the second equation is solved for $y$.
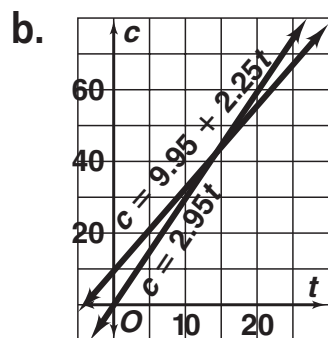
**58.** Elimination; $2x$ would be eliminated from the system if the equations were subtracted.

**59.** Elimination; substitution would be difficult since no coefficient is 1.

**60.** Answers may vary. Sample: $\begin{cases} -3x + 4y = 12 \\ 5x - 3y = 13 \end{cases}$ $(8, 9)$

# Answers for Lesson 3-2  Exercises (cont.)

**61. a.** $c = 9.95 + 2.25t, c = 2.95t$

**b.**



**c.** about 14.2 h; it is where the graphs intersect.

**d.** Answers may vary. Sample: Internet Action, because it would cost $4.05 less per month

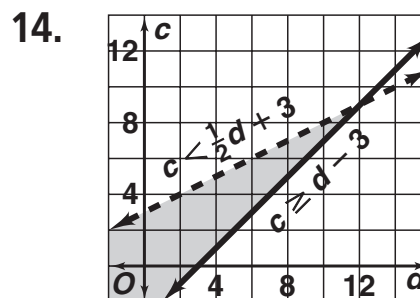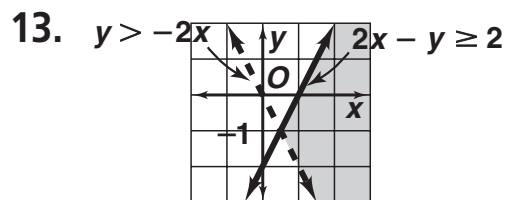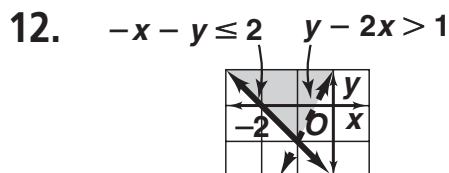**62.** 46 performances **63.** yes; for $-40$ degrees
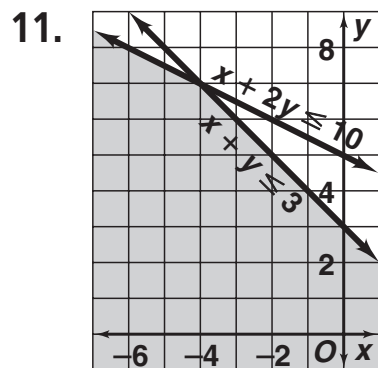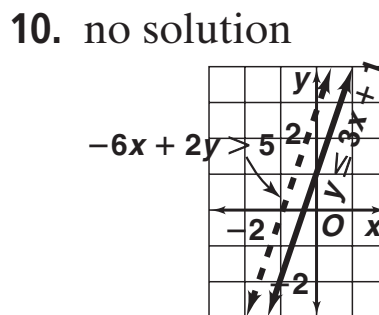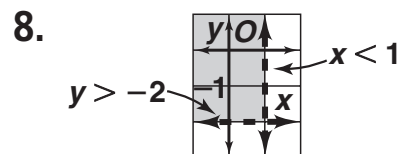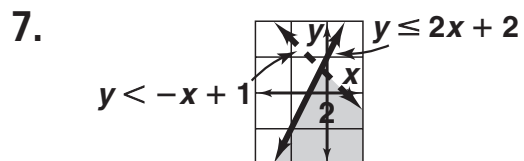
**64.** $-2$ **65.** 0 **66.** 8

# Answers for Lesson 3-3  Exercises

**1.** $(0, 4), (0, 5), (0, 6), (0, 7), (0, 8)$

**2.** $(3, 0), (4, 1), (5, 2), (6, 3), (7, 4)$

**3.** $(0, 7), (0, 6), (0, 5), (0, 4), (0, 3), (0, 2), (0, 1), (0, 0), (1, 6),$
$(1, 5), (1, 4), (1, 3), (1, 2), (1, 1), (1, 0), (2, 5), (2, 4), (2, 3),$
$(2, 2), (2, 1), (2, 0), (3, 4), (3, 3)$

**4.** yes  **5.** no  **6.** yes

**7.**


**8.**


**9.**


**10.** no solution


**11.**


**12.** $-x - y \le 2$  $y - 2x > 1$


**13.** $y > -2x$  $2x - y \ge 2$


**14.**

# Answers for Lesson 3-3 Exercises (cont.)

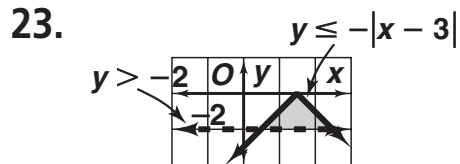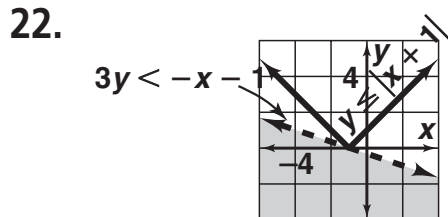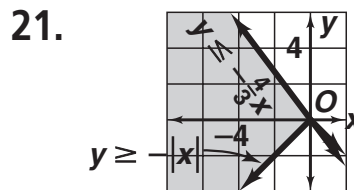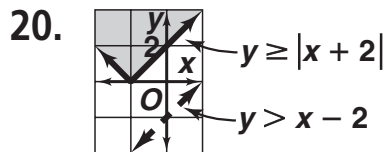**15.** $2x + y < 1$

$-y + 3x < 1$

**16. a.** $\begin{cases} x + y \geq 6 \\ x + y \leq 11 \\ y \geq 2x \\ y \geq 0 \\ x \geq 0 \end{cases}$

**b.**

**17.** $\begin{cases} a + c \geq 40 \\ c \leq 30 \end{cases}$

**18.**

$y > 4$

**19.**

$y > |2x - 1|$

$y < -\frac{1}{3}x + 1$

# Answers for Lesson 3-3    Exercises (cont.)

**20.**



$y \geq |x + 2|$
$y > x - 2$

**21.**



$y \geq -|x|$

**22.**



$3y < -x - 1$

**23.**



$y \leq -|x - 3|$
$y > -2$

**24.**



$-2x + y > 3$

**25.**



$y < |x + 3|$
$5y \geq 2x - 5$

**26.**



**27.**



**28.**



**29.**



$y \leq x - 4$
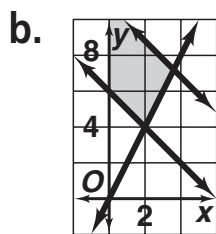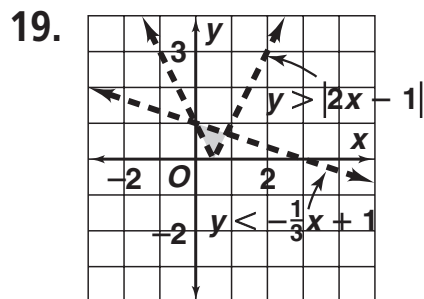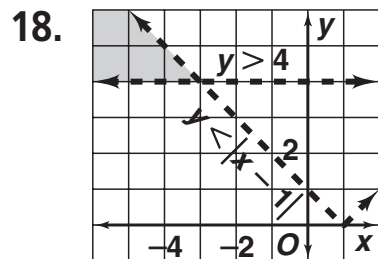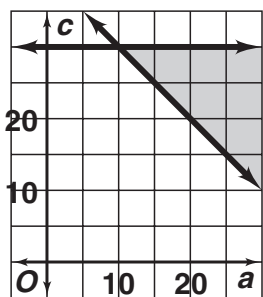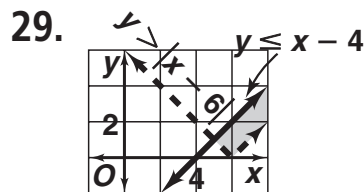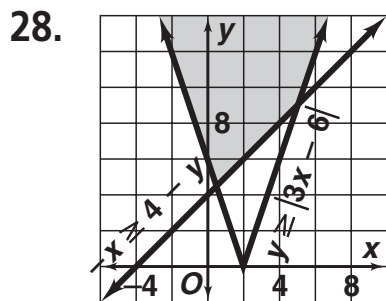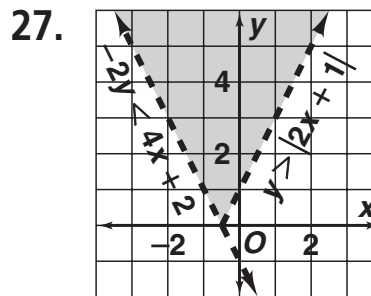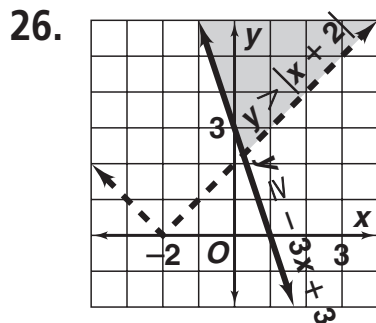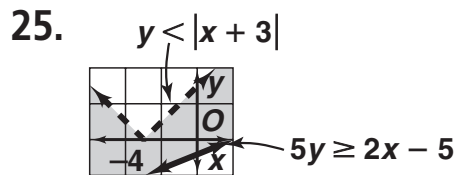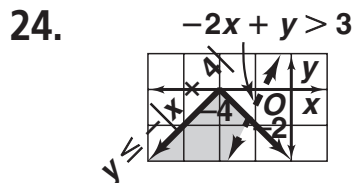
**30.** A, C

**31.** A, B

**32.** A, C

**33.** A, B

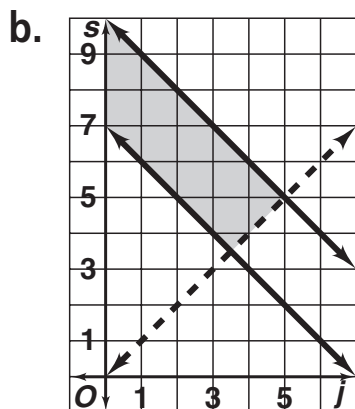**34.** A, C

**35.** B, C

**36.** A, B, C

**37.** A

**38.** B, C

**39.** A
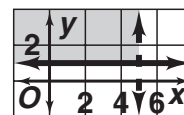
# Answers for Lesson 3-3  Exercises (cont.)

**40. a.**
$$\begin{cases} j + s \geq 7 \\ j + s \leq 10 \\ s > j \\ j \geq 0 \\ s \geq 0 \end{cases}$$

**b.**



$(0, 7)\ (0, 8)\ (0, 9)\ (0, 10)\ (1, 6)\ (1, 7)$
$(1, 8)\ (1, 9)\ (2, 5)\ (2, 6)\ (2, 7)\ (2, 8)$
$(3, 4)\ (3, 5)\ (3, 6)\ (3, 7)\ (4, 5)\ (4, 6)$

**c.** Only whole numbers of juniors and seniors make sense.

**41.** Answers may vary. Sample: $\begin{cases} x < 5 \\ y \geq 1 \end{cases}$



**42.** Answers may vary. Sample: If the isolated variable is greater than the remaining expression, the half-plane above the boundary line is shaded. If the variable is less than the remaining expression, then the half-plane below the line is shaded.
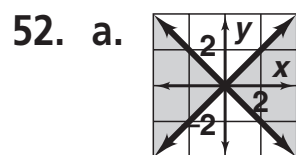
**43.**



**44.**



**45.**



**46.**



**47.**



**48.**
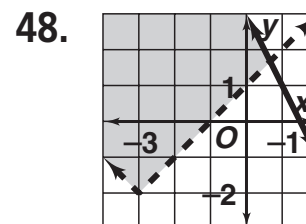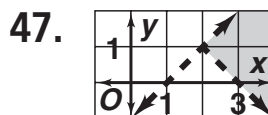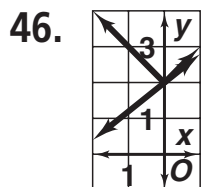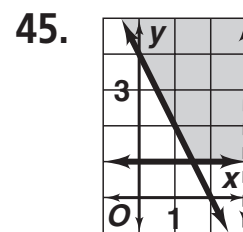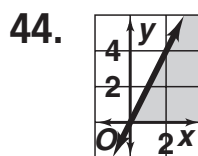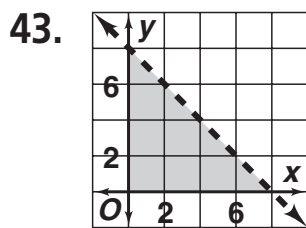


**49.** $\begin{cases} y \geq |x| - 2 \\ y \leq -|x| + 2 \end{cases}$

**49.** $\begin{cases} y \geq |x| - 2 \\ y \leq -|x| + 2 \end{cases}$

**50.** $\begin{cases} y \leq 3 \\ y \geq 0 \\ y \leq 3x + 9 \\ y \leq -3x + 9 \end{cases}$

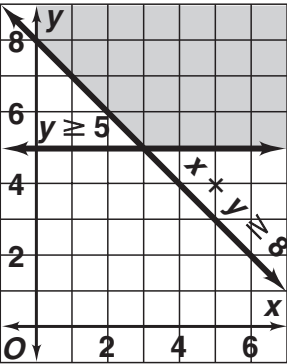**51.** $\begin{cases} y \leq 4 \\ y \geq 0 \\ y \leq 2x \\ y \geq 2x - 8 \end{cases}$

**52. a.**



**b.** Answers may vary. Sample: $|y| \leq \frac{1}{2}|x|$

$|x| \leq 2$

# Answers for Lesson 3-4 Exercises

**1.** When $x = 4$ and $y = 2$, $P$ is maximized at 16.

**2.** When $x = 600$ and $y = 0$, $P$ is maximized at 4200.

**3.** When $x = 6$ and $y = 8$, $C$ is minimized at 36.
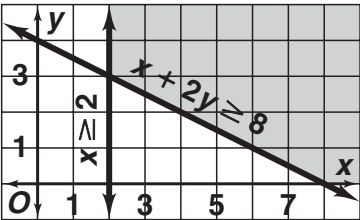
**4.**



vertices: $(0, 0)$, $(5, 0)$, $(5, 4)$, $(0, 4)$; maximized at $(5, 4)$
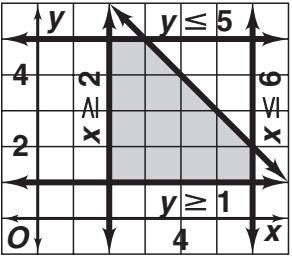
**5.**



vertices: $(3, 5)$, $(0, 8)$; minimized at $(0, 8)$

**6.**



vertices: $(0, 0)$, $(5, 0)$, $(2, 6)$, $(0, 8)$; maximized at $(5, 0)$

**7.**



vertices: $(1, 5)$, $(8, 5)$, $(8, -2)$; minimized at $(8, -2)$

## Answers for Lesson 3-4  Exercises (cont.)

**8.**



vertices: $(8, 0), (2, 3)$;
minimized at $(8, 0)$

**9.**



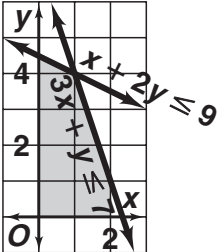vertices: $(2, 1), (6, 1), (6, 2), (2, 5), (3, 5)$;
maximized at $(6, 2)$

**10. a.** $\begin{cases} 2x + y \leq 30 \\ 2y \leq 16 \\ x \geq 0, y \geq 0 \end{cases}$

$P = 500x + 200y$

  **b.** 15 experienced teams, 0 training teams; none; 7500 trees

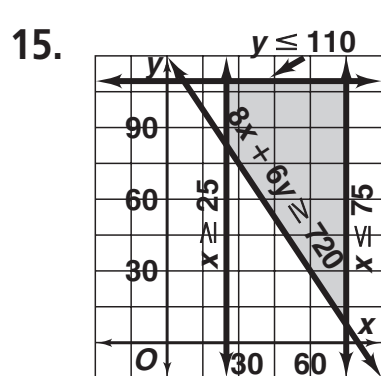  **c.** 11 experienced teams; 8 training teams; 7100 trees

**11.** 70 spruce; 0 maple

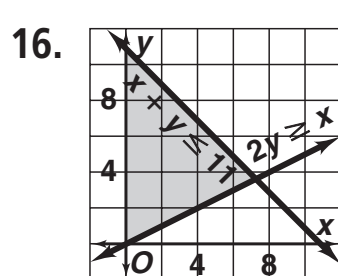**12.** Solving a system of linear equations is a necessary skill used to locate the vertex points.

**13.** A

**14.**



vertices: $(0, 0), (1, 4), (0, 4.5), \left(\frac{7}{3}, 0\right)$;
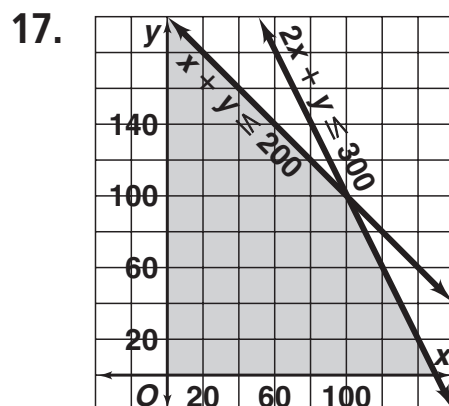maximized when $P = 6$ at $(1, 4)$
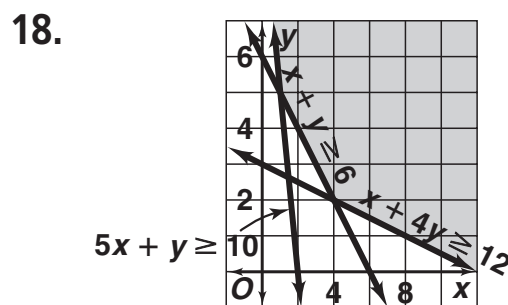
# Answers for Lesson 3-4    Exercises (cont.)

**15.**



vertices: $(75, 20)$, $(75, 110)$, $\left(25, 86\frac{2}{3}\right)$, $(25, 110)$; minimized when $C = 633\frac{1}{3}$ at $\left(25, 86\frac{2}{3}\right)$

**16.**



vertices: $(0, 0)$, $\left(7\frac{1}{3}, 3\frac{2}{3}\right)$, $(0, 11)$; maximized when $P = 29\frac{1}{3}$ at $\left(7\frac{1}{3}, 3\frac{2}{3}\right)$

**17.**



vertices: $(0, 0)$, $(150, 0)$, $(100, 100)$, $(0, 200)$; maximized when $P = 400$ at $(0, 200)$
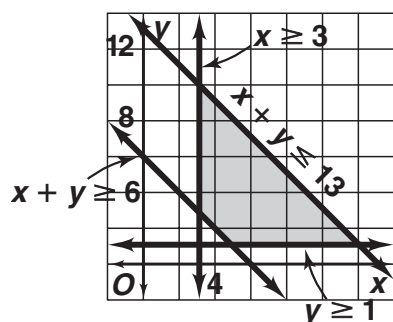
**18.**



vertices: $(12, 0)$, $(0, 10)$, $(4, 2)$, $(1, 5)$; minimized when $C = 80{,}000$ at $(4, 2)$

## Answers for Lesson 3-4    Exercises (cont.)

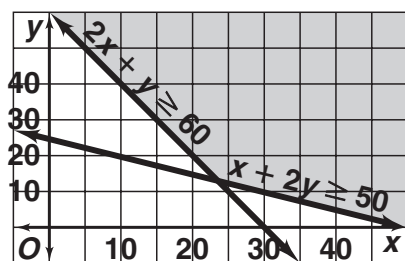**19.**



vertices: $(3, 3), (3, 10), (5, 1), (12, 1)$;
maximized when $P = 51$ at $(12, 1)$

**20.** 3 trays of corn muffins and 2 trays of bran muffins

**21.**



vertices: $(0, 60), \left(23\frac{1}{3}, 13\frac{1}{3}\right), (50, 0)$,
minimized when $x = 23\frac{1}{3}$ and $y = 13\frac{1}{3}$
Round to $(23, 14)$ and $(24, 13)$;
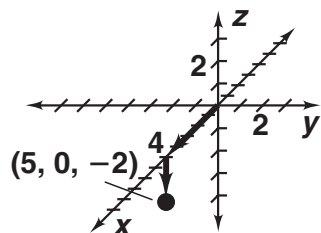$(24, 13)$ gives you a minimum $C$
of 261.

**22.** Check students' work.

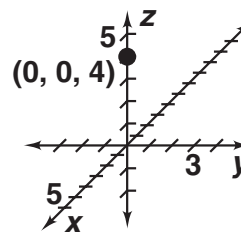**23.** Answers may vary. Sample: $(4, 6), (6, 5), (9, 3.5), (10, 3)$

## Answers for Lesson 3-5　Exercises

**1.** 1 unit back, 5 units right

**2.** 3 units forward, 3 units left, 4 units up

**3.** 2 units forward, 5 units up
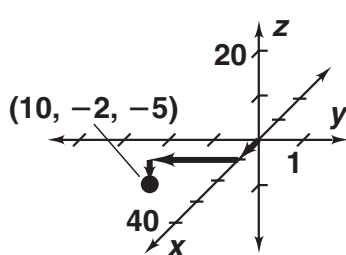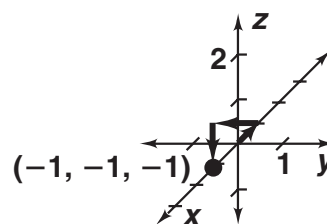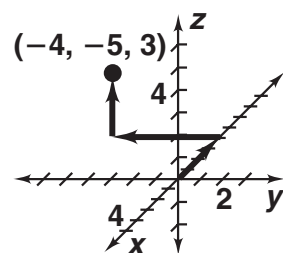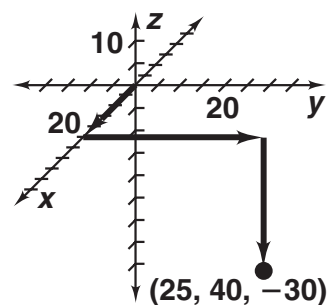
**4.** 4 units back, 7 units left, 1 unit down

**5.**



**6.**



**7.**



**8.**



**9.**



**10.**



**11.**
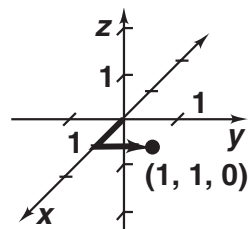


**12.**
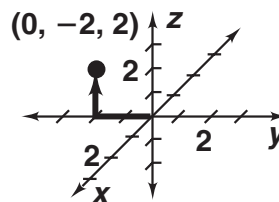


**13.** $(0, 0, 0)$　　**14.** $(0, 0, 50)$　　**15.** $(0, 40, 0)$

**16.** $(60, 0, 50)$　　**17.** $(0, 80, 100)$　　**18.** $(60, 30, 100)$

**19.**



**20.**



**21.**



**22.**



**23.**



**24.**
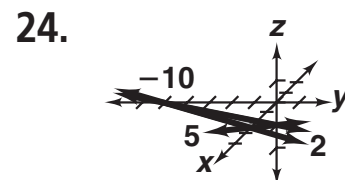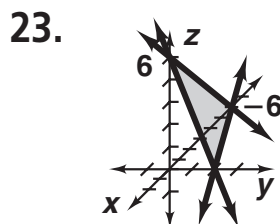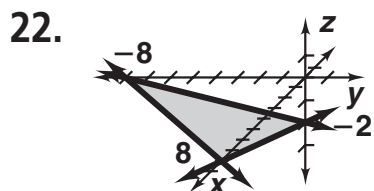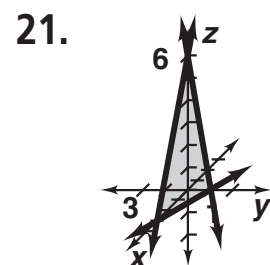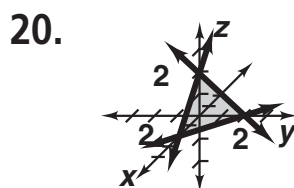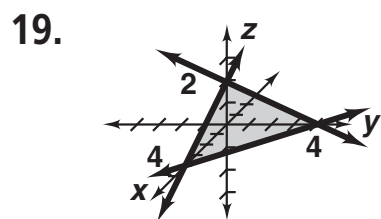


**25.** Answers may vary. Sample: Balcony represents vertical direction, row is backward or forward, and seat is left or right.

**26.** C

**27.**



**28.**



**29.**



**30.**



**31.**



**32.**
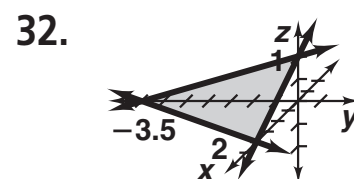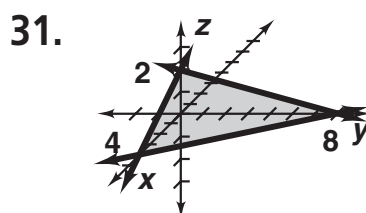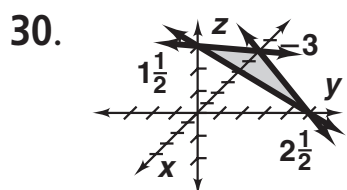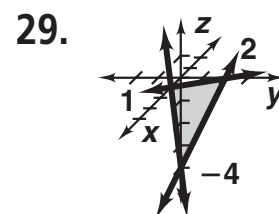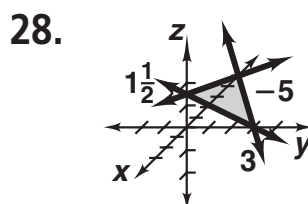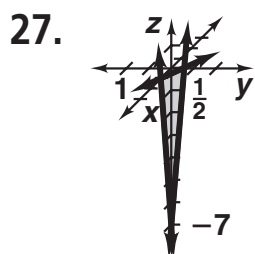


**33.** $xy$-trace: $x + y = 6$
$xz$-trace: $x - 2z = 6$
$yz$-trace: $y - 2z = 6$

## Answers for Lesson 3-5    Exercises (cont.)

**34.** $xy$-trace: $-2x + y = 10$

$xz$-trace: $-2x + 5z = 10$

$yz$-trace: $y + 5z = 10$

**35.** $xy$-trace: $-3x - 8y = 24$

$xz$-trace: $-x - 4z = 8$

$yz$-trace: $-2y - 3z = 6$
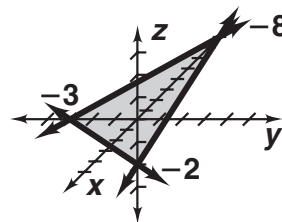
**36.** $xy$-trace: $x + 5y = 5$

$xz$-trace: $x - z = 5$

$yz$-trace: $5y - z = 5$
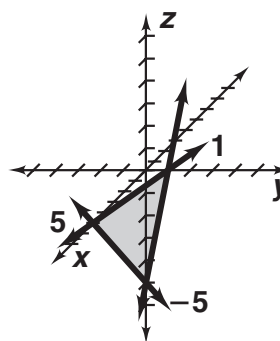
**37.** Mt. Kilimanjaro

**38.** Mt. Tahat

**39.** Valdivia Seamount

**40.** Cape Verde

**41.** Qattara Depression

**42.** Lake Chad

**43.** Jabal Toubkal

**44.** Victoria Falls

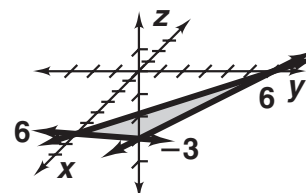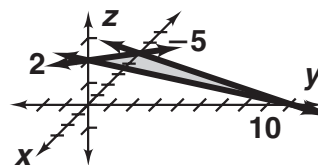**45.** Aswan High Dam

**46.** Lake Victoria

**47.** The student is actually finding the equation of the $yz$-trace. If the student wants the $x$-intercept, the student should substitute 0 for both $y$ and $z$ in the equation of the plane.

**48. a.** $\sqrt{29}$    **b.** $\left( \dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}, \dfrac{z_1 + z_2}{2} \right)$

**49. a.** No, a plane that is parallel to two of the axes (and is therefore perpendicular to the third axis) has only two traces, which are perpendicular.

**b.** No, a plane that intersects two of the axes and is parallel to the third axis has three traces, two of which are parallel.

**50.**
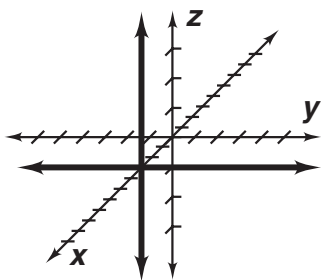


**51.**
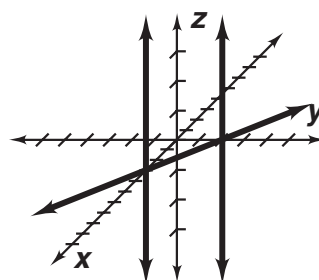


**52.**

## Answers for Lesson 3-6    Exercises

**1.** $(4, 2, -3)$      **2.** $(0, 2, -3)$      **3.** $(2, 1, -5)$

**4.** $(a, b, c) = (-3, 1, -1)$      **5.** $(q, r, s) = (\frac{1}{2}, -3, 1)$

**6.** $(0, 3, -2)$      **7.** $(1, -4, 3)$      **8.** $(1, 1, 1)$

**9.** $(4, -1, 2)$      **10.** $(8, -4, 2)$

**11.** $(a, b, c) = (2, 3, -2)$      **12.** $(r, s, t) = (-2, -1, -3)$

**13.** $(5, 2, 2)$      **14.** $(0, 1, 7)$      **15.** $(4, 1, 6)$

**16.** $(5, -2, 0)$      **17.** $(1, -1, 2)$      18. $(1, 3, 2)$

**19.** $220,000 was placed in short-term notes.
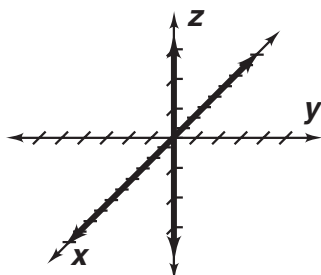$440,000 was placed in government bonds.
$340,000 was placed in utility bonds.

**20.** Section A has 24,500 seats.
Section B has 14,400 seats.
Section C has 10,100 seats.

**21.** 50 nickels, 10 dimes, and 15 quarters

**22.** infinitely many solutions

**23.** one solution      **24.** no solution

**25.** $(8, 1, 3)$      **26.** $(3, 2, -3)$

**27.** $(\frac{1}{2}, 2, -3)$      **28.** $(A, U, I) = (-2, -1, 12)$

**29.** no solution      **30.** $(\ell, w, h) = (21.6, 7.2, 14.4)$

**31.** $(6, 1.5, 3.2)$      **32.** $(-\frac{122}{11}, \frac{72}{11}, \frac{71}{11})$

**33.** $(-\frac{10}{13}, -\frac{2}{13}, \frac{4}{13})$      **34.** $(2, 4, 6)$

**35.** $(-1, 2, 0)$      **36.** $(4, 6, -4)$

**37.** $(2, \frac{10}{3}, \frac{5}{3})$      **38.** $(0, 2, -3)$

**39.** 75 apples; 25 pears      **40.** 72 pounds

# Answers for Lesson 3-6    Exercises (cont.)

**41.** Answers may vary. Sample: When one of the equations can easily be solved for one variable, it is easier to use substitution.

**42.** Answers may vary. Sample: The student is thinking that 0 means that there is no solution. The point $(0, 0, 0)$ is the solution.

**43.** $x + 2y = 180$

$y + z = 180$

$5z = 540$

$x = 36, y = 72, z = 108$

**44.** Answers may vary. Sample: Solution is $(1, 2, 3)$

$$x + y + z = 6$$
$$2x - y + 2z = 6$$
$$3x + 3y + z = 12$$

**45.** Let $E$, $F$, and $V$ represent the numbers of edges, faces, and vertices, respectively. From the statement, "Every face has five edges, and the number of edges is 5 times the number of faces: $E = 5F$." But since each edge is part of two faces, this counts each edge twice. So $E = \frac{5}{2}F$. Since every face has five vertices and every vertex is shared by three faces, $3V = 5F$ or $V = \frac{5}{3}F$. Euler's formula: $V + F = E + 2$. Solving this system of three equations yields $E = 30$, $F = 12$, and $V = 20$.