Answers

Chapter 1

1.1 Arithmetic Sequences, pages 1–13

1. a) arithmetic; $d = 5$; 29, 34, 39 **b)** not arithmetic
c) arithmetic; $d = -4$; −5, −9, −13
d) not arithmetic
e) arithmetic; $d = 3$; 7, 10, 13
f) arithmetic; $d = -13$; −30, −43, −56

2. a) 5, 11, 17, 23; $t_n = -1 + 6n$
b) 50, 41, 32, 23; $t_n = 59 - 9n$
c) 4.5, 3, 1.5, 0; $t_n = 6 - 1.5n$
d) $\frac{1}{5}, \frac{3}{5}, 1, \frac{7}{5}$; $t_n = -\frac{1}{5} + \frac{2}{5}d$

3. a) $t_1 = 4$ **b)** $t_8 = -11$
c) $t_{15} = 80.5$ **d)** $t_{20} = -\frac{18}{7}$

4. a) $d = 12$; $t_1 = -9$; −9, 3, and 15
b) $d = -8$; $t_1 = 22$; 22, 14, and −10
c) $d = 3.2$; $t_1 = 16.2$; 16.2, and 22.6, 25.8
d) $d = 1$; $-\frac{3}{2}$, and $\frac{1}{2}, \frac{3}{2}$

5. a) $n = 12$ **b)** $n = 24$ **c)** $n = 16$ **d)** $n = 38$

6. a) yes; n is a whole number: $n = 17$
b) no; n is not a whole number, so 89 is not a term in the sequence
c) yes; n is a whole number: $n = 6$
d) yes; n is a whole number: $n = 11$

7. a) $d = 4$, $t_1 = 5$; $t_n = 4n + 1$
b) $d = 6$, $t_1 = -4$; $t_n = 6n - 10$
c) $d = -3$, $t_1 = -8$; $t_n = -3n - 5$
d) $d = 4.5x$, $t_1 = 3 - 22x$; $t_n = 4.5xn + 3 - 26.5x$

8. 822 members

9. 7 m

10. $x = 5$; 5, 9.5, 14

11. after 16 years

12. 4, 11, 18, 25

13. a) an arithmetic sequence; because the common difference between consecutive terms is 1; $t_n = n$
b) an arithmetic sequence; because the common difference between consecutive terms is 7; $t_n = -4 + 7n$
c) yes; they have a common difference, 8; $t_n = -6 + 8n$

14. a) Yes. The points (x, y) represent a sequence where the x-values represent n and the y-values represent the terms of the sequence. The sequence is arithmetic because the points form a straight line, which means that the difference between points is constant. The points in the sequence are 7, 5, 3, 1, −1, −3, −5, −7.
b) by substituting into the formula for the general term, $t_n = t_1 + (n - 1)d$; $t_n = 9 - 2n$
c) $t_{60} = 9 - 2(60) = -111$; $t_{300} = 9 - 2(300) = -591$
d) The slope is −2, which is the coefficient of n in the formula $t_n = 9 - 2n$.
e) The y-intercept is 9, which is the constant term in the formula $t_n = 9 - 2n$.

1.2 Arithmetic Series, pages 14–21

1. a) $S_6 = 153$ **b)** $S_7 = 385$
c) $S_9 = 441$ **d)** $S_{10} = -110$

2. a) $S_{30} = 280.5$ **b)** $S_{30} = 1762.5$
c) $S_{30} = \frac{445}{3}$

3. a) $S_{18} = -9$ **b)** $S_{23} = 1715.8$

4. a) $t_1 = -101$ **b)** $t_1 = 10$ **c)** $t_1 = 15$ **d)** $t_1 = 5$

5. a) $n = 20$ **b)** $n = 20$ **c)** $n = 16$ **d)** $n = 9$

6. 204 cans

7. 2 + 6 + 10 + 14 + 18

8. 2 + 5 + 8 + 11 + 14

9. $S_n = \frac{n}{2}(3n - 1)$

10. a) First determine t_1, which is the first multiple of 5 greater than one: $t_1 = 5$. Then determine t_n, the last multiple of 5 less than 999: $t_n = 995$. Finally, determine n, the total multiples of 5: $n = \frac{995}{5} = 199$. Substitute into the formula, $S_n = \frac{n}{2}(t_1 + t_n)$; $S_{199} = 99\,500$.

11. Job A pays a total of \$4350 and Job B pays a total of \$4650. The student should select Job A because it pays \$300 more.

1.3 Geometric Sequences, pages 22–31

1. a) not geometric
b) geometric; $r = 3$; 81, 243, 729
c) geometric; $r = 0.1$; 0.0003, 0.000 03, 0.000 003
d) not geometric
e) geometric; $r = \frac{1}{5}$; $\frac{1}{25}, \frac{1}{125}, \frac{1}{625}$
f) geometric; $r = -0.5$; −0.5, 0.25, −0.125

2. a) $t_n = 3(4)^{n-1}$ **b)** $t_n = 36\left(-\frac{1}{3}\right)^{n-1}$
c) $t_n = 4.5(1.5)^{n-1}$ **d)** $t_n = \frac{1}{5}\left(-\frac{2}{5}\right)^{n-1}$

3. a) $t_{10} = -1024$ **b)** $t_9 = 32\,768$
c) $t_{11} = -0.000\,000\,1$ **d)** $t_{200} = 1$

4. a) E **b)** D **c)** A
d) B **e)** F **f)** C

5. a) $t_n = -3(-2)^{n-1}$
b) $t_n = (4)^{n-1}$ or $t_n = -1(-4)^{n-1}$
c) $t_n = 512(0.5)^{n-1}$

6. 8, $8\sqrt{3}$, 16

7. **a)** $n = 7$ **b)** $n = 10$ **c)** $n = 8$ **d)** $n = 7$

8. **a)** two; There are two sequences.

   b) 2, 6, 18, 54, 162, … and 2, −6, 18, −54, 162, …

9. 24 576, 12 288, 6144, 3072

10. **a)** ±8 and ±32 **b)** 12 and 72 **c)** ±6 and ±24

11. $t_{10} = 352\,514$

12. $x = 10$

13. **a)** \$1000 **b)** \$1562.50

14. **a)** The x-values of the points on the graph correspond to n, and the y-values are the terms of the sequence for each value of x. The first five terms of the sequence are the y-values that correspond to the x-values 1, 2, 3, 4, 5: 48, 24, 12, 6, 3. There is a common ratio of 0.5 between these y-values, so the points represent a geometric sequence.

    b) yes; $t_n = 48(0.5)^{n-1}$

15. **a)** The sequence is 20 000, 2000, 200, 20, 2. This is a geometric sequence with common ratio $r = 0.1$.

    b) Use the general term of the sequence or write the terms until the seventh term is found (by multiplying the previous term by 0.1). The volume on the seventh day is 0.02 cm^3.

1.4 Geometric Series, pages 32–40

1. **a)** yes; a common ratio of 3; $S_7 = 6558$

   b) yes; a common ratio of −3; $S_7 = 4376$

   c) no; no common ratio

   d) yes: a common ration of $\frac{1}{2}$; $S_7 = \frac{127}{192}$

2. **a)** $t_1 = 2$, $r = 3$, $n = 8$; $S_8 = 6560$

   b) $t_1 = 2.1$, $r = -2$, $n = 9$; $S_9 = 359\frac{1}{10}$

   c) $t_1 = 30$, $r = -\frac{1}{6}$, $n = 7$; $S_7 = 25\frac{5555}{7776}$

   d) $t_1 = 24$, $r = -\frac{1}{3}$, $n = 6$; $S_6 = 11\frac{35}{128}$

3. **a)** $S_{12} = -2730$ **b)** $S_8 = 29\,999\,999\,700$

4. **a)** $S_n = 335\,923$ **b)** $S_n = \frac{9525}{4}$

   c) $S_n = 78\,642$ **d)** $S_n = \frac{6305}{6561}$

5. **a)** $S_n = 3^n - 1$ **b)** $S_n = 5(2^n - 1)$

   c) $S_n = 4^n - 1$ **d)** $S_n = 4(2^n - 1)$

6. **a)** $n = 11$; $S_{11} = 6141$ **b)** $n = 6$; $S_6 = -92.969$

7. $S_7 = 5465$ employees

8. 13 terms

9. 664.78 cm

10. 397 mg

11. $S_{10} = 2046$

12. approximately 89.5 turns per second

13. 183 m

14. 3 + 15 + 75 + ⋯ or 75 + 15 + 3 + ⋯

15. **a)** a geometric series; terms have common ratio 0.7

    b) use $S_n = \frac{t_1(r^n - 1)}{r - 1}$ and substitute $t_1 = 50$, $r = 0.7$; $S_7 = 153$ m

1.5 Infinite Geometric Series, pages 41–49

1. **a)** convergent; $S_\infty = -\frac{243}{4}$

   b) convergent; $S_\infty = 32$

   c) divergent; sum does not exist

   d) convergent; $S_\infty = \frac{2}{19}$

   e) divergent; sum does not exist

   f) divergent; sum does not exist

2. **a)** $S_\infty = -4$ **b)** sum does not exist

   c) $S_\infty = -108$ **d)** $S_\infty = \frac{1728}{19}$

   e) $S_\infty \approx 3.31$ **f)** sum does not exist

3. **a)** $\frac{1}{3}$ **b)** $\frac{25}{99}$ **c)** $\frac{447}{99}$ **d)** $\frac{556}{495}$

4. yes; $S_\infty = 3 + \frac{\frac{9}{10}}{\frac{9}{10}} = 4$

5. **a)** $S_\infty = 5$ **b)** $S_\infty = \frac{21}{11}$

6. **a)** $-1 < x < 1$ **b)** $-2 < x < 2$

7. 260 cm

8. 80 m

9. **a)** To solve for t_1, substitute the known values $S_\infty = 105$, and $r = -\frac{2}{3}$ into the formula $S_\infty = \frac{t_1}{1 - r}$: $t_1 = 175$.

   b) $175 - \frac{350}{3} + \frac{700}{9} - \cdots$

10. **a)** Solve for r by substituting the known values $S_\infty = -45$ and $t_1 = -18$ into the formula $S_\infty = \frac{t_1}{1 - r}$: $r = \frac{3}{5}$.

    b) $-18 - \frac{54}{5} - \frac{162}{25} - \frac{486}{125} - \cdots$

Chapter 1 Review, pages 50–54

1. **a)** not arithmetic

   b) arithmetic; $d = \frac{1}{2}$, $t_n = 1\frac{1}{2} + \frac{1}{2}n$

   c) not arithmetic

   d) arithmetic; $d = -3x^2$, $t_n = x^2 - 3nx^2$

2. **a)** 1, −3, −7, −11, −15

   b) −6, 0, 12, 18, 24

   c) $5m$, $5m + 3$, $5m + 6$, $5m + 9$, $5m + 12$

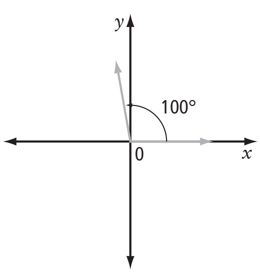
   d) $c + 1$, $2c - 1$, $3c - 3$, $4c - 5$, $5c - 7$

3. **a)** $t_1 = 4, d = 3$ **b)** $t_1 = 42, d = 2$
   c) $t_1 = -19, d = 7$ **d)** $t_1 = 67, d = -5$
4. **a)** 64 **b)** 56
   c) 32 **d)** 28
5. $30 000
6. **a)** 290 **b)** 600
   c) 180 **d)** 375
7. **a)** 893 **b)** 3604
   c) −400 **d)** 0
8. 3 + 7 + 11 + 15 + 19
9. $n = 21$
10. **a)** 1 and 25 or −1 and −25 **b)** 15 and 75
11. **a)** $n = 10$ **b)** $n = 8$
    c) $n = 11$ **d)** $n = 8$
12. $r = \pm 3; \pm 6, 18, \pm 54$
13. **a)** $t_n = 4(3)^{n-1}$ **b)** $t_n = 891\left(\frac{1}{3}\right)^{n-1}$
14. 6 reductions
15. **a)** $t_1 = 24, r = -\frac{1}{2}, n = 10; S_{10} = \frac{1023}{64}$
    b) $t_1 = 0.3, r = \frac{1}{100}, n = 15; S_{15} = \frac{10}{33}$
    c) $t_1 = 8, r = -1, n = 40; S_{40} = 0$
    d) $t_1 = 1, r = -\frac{1}{3}, n = 12;\ S_{12} = \frac{265\ 721}{354\ 294}$
16. **a)** $S_n = 3066$ **b)** $S_n = 10\ 922.5$
17. **a)** $S_n = 1905$ **b)** $S_n = -250\ 954$
18. **a)** 12 terms **b)** 6 terms
19. 11 weeks
20. **a)** convergent; $S_\infty = -\frac{256}{5}$
    b) divergent; sum does not exist
    c) convergent; $S_\infty = \frac{61}{8}$
    d) divergent; sum does not exist
21. $t_1 = 168; 168 - \frac{336}{5} + \frac{672}{25} - \cdots$
22. 300 cm

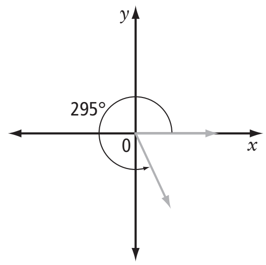
Chapter 2

2.1 Angles in Standard Position, pages 60–67

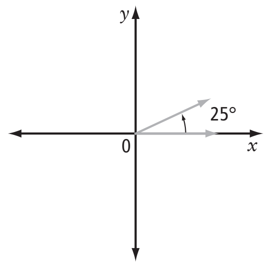
1. **a)** II



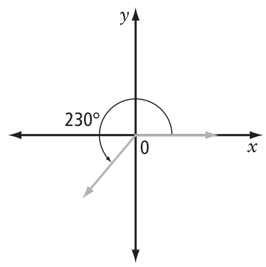
b) IV



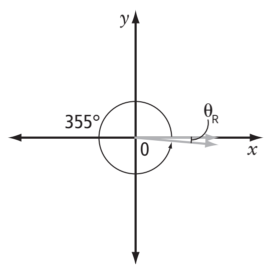
c) I



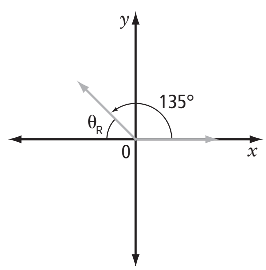
d) III



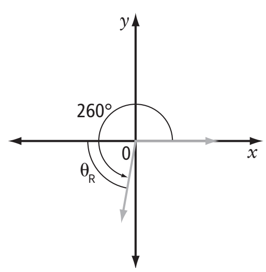
2. **a)** $\theta_R = 5°$



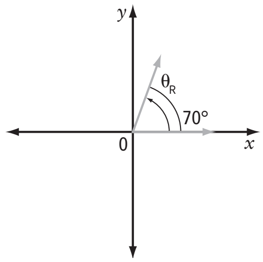
b) $\theta_R = 45°$



c) $\theta_R = 80°$



d) $\theta_R = 70°$



3. **a)** 110°, 250°, 290° **b)** 140°, 220°, 320°
c) 130°, 230°, 310° **d)** 91°, 269°, 271°
e) 153°, 207°, 333°

4. **a)** 140° **b)** 323° **c)** 260°
d) 45° **e)** 170° **f)** 275°

5.

	$\theta = 30°$	$\theta = 45°$	$\theta = 60°$
sin θ	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$
cos θ	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$
tan θ	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$

6. $x = 6\sqrt{3}$, $y = 6$

7. $128 + 128\sqrt{3}$

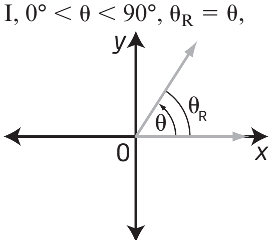
8. $\frac{81}{\sqrt{3}}$

9. 1.40 m by 1.40 m

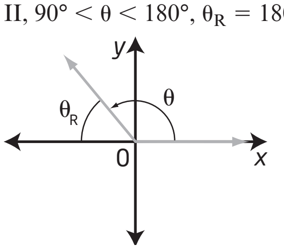
10. $(4\sqrt{3} - 4)$ m

11. Completed table has the following information:

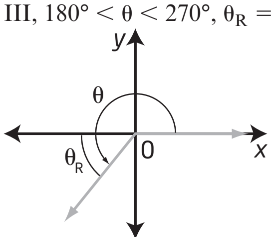
I, $0° < \theta < 90°$, $\theta_R = \theta$,



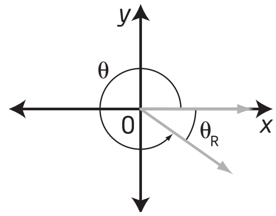
II, $90° < \theta < 180°$, $\theta_R = 180° - \theta$,



III, $180° < \theta < 270°$, $\theta_R = \theta - 180°$,



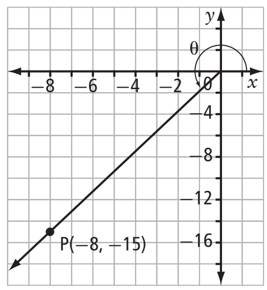
IV, $270° < \theta < 360°$, $\theta_R = 360° - \theta$,



2.2 Trigonometric Ratios of Any Angle, pages 73–79

1. **a)** $x = 6$, $y = -8$, $r = 10$
b) $\sin\theta = -\frac{4}{5}$, $\cos\theta = \frac{3}{5}$, $\tan\theta = -\frac{4}{3}$

2.



$\sin\theta = -\frac{15}{17}$, $\cos\theta = -\frac{8}{17}$, $\tan\theta = \frac{15}{8}$

3. $\sin\theta = 0$, $\cos\theta = 1$, $\tan\theta = 0$

4. **a)** $\sin 210° = -\frac{1}{2}$, $\cos 210° = -\frac{\sqrt{3}}{2}$,
$\tan 210° = \frac{1}{\sqrt{3}}$
b) $\sin 315° = -\frac{1}{\sqrt{2}}$, $\cos 315° = \frac{1}{\sqrt{2}}$,
$\tan 315° = -1$
c) $\sin 270° = -1$, $\cos 270° = 0$,
$\tan 270° =$ undefined

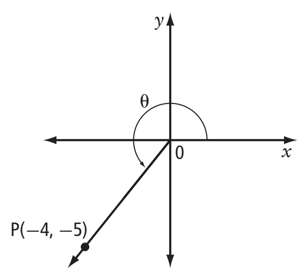
5. $\sin\theta = -\frac{6}{\sqrt{61}}$, $\cos\theta = -\frac{5}{\sqrt{61}}$

6. $\sin\theta = \frac{\sqrt{95}}{12}$, $\tan\theta = -\frac{\sqrt{95}}{7}$

7. $\sin\theta = -\frac{9}{41}$, $\tan\theta = -\frac{9}{40}$

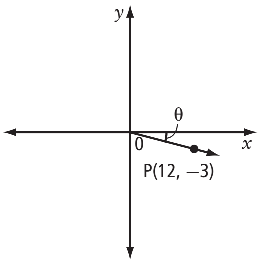
8. **a)** $\theta = 28°, 332°$ **b)** $\theta = 117°, 297°$

9. **a)**



b) 51° **c)** 231°

10. a)



b) 14° **c)** 346°

11.

Trigonometric Ratio	$\sin\theta = \frac{y}{r}$	$\cos\theta = \frac{x}{r}$	$\tan\theta = \frac{y}{x}$
0°	0	1	0
Quadrant I	+	+	+
90°	1	0	undefined
Quadrant II	+	−	−
180°	0	−1	0
Quadrant III	−	−	+
270°	−1	0	undefined
Quadrant IV	−	+	−
360°	0	1	0

2.3 The Sine Law, pages 86–93

1. **a)** 15.4 **b)** 24.6
c) 26° **d)** 11°

2. **a)** 15.3 m **b)** 11.7 km

3. **a)** 38° **b)** 15° **c)** 112°

4. **a)** 68.40 **b)** 9.64 m
c) 2.20 **d)** 43.30

5. **a)** right angle, 1 triangle **b)** 0 triangles
c) $a = b$, 0 triangles **d)** $h < a < b$, 2 triangles
e) $b \leq a$, 1 triangle

6. 1.7754 Å

7. ∠A = 35°, ∠B = 29°, ∠C = 116°, $a = 120$, $b = 100$, $c = 188$

8. acute △ABC: ∠A = 41°, ∠B = 56°, ∠C = 83°, $a = 12.3$ cm, $b = 15.6$ cm, $c = 18.61$ cm
obtuse △ABC: ∠A = 41°, ∠B = 124°, ∠C = 15°, $a = 12.3$ cm, $b = 15.6$ cm, $c = 4.85$ cm

9. Answers may vary.

2.4 The Cosine Law, pages 98–102

1. **a)** $a^2 = b^2 + c^2 - 2bc\cos A$
b) $c^2 = a^2 + b^2 - 2ab\cos C$
c) $l^2 = j^2 + k^2 - 2jk\cos L$
d) $y^2 = x^2 + z^2 - 2xz\cos Y$

2. 246

3. 44 mm or 4.4 cm

4. 145 mm or 14.5 cm

5. **a)** 39° **b)** 121° **c)** 36°

6. 8.1 cm

7. ∠A = 22°, ∠B = 142°, ∠C = 16°, $a = 21$, $b = 35$, $c = 16$

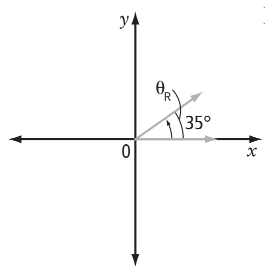
8. 28.7 ft

9.

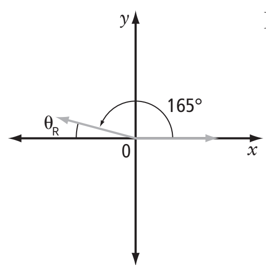
Given Information	Solve For	Formula
m, ∠L, n (SAS)	l	$l^2 = m^2 + n^2 - 2mn\cos L$
l, ∠M, n (SAS)	m	$m^2 = l^2 + n^2 - 2ln\cos M$
l, ∠N, m (SAS)	n	$n^2 = l^2 + m^2 - 2lm\cos N$
l, m, n (SSS)	∠L	$\cos L = \frac{l^2 - m^2 - n^2}{-2mn}$
l, m, n (SSS)	∠M	$\cos M = \frac{m^2 - l^2 - n^2}{-2ln}$
l, m, n (SSS)	∠N	$\cos N = \frac{n^2 - l^2 - m^2}{-2lm}$

Chapter 2 Review, pages 103–105

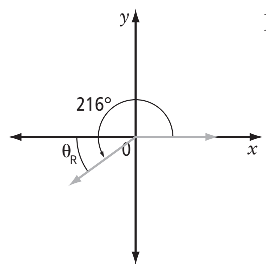
1. **a)** I, $\theta_R = 35°$



b) II, $\theta_R = 15°$



c) III, $\theta_R = 36°$



2. **a)** −1 **b)** $\frac{1}{\sqrt{3}}$ **c)** $-\frac{1}{\sqrt{2}}$

3. $\sin \theta = \frac{5}{\sqrt{41}}$, $\cos \theta = -\frac{4}{\sqrt{41}}$, $\tan \theta = -\frac{5}{4}$

4. $\cos \theta = -\frac{8}{17}$, $\tan \theta = -\frac{15}{8}$

5. **a)** 54°, 306° **b)** 300°, 240°

6. **a)** 19° **b)** 205

7. **a)** 0 triangles **b)** 2 triangles

8. **a)** 13.4 **b)** 27°

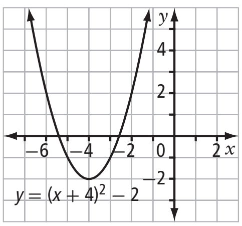
Chapter 3

3.1 Investigating Quadratic Functions in Vertex Form, pages 110–119

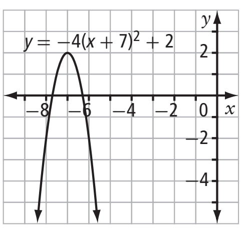
1. **a)** (3, 5); no x-intercepts
   b) (0, 1); two x-intercepts
   c) (11, 0); one x-intercept
   d) $\left(-\frac{1}{2}, \frac{7}{3}\right)$; two x-intercepts

2. **a)** opens upward, $x = 5$; minimum value is −8
   b) opens downward, $x = -3$; maximum is −5

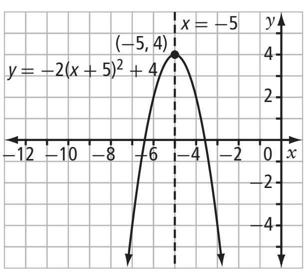
3. **a)** $a = 1$, $p = -4$, $q = -2$; opens upward, minimum value −2; translated 4 units to the left and 2 units down; domain $\{x \mid x \in \mathrm{R}\}$, range $\{y \mid y \geq -2, y \in \mathrm{R}\}$



   b) $a = -4$, $p = -7$, $q = 2$; opens downward, maximum value 2; translated 7 units to the left and 2 units up; domain $\{x \mid x \in \mathrm{R}\}$, range $\{y \mid y \leq 2, y \in \mathrm{R}\}$

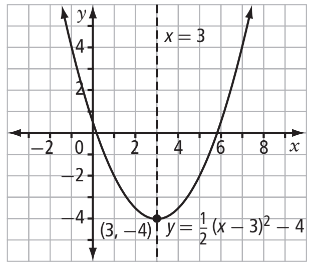


4. **a)**



domain $\{x \mid x \in \mathrm{R}\}$, range $\{y \mid y \leq 4, y \in \mathrm{R}\}$

   b)



domain $\{x \mid x \in \mathrm{R}\}$, range $\{y \mid y \geq -4, y \in \mathrm{R}\}$

5. **a)** $y = -(x + 5)^2 + 2$ **b)** $y = \frac{1}{2}(x + 6)^2$

6. **a)** $y = 5x^2 + 4$ **b)** $y = -2(x - 3)^2$
   c) $y = 4(x - 1)^2 - 1$

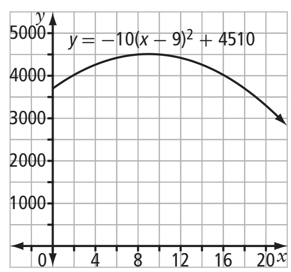
7. **a)** (−6, 0) **b)** (1, −1) **c)** (−2, 4.5)

8. **a)** $y = \frac{1}{9}x^2$ **b)** $y = \frac{1}{9}(x - 3)^2 - 1$
   c) Example: The vertical stretch and domain remain the same while the vertex, axis of symmetry, and range are different.

9. **a)** There are infinitely many parabolas. For example, any parabola with vertex on the line $x = 4$.
   b) Example: maximum at (4, 16) gives $y = -(x - 4)^2 + 16$
   c) Example: maximum at (4, 8) gives $y = -\frac{1}{2}(x - 4)^2 + 8$
   d) One or more of p and q change when the vertex of a parabola changes, depending on how the vertex is moved. The value of a may change when the location of the vertex changes.

10. **a)** Example: If θ = 30°, then $d = -0.88v^2$. This graph has its vertex at the origin and is vertically stretched compared to the graph of $y = x^2$, but opens downward.
    b) Answers may vary.
    c) Example: All the parabolas will have vertices at the origin. The vertical stretch factor will change depending on the angles. The domain and range will be the same for all graphs.

11. **a)** $3700
    b)



    c) Example: As prices initially rise more revenue will result, but with each price increase fewer people will buy a shirt. So, eventually prices can be so high that total revenue will decrease.

d) The vertex (9, 4510) is the maximum point on the graph. So, when $x = 9$ the price of each T-shirt is \$21 and the maximum revenue is \$4510.

3.2 Investigating Quadratic Functions in Standard From, pages 123–132

1. **a)** quadratic: $f(x) = -5x^2 - 20x - 12$

b) not quadratic

c) quadratic: $f(x) = 8x^2 - 29x - 55$

d) not quadratic

2. **a)** vertex (1, 4), axis of symmetry $x = 1$, y-intercept 3, x-intercepts −1 and 3, maximum value 4, domain $\{x \mid x \in R\}$, range $\{y \mid y \leq 4, y \in R\}$

b) vertex (−3, 0), axis of symmetry $x = -3$, y-intercept 9, x-intercept −3, minimum value 0, domain $\{x \mid x \in R\}$, range $\{y \mid y \geq 0, y \in R\}$

c) vertex (−2, 2), axis of symmetry $x = -2$, y-intercept −6, x-intercepts −3 and −1, maximum value 2, domain $\{x \mid x \in R\}$, range $\{y \mid y \leq 2, y \in R\}$

3. **a)** vertex (2.5, −7.3), axis of symmetry $x = 2.5$, minimum value −7.3, domain $\{x \mid x \in R\}$, range $\{y \mid y \geq -7.25, y \in R\}$, x-intercepts −0.2 and 5.2, y-intercept −1

b) vertex (0.3, 3.1), axis of symmetry $x = 0.3$, maximum value 3.1, domain $\{x \mid x \in R\}$, range is $\{y \mid y \leq 3.1, y \in R\}$, x-intercepts 1.5 and −1, y-intercept 3

c) vertex (11, −3), axis of symmetry $x = 11$, minimum value −3, domain $\{x \mid x \in R\}$, range $\{y \mid y \geq -3, y \in R\}$, x-intercepts 7.5 and 14.5, y-intercept 27.3

4. **a)** (2, 16) **b)** (−1, −4)

c) (4, 41) **d)** $\left(\frac{3}{2}, -\frac{19}{2}\right)$

5. **a)** two x-intercepts **b)** two x-intercepts

c) one x-intercept **d)** two x-intercepts

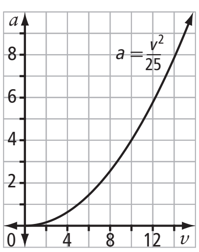
e) no x-intercepts **f)** no x-intercepts

6. **a)** 0 m **b)** 5 m after 1 s **c)** 2 s

d) domain $\{t \mid 0 \leq t \leq 2, t \in R\}$, range $\{h \mid 0 \leq h \leq 5, h \in R\}$

7. **a)** $a = \frac{v^2}{25}$

b) vertex (0, 0), axis of symmetry $x = 0$, x- and y-intercept of 0

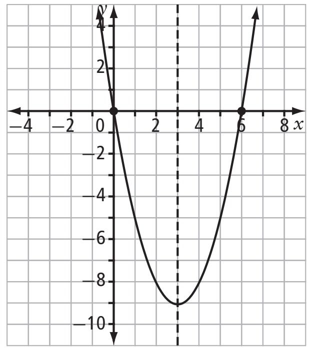


c) domain $\{v \mid v \geq 0, v \in R\}$; since speed is positive

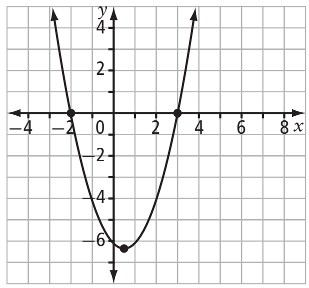
d) range $\{a \mid a \geq 0, a \in R\}$; since the graph opens up

e) The curve does not fit the criteria. Example: When $v = 14$, $a = 7.84$ m/s^2 which is not 6 m/s^2.

8. **a)** Yes, it is possible to have more than one correct answer. Example:

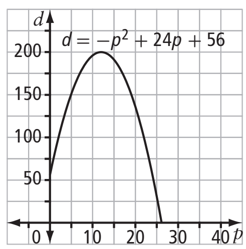


b)



9. **a)** (12, 200)

b)

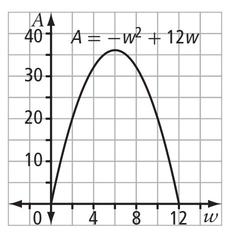


c) The vertex indicates that maximum demand is 200 at a price of \$12.

d) Demand initially increases as price increases, but when price exceeds \$12 demand decreases.

10. **a)** $A = w(12 - w)$

b)



c) (6, 36); represents the maximum area of the dog enclosure

d) 6 m by 6 m; maximum area of 36 m^2

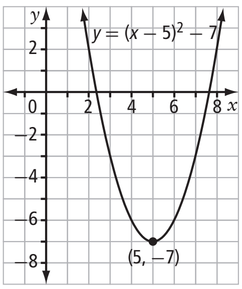
11. **a)** Knowing the location of the vertex and direction of opening allows you to visualize the parabola and its number of x-intercepts.

b) Knowing the axis of symmetry and direction of opening is not enough to know the number of x-intercepts because the vertex may be above, on, or below the x-axis and so may have two, one, or no x-intercepts. Examples may vary.

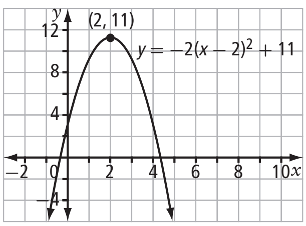
12. $y = \frac{4ac - b^2}{4a}$. Explanations may vary.

3.3 Completing the Square, pages 137–141

1. a) $y = (x + 1)^2 + 2$; vertex $(-1, 2)$
   b) $y = (x + 6)^2 - 16$; vertex $(-6, -16)$
   c) $y = -(x - 4)^2 + 9$; vertex $(4, 9)$
   d) $y = -(x + 5)^2 - 6$; vertex $(-5, -6)$
2. a) $y = 2(x + 2)^2 - 7$; vertex $(-2, -7)$
   b) $y = 5(x - 6)^2 - 14$; vertex $(6, -14)$
   c) $y = -4(x - 3)^2 + 15$; vertex $(3, 15)$
   d) $y = -7(x + 3)^2 + 66$; vertex $(-3, 66)$
3. a) $y = (x - 5)^2 - 7$



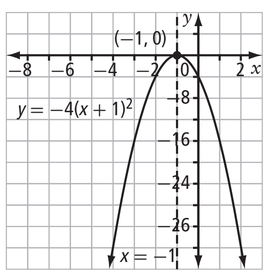
   b) $y = -2(x - 2)^2 + 11$



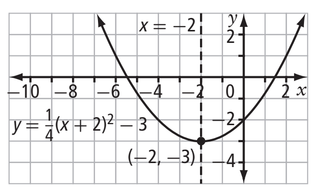
4. a) not quadratic
   b) quadratic; $y = -2x^2 + 4x + 28$ with vertex $(1, 30)$
   c) quadratic; $y = 2x^2 - 19x + 41$ with vertex $\left(\frac{19}{4}, -\frac{33}{8}\right)$
   d) not quadratic
5. a) Expanding $y = (x + 1)^2 - 36$ leads to the function $y = x^2 + 2x - 35$. Completing the square on $y = x^2 + 2x - 35$ results in $y = (x + 1)^2 - 36$. Also, the graphs of the two functions appear identical.
   b) Expanding $y = -2(x - 4)^2 + 3$ leads to the function $y = -2x^2 + 16x - 29$. Completing the square on $y = -2x^2 + 16x - 29$ results in $y = -2(x - 4)^2 + 3$. Also, the graphs of the two functions appear identical.
   c) Expanding $y = \frac{1}{2}(x - 5)^2 - 4$ leads to the function $y = \frac{1}{2}x^2 - 5x + \frac{17}{2}$. Completing the square on $y = \frac{1}{2}x^2 - 5x + \frac{17}{2}$ results in $y = \frac{1}{2}(x - 5)^2 - 4$. Also, the graphs of the two functions appear identical.
6. a) minimum of −6.33 at $x = 0.67$
   b) minimum of −2 at $x = 6$
   c) maximum of 7 at $x = 4$
   d) minimum of 0.99 at $x = 0.06$
7. 80 components
8. a) The maximum height is 22 m after 2 s.
   b) Answers may vary.
   c) The maximum height is 22.39 m. Answers may vary.
9. a) $r = (12 + x)(500 - 25x)$, where x is the number of $1 price increases and r is the sales revenue
   b) $r = -25(x - 4)^2 + 6400$
   c) The vertex represents the number of $1 price increases that yields the maximum revenue.
   d) There should be 4 increases of $1, so the price of the product should be $16 to obtain a maximum revenue of $6400.
10. a) $2l + 10w = 100$
   b) Answers may vary. Example: $l = -5w + 50$
   c) $A = w(-5w + 50)$ d) $(5, 125)$
   e) The length should be 25 m and each width should be 5 m.

Chapter 3 Review, pages 142–144

1. a) two x-intercepts, $x = -5$, domain $\{x \mid x \in R\}$, range $\{y \mid y \leq 6, y \in R\}$
   b) one x-intercept, $x = 8$, domain $\{x \mid x \in R\}$, range $\{y \mid y \geq 0, y \in R\}$
2. a) $(3, -7)$; maximum value is −7
   b) $(-11, 8)$; minimum value is 8
3. a)



   b)



4. a) $y = -\frac{5}{16}x^2$ b) $y = -\frac{5}{16}(x - 4)^2 + 5$

c) Answers may vary. Example: The value of a is the same but the values of p and q change.

5. a) (−4, 0), (2, 0), (0, −8)

b) (−9, 0), (−1, 0), (0, 9)

6. a) $-\frac{3}{2}$ b) $-\frac{5}{6}$

7. a) $x = -5$, opens downward

b) $x = \frac{2}{3}$, opens upward

8. a) $y = (x + 3)^2 + 6$, domain $\{x \mid x \in \mathrm{R}\}$, range $\{y \mid y \geq 6, y \in \mathrm{R}\}$

b) $y = -3(x + 6)^2 + 8$, domain $\{x \mid x \in \mathrm{R}\}$, range $\{y \mid y \leq 8, y \in \mathrm{R}\}$

c) $y = 2(x - 4)^2 - 10$, domain $\{x \mid x \in \mathrm{R}\}$, range $\{y \mid y \geq -10, y \in \mathrm{R}\}$

d) $y = \frac{1}{2}(x - 1)^2 + \frac{5}{2}$, domain $\{x \mid x \in \mathrm{R}\}$, range $\left\{y \mid y \geq \frac{5}{2}, y \in \mathrm{R}\right\}$

9. a) (10, 105)

b) The maximum profit of \$105 occurs on the 10th day of sales.

10. a) $r = (10 + v)(120 - 5v)$

b) The maximum revenue of \$1445 occurs at a price of \$17.

Chapter 4

4.1 Graphical Solutions of Quadratic Equations, pages 151–155

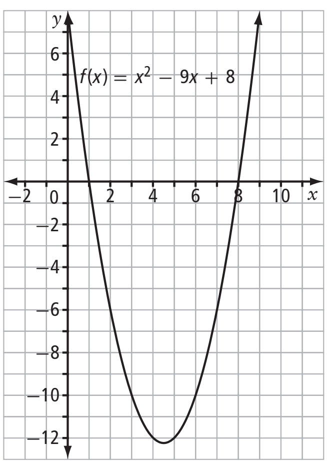
1. a) 2, because there are two x-intercepts; $x = -2, 2$

b) 0, because there are no x-intercepts; no root

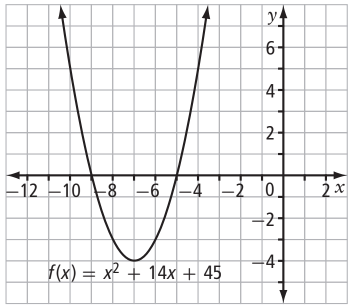
c) 2, because there are two x-intercepts; $x = 0, 3$

d) 1, because there is one x-intercept; $x = -5$

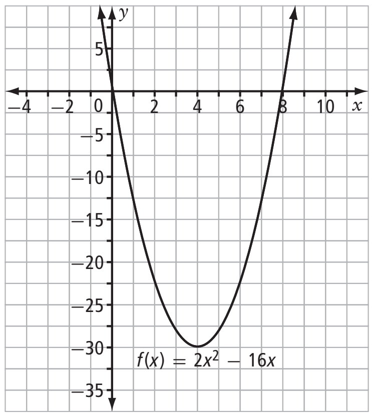
2. a) $x = 1, 8$



b) $x = -9, -5$



c) $x = 0, 8$

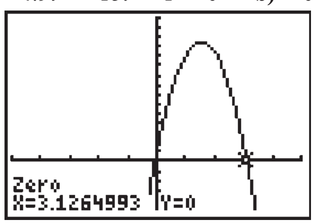


3. a) −3, 3.33 b) −2.67, 0.75

c) 1.5, 2.67 d) −3, −2.75

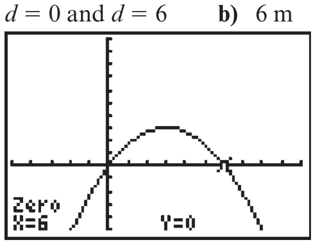
4. 4 and 8

5. a) $-4.9t^2 + 15t + 1 = 0$ b) −0.1, 3.1

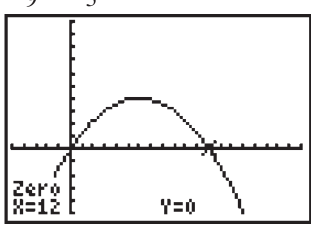


c) A negative number to represent time does not make sense in this problem.

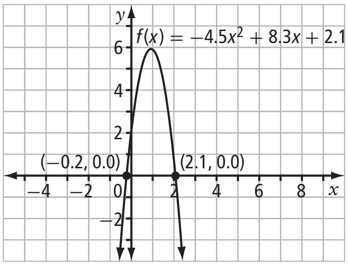
6. a) $d = 0$ and $d = 6$ b) 6 m



7. a) $-\frac{w^2}{9} + \frac{4w}{3} = 0$ b) 12.0 m



8. a) $-4.5t^2 + 8.3t + 2.1 = 0$ b) 2.1 s



9. Examples:
   a) The value of a is the same in both cases.
   b) The form $y = a(x - p)^2 + q$ is more useful for finding the vertex.

10. Examples:
   a) $y = (x - 7)^2$
   b) The vertex is on the x-axis, so $x = 7$ is the only root.

4.2 Factoring Quadratic Equations, pages 160–164

1. a) $(x - 6)(x - 3)$ b) $5(b - 3)(b + 2)$
2. a) $(n - 4)(3n + 1)$ b) $(x + 2)(4x + 3)$ c) $(t - 6)(2t - 5)$ d) $(3x + 2)(4x - 3)$
3. a) $\frac{1}{2}(x - 6)(x + 2)$ b) $\frac{1}{4}(x - 4)(x + 6)$ c) $0.1(a - 6)(a + 5)$ d) $0.1(z - 10)(5z - 4)$
4. a) $(0.9x + 0.5y)(0.9x - 0.5y)$
   b) $(1.1k - 0.1x)(1.1k + 0.1x)$
   c) $\left(\frac{1}{5}d - \frac{1}{7}f\right)\left(\frac{1}{5}d + \frac{1}{7}f\right)$
   d) $2(2a - 3b)(2a + 3b)$
5. a) $(x + 6)(x - 2)$ b) $4(x + 4)(x + 3)$ c) $(x + 6)(2x - 1)$ d) $(10x - 7)(10x - 3)$
6. a) $-9, 5$ b) $-\frac{9}{2}, 4$ c) $-\frac{3}{4}, \frac{11}{2}$ d) $0, \frac{14}{3}$
7. a) 4, 5 b) −6 c) $-6, \frac{7}{3}$ d) $\frac{3}{4}, \frac{3}{2}$ e) 0, −6 f) −9, −6
8. a) $w(w + 3) = 154$ b) 11 in. by 14 in.
9. a) $x + 1$ b) $x(x + 1) = 156$ c) 12 and 13, or −13 and −12
10. a) $-0.1d^2 + 4.8d = 0$ b) 48 m
11. a) 140 m^2
   b) $(2x + 8)(2x + 12) = 140$; 1 m
12. If $c = 0$, then one of the factors equals zero. Example: $x^2 - 3x = 0$ factors to $x(x - 3)$, and the factors are 0 and 3.
13. Example: Graph the corresponding function and determine the x-intercepts.

4.3 Solving Quadratic Equations by Completing the Square, pages 168–171

1. a) 36 b) $\frac{9}{4}$ c) $\frac{1}{64}$ d) 0.16
2. a) −1, 9 b) −9, 3 c) $-2\sqrt{5} - 5, 2\sqrt{5} - 5$ d) $-2\sqrt{10} + 1, 2\sqrt{10} + 1$ e) $-\sqrt{6} - \frac{3}{2}, \sqrt{6} - \frac{3}{2}$
3. a) −1, 5 b) −12, 2 c) $-\frac{5}{3}, \frac{1}{3}$ d) $\frac{1}{5}, \frac{13}{5}$
4. a) −5, 11 b) $-\sqrt{10} + 2, \sqrt{10} + 2$ c) $-2\sqrt{2} + 5, 2\sqrt{2} + 5$ d) $-3\sqrt{2} - 2, 3\sqrt{2} - 2$
5. a) $A = \pi(x + 5)^2$ b) 1.9 m
6. a) The room is a rectangle with sides $8 + x$ and $6 + x$.
   b) $(6 + x)(8 + x) = 144$ c) 11.0 ft by 13.0 ft
7. line 2 should be $x^2 - x + \frac{1}{4} = 5 + \frac{1}{4}$; $\frac{-\sqrt{21} + 1}{2}, \frac{\sqrt{21} + 1}{2}$
8. 8, 15, 17
9. 100 yd
10. Example: $x^2 + 4x = -10$; Any equation that requires the square root of a negative number cannot be solved.
11. Example: It depends on whether the zeros of the quadratic function or the vertex of the graph are required.

4.4 The Quadratic Formula, pages 177–180

1. a) 1 root b) 2 roots c) 0 roots d) 1 root
2. a) $\frac{3 - \sqrt{3}}{3}, \frac{\sqrt{3} + 3}{3}$ b) $-\frac{2}{3}, \frac{1}{2}$ c) $\frac{2 + \sqrt{2}}{3}, \frac{2 - \sqrt{2}}{3}$ d) $\frac{5 + \sqrt{57}}{8}, \frac{5 - \sqrt{57}}{8}$
3 a) −0.6, 1.6 b) 0.2, 2.2 c) −1.5, 10 d) −1.5, 3.5
4. 0 or 6
5. 3, 12
6. 5 cm
7. a) 4.34 s b) 4.30 s
   c) In both cases, one root is negative, which does not make sense in this context.
8. 69.28 m
9. a) row 1: 125; 5 row 2: 100; 2
   row 3: (100)(125); $(125 + 5n)(100 - 2n)$
   b) $(125 + 5n)$ represents the cost of a calculator for any number of price increases of $5.
   $(100 - 2n)$ represents the fact that for each price increase, the store sells two fewer calculators.
   The revenue is the price multiplied by the number sold, so $r(n) = (125 + 5n)(100 - 2n)$.
   c) Set the revenue equation equal to 14 000 and solve for n. Since $n = 10$ and $n = 15$, there can be 10 to 15 price increases, resulting in a price range of $175 to $200.

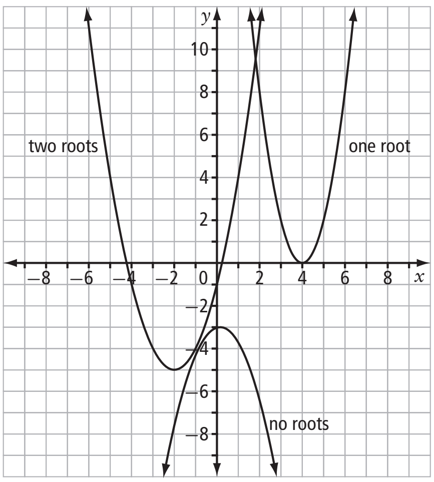
Chapter 4 Review, pages 181–186

1. **a)** –1, 5 **b)** 3

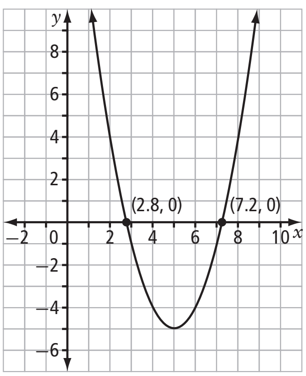
2. **a)** Example: The location of the vertex and the direction of opening determine the number of zeros for the quadratic function. In this case, the graph would intersect the *x*-axis in two places.

b) Example: The location of the vertex is on the *x*-axis.

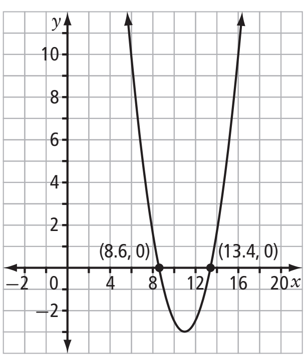
c) Example: The minimum is above the *x*-axis, or the maximum is below the *x*-axis, meaning that the graph does not intersect the *x*-axis.



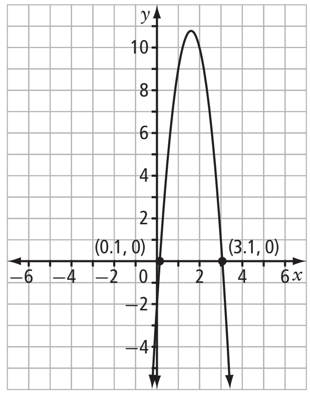
3. **a)** 2.8, 7.2



b) 8.6, 13.4



c) 0.1, 3.1



4. **a)** $(a - 7b + 68)(a + 7b - 58)$

b) $(x + 3)(x - 5)$ **c)** $\left(\frac{3m}{4} + \frac{10n}{9}\right)\left(\frac{3m}{4} - \frac{10n}{9}\right)$

5. **a)** −4, −2 **b)** $\frac{2}{3}$, 1

c) $\frac{3}{2}, \frac{9}{2}$ **d)** $-\frac{3}{2}, \frac{3}{2}$

6. 9 in. by 12 in.

7. **a)** ± 13 **b)** −18, 4

c) $-4\sqrt{5} + 12, 4\sqrt{5} + 12$ **d)** −5, 3

8. **a)** $-\sqrt{23} - 4, \sqrt{23} - 4$; −8.8, 0.8

b) $-3\sqrt{2} + 5, 3\sqrt{2} + 5$; 0.8, 9.2

9. 30th day

10. **a)** 2 roots **b)** 2 roots

c) 1 root **d)** 0 roots

11. **a)** $5 - \sqrt{15}, 5 + \sqrt{15}$; 1.1, 8.9

b) $\frac{-1 + \sqrt{41}}{5}, \frac{-1 - \sqrt{41}}{5}$; −1.5, 1.1

12. **a)** −7, 3 **b)** $-\frac{2}{5}$, 3

c) $\frac{-9 + \sqrt{57}}{4}, \frac{-9 - \sqrt{57}}{4}$

Chapter 5

5.1 Working With Radicals, pages 193–198

1.

Mixed Radical	$5\sqrt{5}$		$3\sqrt{7}$		$-2\sqrt[3]{7}$	
Entire Radical		$\sqrt{252}$		$-\sqrt{375}$		$\sqrt[4]{486}$

2. **a)** $b\sqrt[3]{by}$ **b)** $\sqrt{4a}, a \geq 0$

c) $-2x\sqrt[3]{6y}$ **d)** $2a\sqrt[4]{2a}, a \geq 0$

e) $\sqrt{98y2z}, y \geq 0, z \geq 0$ **f)** $-\sqrt{45m^5}, m \geq 0$

3. $\sqrt{63} = 3\sqrt{7}$, so $\sqrt{63}$ and $\sqrt{7}$, are like radicals;

$-\sqrt{27} = -3\sqrt{3}$ and $3\sqrt{75} = 15\sqrt{3}$, so $-\sqrt{27}$ and $3\sqrt{75}$ are like radicals;

$\sqrt[3]{250} = 5\sqrt[3]{2}$ and $4\sqrt[3]{16} = 8\sqrt[3]{2}$, so $\sqrt[3]{250}$ and $4\sqrt[3]{16}$ are like radicals

4. a) Example: $-5\sqrt{7}$ b) Example: $5\sqrt[3]{2}$
c) Example: $10\sqrt{2m}$ d) Example: $8a\sqrt[4]{2a}$
e) Example: $5x\sqrt{2}$ f) Example: $-4y\sqrt{5xy}$

5. a) $-\sqrt{60}, -8, -2\sqrt{17}, -5\sqrt{3}$
b) $18, \frac{3}{10}\sqrt{3500}, 9\sqrt{\frac{15}{4}}, \sqrt{300}$
c) $3\sqrt[4]{8}, 5, \sqrt[4]{615}, 4\sqrt[4]{\frac{9}{4}}$

6. a) $8\sqrt{7}$ b) $15\sqrt{7} - 17\sqrt{2}$
c) $\sqrt[3]{9} + 2$ d) 0

7. a) $13\sqrt{m}, m \geq 0$ b) $-x\sqrt{3x}, x \geq 0$
c) $-3ab\sqrt{2b}, b \geq 0$ d) $2y\sqrt{y}, y \geq 0$

8. 3 in.

9. 5 s

10. $8\sqrt{2}$ ft

11. $4\sqrt{2}$ ft

12. $20\sqrt{42}$ ft

13. The error made was that the unlike radicals were added. You must simplify and then add. The answer should be $6\sqrt{b}$.

14. $25\sqrt{5} - 3\sqrt{3}$

15. The two legs of the triangle are $\frac{s}{\sqrt{2}}$.
$$A = \frac{1}{2}ab$$
$$= \frac{1}{2}\left(\frac{s}{\sqrt{2}}\right)\left(\frac{s}{\sqrt{2}}\right)$$
$$= \frac{s^2}{4}$$

5.2 Multiplying and Dividing Radical Expressions, pages 203–209

1. a) $30\sqrt{6}$ b) $12a^2\sqrt{6}$
c) $-70x^2$ d) $(3y^2)\sqrt[3]{y}$

2. a) $2\sqrt{30} + 4\sqrt{5}$ b) $-5\sqrt{30} + 3\sqrt{2}$
c) $6\sqrt{35x} - 2x\sqrt{7}$ d) $5\sqrt{21a} - 7a\sqrt{3} + 6\sqrt{7a}$

3. a) $-22 + 13\sqrt{3}$ b) $58 + 12\sqrt{6}$
c) 4 d) $3\sqrt{21} - 2\sqrt{7} - 12\sqrt{3} - 1$

4. a) $-9k + 19\sqrt{3k} - 20, k \geq 0$
b) $2 - 6\sqrt{10m} + 45m, m \geq 0$
c) $-40x + 5x\sqrt{10} - 4\sqrt{10x} + 5\sqrt{x}, x \geq 0$
d) $16y + 40y\sqrt[3]{4y^2} - y\sqrt[3]{2y} - 5y^2$, any real number

5. a) 3 b) -20 c) $\frac{3\sqrt{7}}{4}$
d) $\frac{-3\sqrt{6}}{16}$ e) $\frac{\sqrt{6}}{2y}$ f) $\frac{3\sqrt{2a} - 3a\sqrt{6}}{16a}$

6. row 1: $4 - \sqrt{5}$, 11; row 2: $-5 + 3\sqrt{3}$, -2;
row 3: $7\sqrt{5} - 4\sqrt{2}$, 213; row 4: $2\sqrt{z} + \sqrt{3}$, $4z - 3$

7. a) $\frac{-(4\sqrt{2} + 28)}{47}$ b) $\frac{-(3\sqrt{30} - 12\sqrt{5})}{10}$
c) $-\frac{4\sqrt{5} + 8\sqrt{2} + 10\sqrt{10} + 25}{109}$ d) $\frac{36 + 9\sqrt{x}}{16 - x}$

8. $60\sqrt{10}$

9. $32\pi\sqrt{13}$

10. a) $10\sqrt{2}$ cm^2 b) 242 cm^2 c) $12\sqrt{6}$ cm^2

11. Tineka did not apply the distributive rule properly when expanding the squared binomial. The proper solution is $23 - 6\sqrt{10}$.

12. $(2 - \sqrt{7})^2, (\sqrt{7} + 2)(\sqrt{7} - 2), \sqrt{7}(\sqrt{7} + 2), (\sqrt{7} + 2)^2$

13. 2.26 m

14. Anthony made an error when multiplying the numerator. The product should be $4\sqrt{m} + m - 12$. Also, the denominator should be $36 - m$. The correct solution is $\frac{4\sqrt{m} + m - 12}{36 - m}, m \geq 0, m \neq 36$.

15. i) All possible factors have been removed from each radical.
ii) The radical contains no fractions.
iii) The denominator is a rational number.

16. False. The radicand of a radical with an even index must be positive. Therefore, $\sqrt{-8}$ and $\sqrt{-2}$ are not real numbers.

5.3 Radical Equations, pages 216–222

1. a) $16x^2 - 40x + 25$ b) $7y$ c) $2x - 3$
d) $324m$ e) $9n - 48\sqrt{n} + 64$

2. $x = 2$ is correct, $x = 6$ is extraneous

3. a) $x = 83, x \geq 2$ b) $m = 1000, m \geq 0$
c) $a = 6, a \geq 1$
d) $p = 1, p \leq 2$; $p = -2$ is an extraneous root
e) $n = 5$; $n \geq \frac{-19}{6}$; $n = -3$ is an extraneous root
f) $c = 10$ and $c = 9$, $c \geq \frac{54}{7}$

4. a) $x = 0$ b) $x = -3 + 3\sqrt{3}$ c) $x = 16, x \geq 7$

5. a) $n = 1$ b) $x = 20$ c) $y = 3, -1$ d) $c = 2$

6. The term $(m - 4)$ was squared incorrectly. The correct squaring is $m^2 - 8m + 16$. You can factor this equation, resulting in roots of $m = 3$ and $m = 2$, both of which are extraneous.

7. a) 19.44 m/s b) 70 km/h

8. 39.06 ft

9. 1.528 m

10. 8 cm

11. a) $(a - b)^2 = (a - b)(a - b)$
$= a^2 - 2ab + b^2$
Therefore, $(a - b)^2 \neq a^2 - b^2$.
b) Example: Let $a = 10$ and $b = 6$
Left side = 16; Right side = 64
The left side is not equal to the right side.
c) If $a = b$, then $(a - b)^2 = a^2 - b^2$.

12. $\sqrt{4n + 8} - 3 = n$

$\sqrt{4n + 8} = n + 3$ Isolate the radical.

$(\sqrt{4n + 8})^2 = (n + 3)^2$ Square both sides.

$4n + 8 = n^2 + 6n + 9$

$0 = n^2 + 2n + 1$

$0 = (n + 1)(n + 1)$ Factor.

$n + 1 = 0$ Use the zero property.

$n = -1$

Verify by substitution.

Left Side	Right Side
$\sqrt{4(-1) + 8} - 3$	-1
$= \sqrt{4} - 3$	
$= 2 - 3$	
$= -1$	

The left side equals the right side, therefore $n = -1$ is the solution.

13. **a)** $\sqrt{2a + 9} - \sqrt{a - 4} = 0$

$\sqrt{2a + 9} = \sqrt{a - 4}$

$(\sqrt{2a + 9})^2 = (\sqrt{a - 4})^2$

$2a + 9 = a - 4$

$a = -13$

Substituting into the original yields $\sqrt{-17}$, which is non-real.

b) Example: $\sqrt{x - 7} - \sqrt{5x + 1} = 0$

Chapter 5 Review, pages 223–227

1. **a)** $12\sqrt{2}$ **b)** $8c\sqrt{2}$
c) $2a^2b\sqrt{6b}$, $b \geq 0$ **d)** $5xy\sqrt[3]{2y^2}$

2. **a)** $\sqrt{96}$ **b)** $-\sqrt{175m^2}$
c) $-\sqrt[3]{54y^5}$ **d)** $-\sqrt[4]{96x^5y^3}$

3. **a)** $-\sqrt{6}$ **b)** $-3\sqrt{5}$
c) $-9\sqrt{2} + 6\sqrt{2x} - 4x\sqrt{2x}$, $x \geq 0$
d) 0, x is any real number, y is any real number

4. $4\sqrt{15}$, $\sqrt{250}$, 16, $3\sqrt{30}$

5. $4\sqrt{197}$ ft

6. **a)** $2\sqrt{21}$ **b)** $6x^3$
c) $-200y\sqrt{10}$ **d)** $-21 + 3\sqrt{3}$
e) $2 - 6\sqrt{10r} + 45r$, $r \geq 0$ **f)** $9 - 2x$, $x \geq 0$

7. **a)** $\frac{4\sqrt{5}}{5}$ **b)** $\frac{-\sqrt{6}}{24}$ **c)** $-\frac{(3\sqrt{5} - 12)}{11}$
d) $\frac{-(3\sqrt{2} - 6\sqrt{5} + 4\sqrt{6} - 8\sqrt{15})}{18}$
e) $\frac{\sqrt{10}}{2y}$, $x > 0$, $y > 0$
f) $\frac{3n^2\sqrt{10n} + n\sqrt{20n}}{10n}$, $n > 0$

8. **a)** $\sqrt{3k} + 5$ **b)** $-3\sqrt{2} + 4\sqrt{7}$

9. **a)** $16\sqrt{3} + 4\sqrt{30}$ cm **b)** 72 cm^2

10. **a)** 6, $a \geq 0$ **b)** 48, $n \geq 44$
c) 6, $b \leq 6$ **d)** 5, $x \geq 4$

11. 9 cm and 18 cm

12. 144 squares

Chapter 6

6.1 Rational Expressions, pages 234–240

1. **a)** $x \neq -4$ **b)** $x \neq \frac{1}{2}$ **c)** $x \neq 0, 1$
d) $x \neq -2, \frac{2}{3}$ **e)** $x \neq -3, 0$ **f)** $x \neq -7, 3$
g) $x \neq 0, \frac{1}{2}$ **h)** $x \neq \pm 10$

2. **a)** $2x$, $x \neq -1$ **b)** $3x$, $x \neq 0, \frac{3}{2}$
c) $\frac{x - 7}{x + 7}$, $x \neq -7, -4$ **d)** $\frac{2x + 7}{x}$, $x \neq -6, 0$

3. **a)** $\frac{2x^2y}{3}$, $y \neq 0$ **b)** $\frac{r}{2h}$, $r \neq 0$, $h \neq 0$
c) $\frac{2x + 14}{x + 1}$, $x \neq -1, 0$
d) $\frac{a - b^2}{5 + 25a}$, $a \neq 0, -\frac{1}{5}$; $b \neq 0$

4. **a)** $\frac{x + 5}{x + 10}$, $x \neq -10, 5$ **b)** $\frac{x - 1}{x}$, $x \neq -6, 0$
c) $\frac{x + 5}{2}$, $x \neq 7$ **d)** $2x + 4$, $x \neq -1$
e) $\frac{a + 1}{a + 7}$, $a \neq -7, 2$ **f)** $\frac{z + 6}{z - 6}$, $z \neq -3, 6$
g) $\frac{2x + 1}{x + 1}$, $x \neq -1, 6$ **h)** $\frac{3x + 1}{3x - 6}$, $x \neq 2, 3$

5. **a)** $1 - x$; -1 **b)** $x - 2$; -1
c) $b - 2a$; -1 **d)** $5x + 2$; -1

6. **a)** $\frac{-3a}{7 + a}$, $a \neq \pm 7$ **b)** $\frac{-x - 9}{2x}$, $x \neq 0, 9$
c) $\frac{4x}{x - 3}$, $x \neq 3$ **d)** $\frac{-a}{2b + a}$, $a \neq \pm 2b$

7. **a)** $\frac{6x^2 - 24x + 16}{x^3 - 4x^2 + 8x}$, $x \neq 0, 2, 4$
b) $x > 4$; all sides have positive lengths

8. $\frac{2r + 2h}{rh}$, $r, h \neq 0$

9. **a)** No; the numerator is not a polynomial
b) $a \neq 0$; otherwise $y = ax^2 + bx + c$ becomes $y = bx + c$, which is a linear relation, not a quadratic relation

10. **a)** $x \neq 1, 3$
b) Example: any answer in which the denominator is $x^2 - 5x + 6$
c) $x - 8$, $x \neq -3$ **d)** Example: $\frac{x^2 - 7x - 8}{x + 1}$

11. no; cannot cancel terms

6.2 Multiplying and Dividing Rational Expressions, pages 245–251

1. **a)** $x \neq 2, 4$ **b)** $r \neq -h, 0$
c) $x \neq \pm 1, -\frac{2}{3}$ **d)** $y \neq -1, -6, -10$

2. a) $\frac{7x}{3}$ b) $\frac{x + 4}{2x - 7}$
c) $\frac{6x - 3}{x^2 + 2x + 1}$ d) $\frac{1}{49 - x^2}$
3. a) $l \neq 0, w \neq 0, 2$ b) $x \neq \pm 2, \frac{3}{2}, -5$
4. a) $\frac{x^2y}{2}, x, y \neq 0$ b) $\frac{x}{2}; x \neq 0, 3$
c) $\frac{x + 6}{x + 2}, x \neq -2, 6$ d) $\frac{x^2 + 4x + 3}{x - 4}, x \neq 2, 4$
e) $2x + 1, x \neq -3, 4$ f) $\frac{x}{x + 5}, x \neq \pm 10, -5, 4$
5. a) $\frac{1}{2}, x \neq \frac{5}{4}, -2$ b) $ab^2, a, b \neq 0, c \neq 1$
c) $\frac{x + 6}{3x - 24}, x \neq -2, 7, 8$
d) $\frac{x^2 - x - 30}{x^2 + 3x + 2}, x \neq -5, -3, -2, -1$
6. a) $\frac{x + 8}{x}, x \neq -8, 0, 4$ b) $\frac{-x + 8}{x - 1}, x \neq \pm 3, 1, 9$
c) $\frac{x + 4}{22 - 2x}, x \neq -4, 0, \pm 11$
d) $\frac{x^2 - x - 30}{x^2 + 3x + 2}, x \neq -5, 8, 12$
7. a) $\frac{2}{x - 5}, x \neq -6, \pm 5, 4$
b) $\frac{x^2 + 11x + 10}{x^2}, x \neq -10, -1, -\frac{1}{2}, 0, 3$
c) $\frac{-3x^2 - 8x + 3}{50x + 450}, x \neq -9, \frac{1}{3}, 1, 3, 8$
8. did not cancel a factor of the first numerator (step 1); did not use the distributive law correctly (step 3); $\frac{x + 2}{4}, x \neq -1, -2$
9. multiplied instead of divided (step 2) *or* did not take the reciprocal of the second rational expression (missed a step); missing the non-permissible values from the numerator of the second expression (step 3); $\frac{x^2 - 8x + 16}{x^2 + 9x + 18}, x \neq -6, -3, 4$
10. approximately 0.52 or 52%
11. $\frac{2x^2 - 13x + 21}{x - 5}; x \neq -6, 5$; explanations will vary.

6.3 Adding and Subtracting Rational Expressions, pages 256–262

1. a) $\frac{10x - 3}{4x}, x \neq 0$ b) $\frac{x^2 + 2x + 2}{x - 8}, x \neq 8$
2. a) $\frac{3x - 9}{x^2}, x \neq 0$ b) $\frac{x^2 + 2x + 1}{x^2 - 25}, x \neq \pm 5$
c) $x - 1, x \neq -9$ d) $-x - 6, x \neq 6$
3. a) $5xy$ b) $3x^2$
c) $x(x + 1)$ d) $(x - 7)(x + 5)$
e) $(x + 2)(x + 6)(x - 2)$
f) $-1(x - 5)(x - 5)$
4. a) $\frac{y + 6}{6xy}, x, y \neq 0$ b) $\frac{x - 7}{7x^2}, x \neq 0$
c) $\frac{x + 1}{x(x - 3)}, x \neq 0, 3$
d) $\frac{x - 9}{(x + 7)(x - 8)}, x \neq -7, 8$
e) $\frac{2x - 1}{(x + 2)(x + 4)(x - 3)}, x \neq -4, -2, 3$
f) $\frac{x - 3}{-1(x - 4)(x + 4)}, x \neq 4$
5. a) $\frac{a^2 + 7a + 14}{(a + 7)(a + 5)}, a \neq -7, -5$
b) $\frac{x + 6}{x + 1}, x \neq -1, 4$
6. a) $\frac{x - 18}{(x - 9)(x - 12)}, x \neq 9, 12$
b) $\frac{x + 1}{(x + 6)(x + 2)}, x \neq -6, \pm 2$
7. a) $\frac{5}{n}, n > 0$ b) $\frac{5}{n - 1}, n > 1$
c) $\frac{10n - 5}{n^2 - n}, n > 1$
8. a) $\frac{480}{y}, y > 0$ b) $\frac{120}{y - 5}, y > 5$
c) $\frac{600y - 2400}{y^2 - 5y}, y > 5$
9. a) $\frac{x^2 + 3x - 14}{x - 2,} x \neq -7, 1, 2$
b) $\frac{x^2 + 4x + 9}{2x^2 + 3}, x \neq -10, -\frac{3}{2}, 0, 6, 7$
10. Answers will vary.

6.4 Solving Rational Equations, pages 268–273

1. a) $7 + 3 = 4x(5x - 3), x \neq 0$
b) $(x + 2)(x + 1) + (x - 8)(2x + 1) = -7, x \neq -2, 8$
c) $2x(21 - 5x) = 2(x) - (x - 3)(x - 2), x \neq 0, 3$
2. a) $x = 3; x \neq 0$ b) $x = 3, x = 4; x \neq \pm 1$
3. a) $x = 9; x \neq 0, 8$ b) $x = 3; x \neq 0, 5$
4. 6 min
5. approximately 41 min
6. 107 km/h
7. 7.3 km/h; 1 h 42 min
8. −22, −21
9. 28, 30
10. Answers will vary.

Chapter 6 Review, pages 274–276

1. a) $\frac{x - 5}{x - 6}, x \neq 5, 6$ b) $\frac{x + 1}{x}, x \neq -4, 0$
2. Yes; by factoring out (−1) from both terms of the numerator, you can then cancel out $(x - 7)$ in the numerator and denominator.
3. $\frac{-2x + 1}{3x + 18}, x \neq -6, 0, 4, 7$
4. $\frac{x^2 + 7x + 12}{5x - 10}, x \neq -3, 2$
5. $4x(x - 6)(x + 6)$
6. a) $\frac{x - 1}{x - 10}, x \neq \pm 10$
b) $\frac{(x + 3)(x + 1)}{x(x + 5)(x - 1)}, x \neq -5, 0, 1$
7. 15.4 min

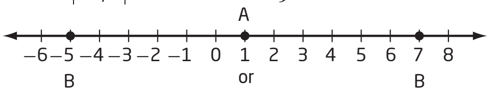
Chapter 7

7.1 Absolute Value, pages 280–284

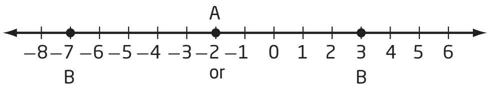
1. **a)** $\frac{5}{6}$ **b)** $1\frac{1}{4}$ **c)** 0.8
d) 12 **e)** 1.2 **f)** 0

2. $2\frac{3}{5}$, $|-2.5|$, $\left|\frac{-15}{7}\right|$, $|-2.09|$, -2, $-2\frac{6}{9}$

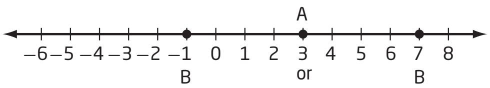
3. **a)**



b)



c)



4. **a)** 0.3 **b)** −8 **c)** 8
d) −1 **e)** 0.09 **f)** 4

5. **a)** $|156 - (-458)|$ or $|-458 - 156|$ **b)** 614 m

6. **a)** $|-39 - 357|$ or $|357 - (-39)|$ **b)** 396

7. **a)** $|-23 - (-27)|$ or $|-27 - (-23)|$
b) $|15 - 35|$ or $|35 - 15|$

8. **a)** $|25.98 - 26.83|$ or $|26.83 - 25.98|$
b) rise of $0.85

9. Differences: use of absolute value symbols; Similarities: both expressions will produce the same result, that is: $(x_1 - x_2)^2 = |x_1 - x_2|^2$

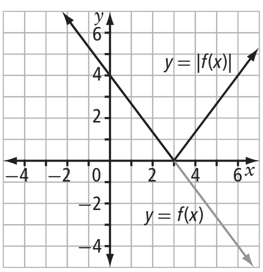
10. Answers will vary.

7.2 Absolute Value Functions, pages 290–296

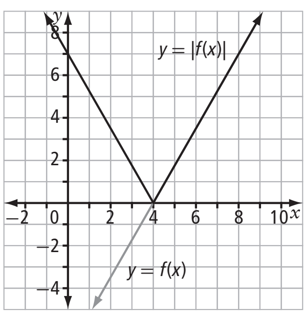
1. **a)** 0, 6, 12, 14 **b)** 7, 4, 1, 2, 5

2. (−1, 10), (0, 6), (1, 2), (2, 2)

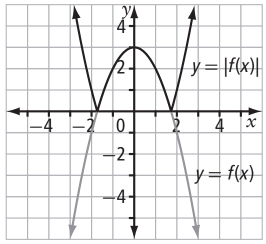
3. **a)**



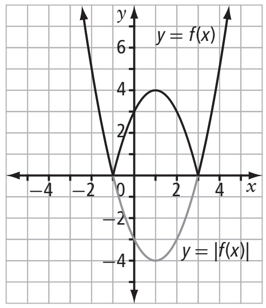
b)



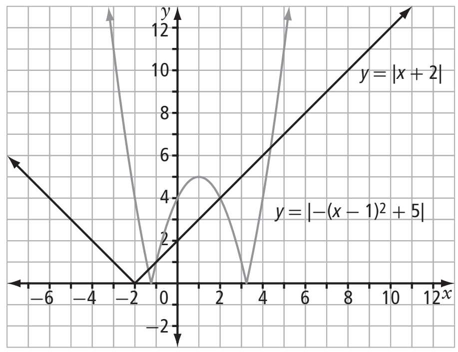
4. **a)**



b)



5. **a), b)**



6. **a)** $y = \begin{cases} x - 5, \text{ if } x \geq 5 \\ -(x - 5), \text{ if } x < 5 \end{cases}$

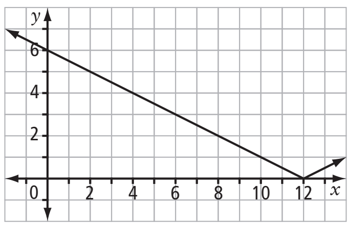
b) $y = \begin{cases} \frac{1}{3}x + 2, \text{ if } x \geq -6 \\ -\left(\frac{1}{3}x + 2\right), \text{ if } x < -6 \end{cases}$

7. **a)** $y = \begin{cases} -x^2 + 2, \text{ if } -\sqrt{2} \leq x \leq \sqrt{2} \\ -(-x^2 + 2), \text{ if } x < -\sqrt{2} \text{ or } x > \sqrt{2} \end{cases}$

b) $y = \begin{cases} 2(x - 1)^2 - 2, \text{ if } 0 \leq x \leq 2 \\ -[2(x - 1)^2 - 2], \text{ if } x < 0 \text{ or } x > 2 \end{cases}$

8. **a)**

x	$y = \left\lvert\frac{1}{2}x - 6\right\rvert$
0	6
12	0
2	5
4	4
18 or 6	3
−2	7
−6	9

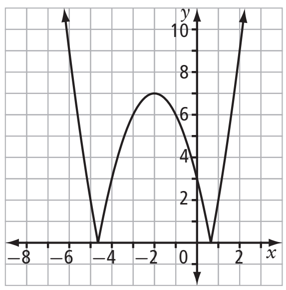
b) 

c) Domain: $\{x \mid x \in R\}$; Range: $\{y \mid y \geq 0, y \in R\}$

d) $y = \begin{cases} \frac{1}{2}x - 6, \text{ if } x \geq 12 \\ -\left(\frac{1}{2}x - 6\right), \text{ if } x < 12 \end{cases}$

9. **a)** $y = |(x + 2)^2 - 7|$

b) $(-2, 7)$, $(-2 - \sqrt{7}, 0)$, $(-2 + \sqrt{7}, 0)$, $(0, 3)$

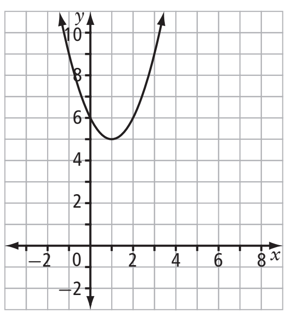
c) 

d) Domain: $\{x \mid x \in R\}$;
Range: $\{y \mid y \geq 0, y \in R\}$

e) $y = \begin{cases} x^2 + 4x - 3, \text{ if } x < -2 - \sqrt{7} \text{ or } x > -2 + \sqrt{7} \\ -(x^2 + 4x - 3), \text{ if } -2 - \sqrt{7} \leq x \leq -2 + \sqrt{7} \end{cases}$

10. **a)** none; none; none

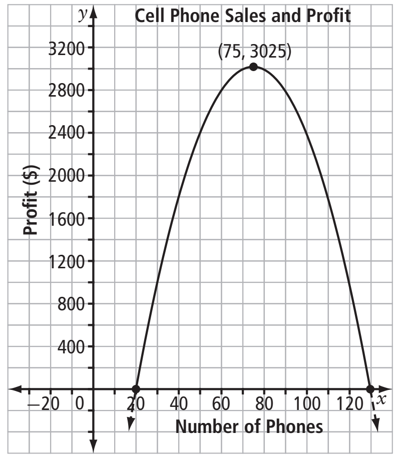
b) The graphs are the same.

c) 

11. **a)** $y = |2x|$ **b)** $y = |3x + 6|$

12. **a)** Yes, by definition, $2 - x = 2 - x$ and $2 - x = -2 + x$, both equations have $x = 2$ as the solution.

b) Yes, $|x^2| = x^2$, by definition, $x^2 = x^2$ for all real values of x, and $x^2 = -(x^2)$, only if $x = 0$.

13. **a)** 

b) $y = |-x^2 + 150x - 2600|$ **c)** \$3025

d) No, sales can go to infinity: profit can go to infinity

7.3 Absolute Value Equations, pages 303–308

1. **a)** 11, −11 **b)** 6, −6 **c)** 2, −2 **d)** 9.5, −9.5

2. **a)** 7, −3 **b)** 6, −12 **c)** 13, −3

3. **a)** 10, $\frac{-76}{7}$ **b)** No solution **c)** No solution

4. **a)** 6, –14 **b)** $\pm\sqrt{5}$, −1

5. **a)** Example: $0.5 = |x - 32|$ **b)** 31.5 oz and 32.5 oz

6. **a)** Example: $0{:}15 = |x - 08{:}00|$ **b)** 8:15 to 7:45

7. **a)** Example: $0.01 = |x - 2.5|$ **b)** 2.49 mm to 2.51 mm

8. **a)** Example: $0.002 = |i - 0.036|$

b) 0.038 A to 0.034 A

9. Example: $0.35 = |x - 9.6|$; 9.25 lb to 9.95 lb

10. 24 screens, \$64 000

11. No

$4 - 9|-6 - x| = -15$
$-9|-6 - x| = -19$
$|-6 - x| = \frac{19}{9}$
$-6 - x = \frac{19}{9}$
$x = \frac{-73}{9}$
$-6 - x = \frac{-19}{9}$
$x = \frac{-35}{9}$

12. **a)** Example: let $a = 7$, $b = -5$, $c = -1$
$d = |7| + |-5| + |-1|$
$d = 7 + 5 + 1$
$d = 13$
$d = |7 + (-5) + (-1)|$
$d = |1|$
$d = 1$

b) $\neq$

13. Example: $d = |m_1 - m_2|$

14. **a)** $|4x + 7| + 8 = 2$ Isolate the absolute value
$|4x + 7| = -6$; This is not possible according to the definition of absolute value.

b) Example: $|2x - 8| = -10$; This is not possible according to the definition of absolute value.

7.4 Reciprocal Functions, pages 318–323

1.

$y = f(x)$	$y = \frac{1}{f(x)}$
$y = -x$	$y = \frac{1}{-x}$
$y = 3x - 1$	$y = \frac{1}{3x - 1}$
$y = x^2 - 4x + 4$	$y = \frac{1}{x^2 - 4x + 4}$
$y = x^2$	$y = \frac{1}{x^2}$
$y = \frac{x}{2}$	$y = \frac{2}{x}$

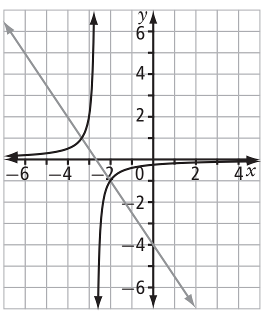
2. **a)** $x = 0$ **b)** $x = -5$ **c)** $x = \frac{2}{7}$
d) $x = 4$ and $x = -4$ **e)** $x = -3$ and $x = 2$

3.

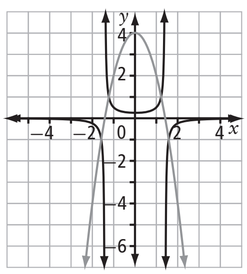
$y = f(x)$	$y = \frac{1}{f(x)}$	Invariant Point(s)
$y = x - 8$	$y = \frac{1}{x - 8}$	(9, 1), (7, −1)
$y = 3x - 4$	$y = \frac{1}{3x - 4}$	$\left(\frac{5}{3}, 1\right)$, (1, −1)
$y = x^2 - 25$	$y = \frac{1}{x^2 - 25}$	$(\sqrt{26}, 1)$, $(\sqrt{24}, -1)$
$y = x^2 - x - 29$	$y = \frac{1}{x^2 - x - 29}$	(6, 1), (−5, 1), $\left(\frac{1 - \sqrt{113}}{2}, -1\right)$, $\left(\frac{1 + \sqrt{113}}{2}, -1\right)$

4. **a)** $\{x \mid x \in R, x \neq 0\}$; $\{y \mid y \in R, y \neq 0\}$; $x = 0$
b) $\{x \mid x \in R, x \neq 1\}$; $\{y \mid y \in R, y > 0\}$; $x = 1$

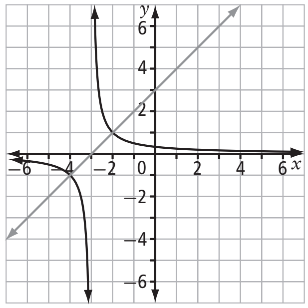
5. **a)**



b)

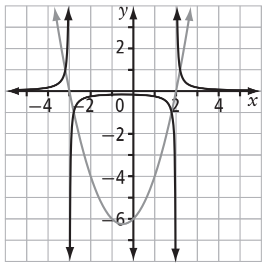


6. **a)**



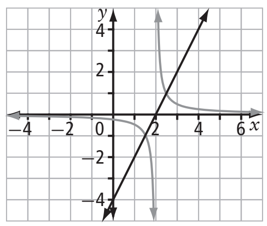
$x = -3$, $y = 0$; (−2, 1), (−4, −1);
$f(x)$: (−3, 0), (0, 3); $\frac{1}{f(x)}: \left(0, \frac{1}{3}\right)$

b)



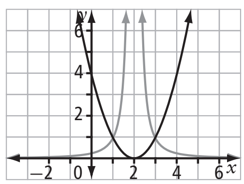
$x = 2$, $x = -3$, $y = 0$; $\left(\frac{-1 \pm \sqrt{29}}{2}, 1\right)$, $\left(\frac{-1 \pm \sqrt{21}}{2}, -1\right)$; $f(x)$: (2, 0), (−3, 0), (0, −6); $\frac{1}{f(x)}: \left(0, \frac{-1}{6}\right)$

7. **a)**



$y = 2x - 4$

b)



$y = (x - 2)^2$

8. **a)** $\frac{s}{\sqrt{d}} = 365$ **b)** $d = \left(\frac{s}{365}\right)^2$
c) **i)** 4.80 km **ii)** 2.53 km **iii)** 0.27 km

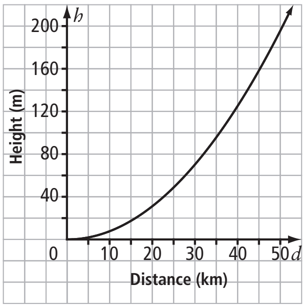
9.

Characteristic	$y = 2x + 5$	$y = \frac{1}{2x + 5}$
x-intercept	$\frac{-5}{2}$	none
y-intercept	5	$\frac{1}{5}$
Invariant points	(−2, 1) (−3, −1)	

10. a)

Height, h (m)	Distance, d (km)
2	5
11.3	12
40	22.6
100	35.7
195.9	50

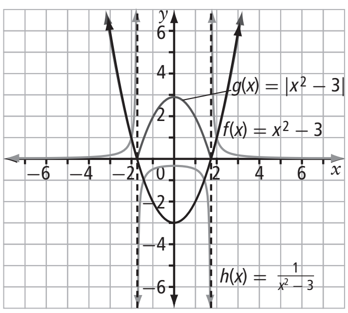
b)



c) approximately 16 km **d)** approximately 5 m

11.

	$f(x)$	$g(x)$	$h(x)$
x-intercept(s)	$(\sqrt{3}, 0)$, $(-\sqrt{3}, 0)$	$(\sqrt{3}, 0)$, $(-\sqrt{3}, 0)$	none
y-intercept(s)	(0, −3)	(0, 3)	$\left(0, -\frac{1}{3}\right)$
Domain	$\{x \mid x \in R\}$	$\{x \mid x \in R\}$	$\{x \mid x \in R, x \neq -\sqrt{3}$ and $x \neq \sqrt{3}\}$
Range	$\{y \mid y \geq -3, y \in R\}$	$\{y \mid y \geq 0, y \in R\}$	$\{y \mid y \in R, y \neq 0\}$
Piecewise function		$g(x) = x^2 - 3$, for $x < -\sqrt{3}$ or $x > \sqrt{3}$; $g(x) = -(x^2 - 3)$ for $-\sqrt{3} \leq x \leq \sqrt{3}$	
Invariant points	For $f(x)$ and $h(x)$: $(\pm 2, 1)$, $(\pm\sqrt{2}, -1)$		
Asymptote(s)	none	none	$x = \sqrt{3}$, $x = -\sqrt{3}$



Chapter 7 Review, pages 324–331

1. a) 17 **b)** $-1\frac{1}{2}$ **c)** 1.02

2. $\left|\frac{41}{2}\right|$, $|-20.1|$, $\left|-19\frac{3}{4}\right|$, −19.65, $-|20|$, −20.2

3. a) 18 **b)** 6 **c)** 8

4. a) $|9 - 12| + (-2)(4) = -5$

b) $|(1.3 - 3.3)|^3 = 8$

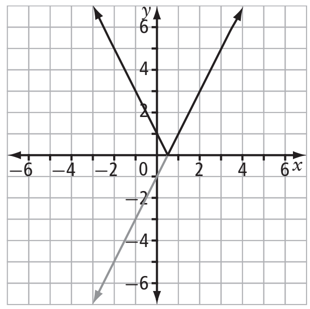
c) $8 - 11|12 - 15| = -25$

5. a) Example: $|-732 - 600|$ **b)** 1332 feet

6. a)

x	$f(x)$	$g(x)$
−1	−3	3
0	−1	1
1	1	1
2	3	3
3	5	5
4	7	7

b)



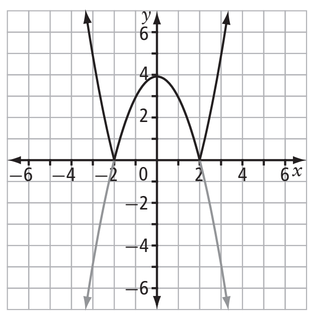
c)

	$f(x)$	$g(x)$
Domain	$\{x \mid x \in R\}$	$\{x \mid x \in R\}$
Range	$\{y \mid y \in R\}$	$\{y \mid y \in R, y \geq 0\}$
x-intercepts	(0.5, 0)	(0.5, 0)
y-intercepts	(0, −1)	(0, 1)
Piecewise function		$y = \begin{cases} 2x - 1, & \text{if } x \geq 0.5 \\ -2x + 1, & \text{if } x < 0.5 \end{cases}$

7. a)

x	$f(x)$	$g(x)$
−3	−5	5
−2	0	0
−1	3	3
0	4	4
1	3	3
2	0	0
3	−5	5

b)

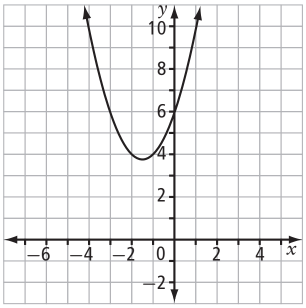


c)

	$f(x)$	$g(x)$
Domain	$\{x \mid x \in R\}$	$\{x \mid x \in R\}$
Range	$\{y \mid y \le 4\}$	$\{y \mid y \ge 0\}$
x-intercepts	(−2, 0), (2, 0)	(−2, 0), (2, 0)
y-intercepts	(0, 4)	(0, 4)
Similarities	Same intercepts and domain	
Differences	Different range, one opens up, the other opens down	
Piecewise function	N/A	$y = \begin{cases} -x^2 + 4, \text{ if } -2 \le x \le 2 \\ x^2 - 4, \text{ if } x < -2 \text{ or } x > 2 \end{cases}$

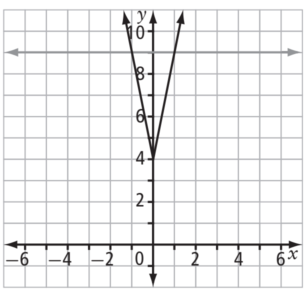
8. a) Both equations produce the same graph

b)

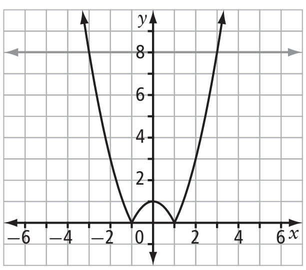


9. $y = \left|\frac{1}{2}x + 3\right|$

10. a) $x = 1$ and $x = -1$



b) $x = -3$ and $x = 3$



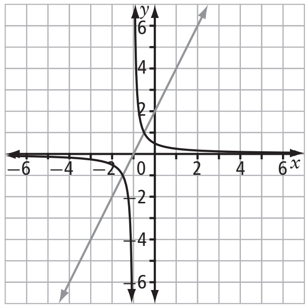
11. a) $x = 2, x = -12$ **b)** $x = 5, x = \frac{1}{2}$

c) $x = 4 \pm 2\sqrt{6}$

12. a) Example: $0.5 = |x - 50|$

b) 49.5 mg to 50.5 mg

13. a)



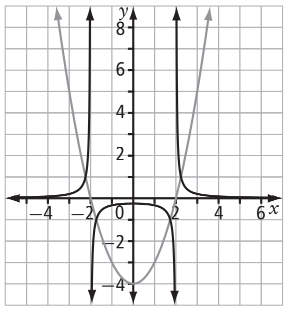
asymptotes: $x = -1, y = 0$

invariant points: $\left(\frac{-1}{2}, 1\right), \left(\frac{-3}{2}, -1\right)$

x-intercept: for $f(x)$: $(-1, 0)$ for $\frac{1}{f(x)}$: none

y-intercept: for $f(x)$: $(0, 2)$ for $\frac{1}{f(x)}$: $\left(0, \frac{1}{2}\right)$

b)



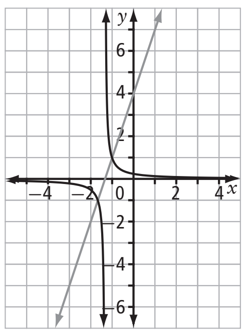
asymptotes: $x = 2, x = -2, y = 0$

invariant points: $(\sqrt{5}, 1), (-\sqrt{5}, 1), (\sqrt{3}, -1)$, $(\sqrt{3}, -1)$

x-intercepts: for $f(x)$: $(2, 0), (-2, 0)$ for $\frac{1}{f(x)}$: none

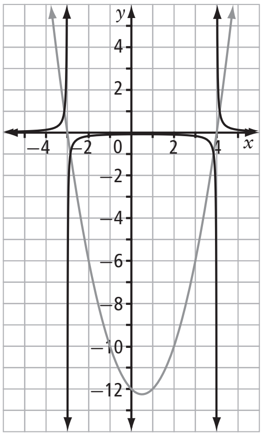
y-intercept: for $f(x)$: $(0, -4)$ for $\frac{1}{f(x)}$: $\left(0, \frac{-1}{4}\right)$

14. a)



	$f(x)$	$\frac{1}{f(x)}$
Asymptotes		$x = \frac{-4}{3}, y = 0$
x-intercept	$\left(\frac{-4}{3}, 0\right)$	None
y-intercept	(0, 4)	$\left(0, \frac{1}{4}\right)$
Invariant points	$(-1, 1), \left(\frac{-5}{3}, -1\right)$	
Domain	$\{x \mid x \in R\}$	$\left\{x \mid x \in R, x \ne \frac{-4}{3}, x \ne 0\right\}$
Range	$\{y \mid y \in R\}$	$\{y \mid y \in R, y \ne 0\}$

b)



	$f(x)$	$\frac{1}{f(x)}$
Asymptotes	None	$x = 4$, $x = -3$, $y = 0$
x-intercept	(4, 0), (−3, 0)	None
y-intercept	(0, −12)	$\left(0, \frac{-1}{12}\right)$
Invariant points	$\left(\frac{1 \pm \sqrt{53}}{2}, 1\right), \left(\frac{1 \pm 3\sqrt{5}}{2}, -1\right)$	
Domain	$\{x \mid x \in R\}$	$\{x \mid x \in R, x \neq 0, x \neq 4, x \neq -3\}$
Range	$\{y \mid y \in R, y \geq -12\}$	$\{y \mid y \in R, y \neq 0\}$

15. a) $R = \frac{P}{I^2}$ **b)** 125 ohms
c) 5 amperes **d)** 150 watts

Chapter 8

8.1 Solving Systems of Equations Graphically, pages 338–344

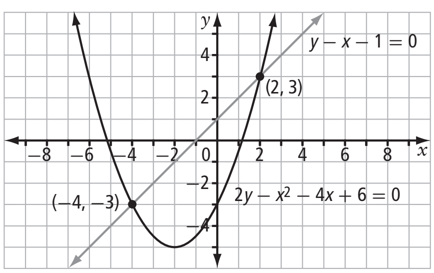
1. a) (0, −3) **b)** (−1, 5) **c)** (−2, 11)

2. a) quadratic-quadratic; (−2, −2) and (2, −2)

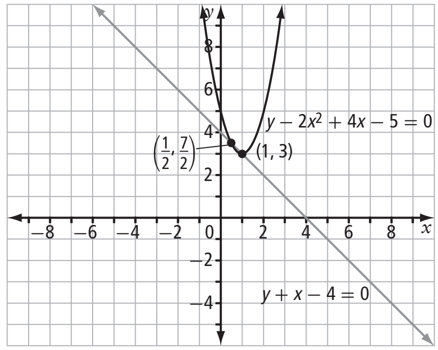
b) linear-quadratic; (0, −4)

c) quadratic-quadratic; no solution

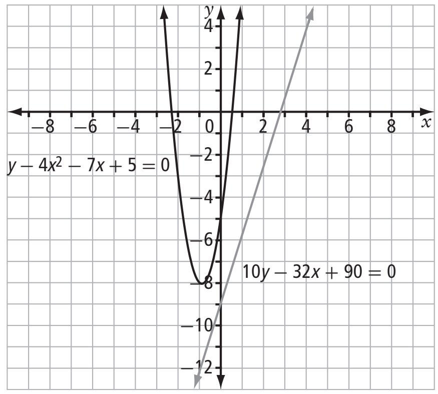
3. a) (−4, −3) and (2, 3)



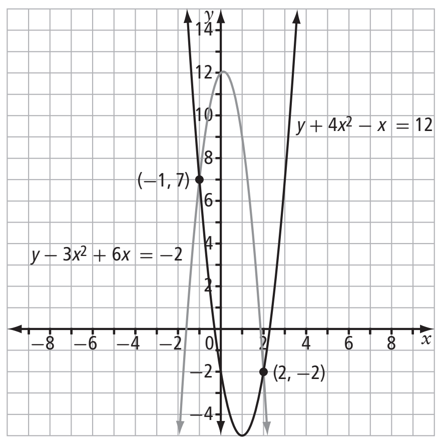
b) $\left(\frac{1}{2}, \frac{7}{2}\right)$ and (1, 3)



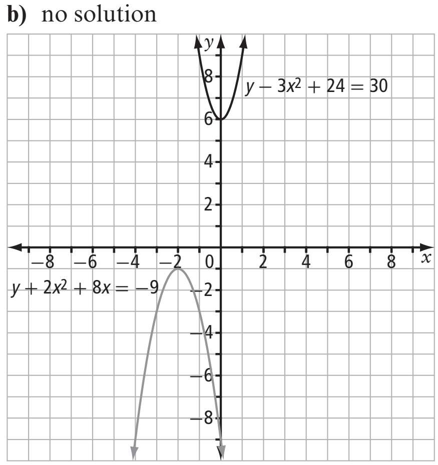
c) no solution



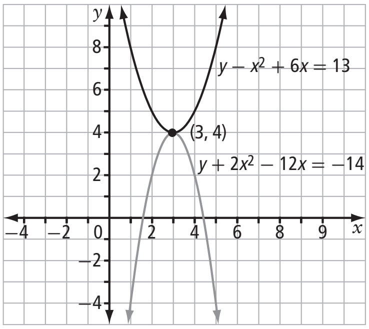
4. a) (−1, 7) and (2, −2)



b) no solution

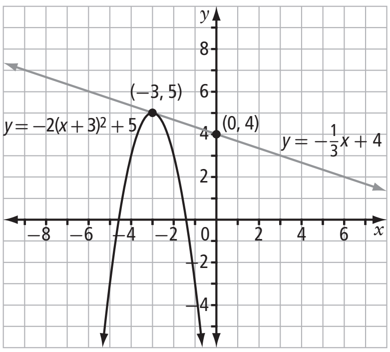


c) (3, 4)



5. Example:

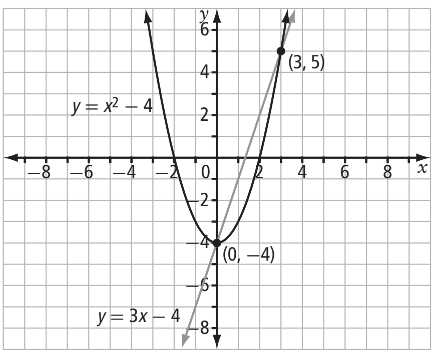
a)



b) (−3, 5) and (0, 4); $y = -\frac{1}{3}x + 4$ **c)** (−3, 5)

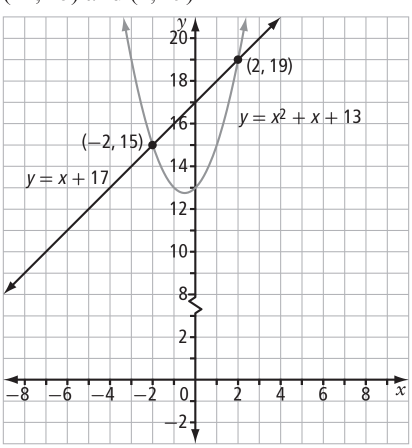
6. Example:

a)



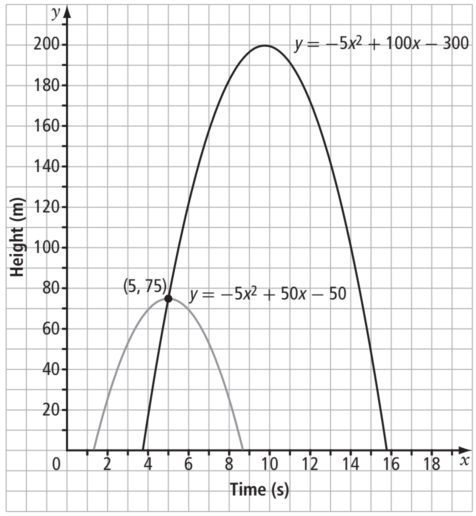
b) $y = x^2 - 4$ **c)** (0, −4) and (3, 5)

7. **a)** (−2, 15) and (2, 19)



b) (−2, 15) cannot be used because the question states that both numbers are positive.

8. They intersect at (5, 75). After 5 s, they are both 75 m above the ground.



9. **a)** No solution. The parabola opens upward. The *y*-intercept of the line is below the vertex.

b) An infinite number of solutions. When the first equation is expanded, it is exactly the same as the second equation.

c) One solution. The parabolas share the same vertex at (−2, 4). One parabola opens upward, the other downward.

d) Two solutions. The vertex of one parabola is directly above the other. One parabola has a smaller vertical stretch factor.

8.2 Solving Systems of Equations Algebraically, pages 350–355

1. **a)** (2, 2) **b)** (0, 1) and (1, 2)

c) (−2, −1) and (3, 14) **d)** $\left(-\frac{1}{2}, 2\right)$ and (1, 5)

2. **a)** (−1, 3) and (3, −37)

b) $\left(-\frac{1}{4}, \frac{1}{4}\right)$

c) (−1, 7) and $\left(-\frac{10}{3}, -\frac{7}{9}\right)$

d) no solution

3. $m = 4$, $n = 16$

4. **a)** $x + y = 11$

b) $2x^2 - 10x + 12 = 10y$

c) $x = 7$, $y = 4$

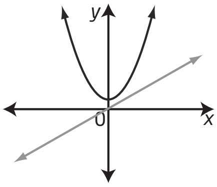
d) base = 8 cm, height = 5 cm, and width = 6 cm

5. 11 and 8

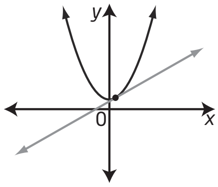
6. (1.45, 3.80) and (3.22, –0.91)

Chapter 8 Review, pages 356–360

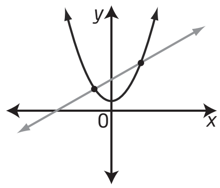
1. a) no solution



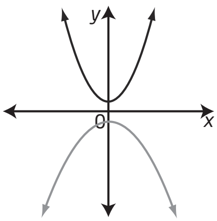
1 solution



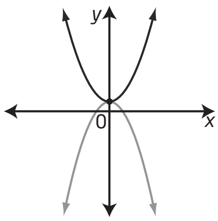
2 solutions



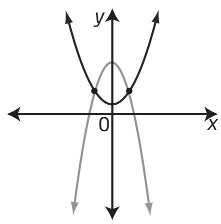
b) no solution



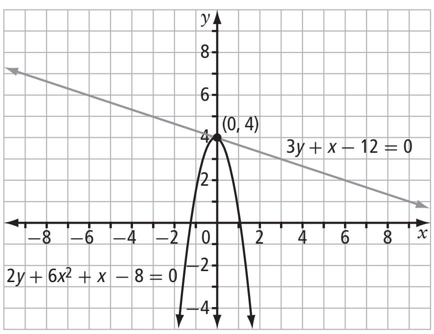
1 solution



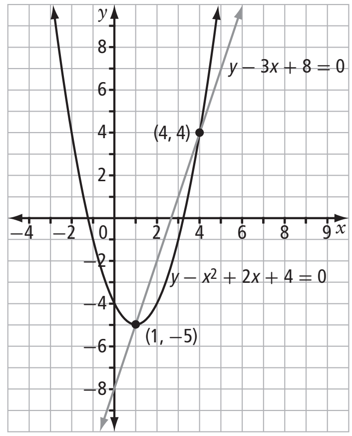
2 solutions



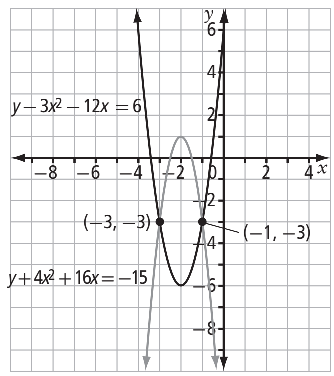
2. a) (0, 4)



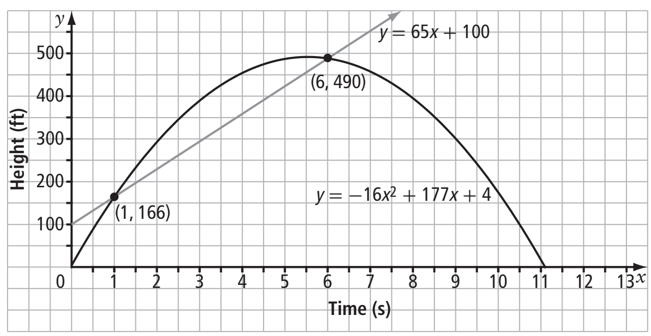
b) (4, 4) and (1, –5)



c) (–3, –3) and (–1, –3)



3. a)



b) (1, 166) and (6, 490); The boy sees the rocket as it goes up (1 s after release, at a height of 166 ft) and as it is coming down (6 s after release, at a height of 490 ft).

4. a) (1, 9) and (–2, 27) **b)** (–4, –3)

c) (–0.57, 6.23) and (1.77, 5.29)

5. 3 and 7

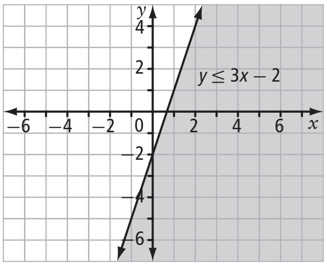
6. (3.75, 2.94); The balls will hit each other at a point 2.94 m in the air. The point where the balls collide is a distance of 3.75 m from the first player and 5.25 m from the second player.

Chapter 9

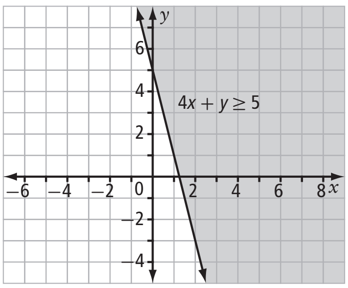
9.1 Linear Inequalities in Two Variables, pages 368–378

1. **a)** $(-1, 4), (3, 7)$ **b)** $(0, 7), (-2, 5), (-6, 1)$
c) $(-3, -4), (2, -10)$ **d)** $(0, 0), (-4, -3), (3, 1)$

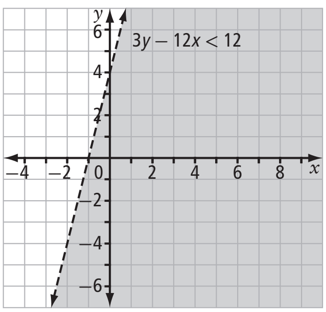
2. **a)**



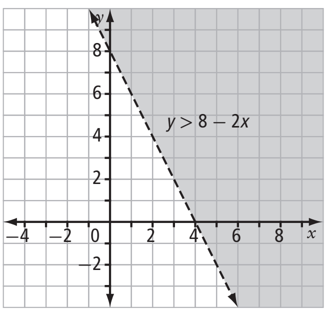
b)



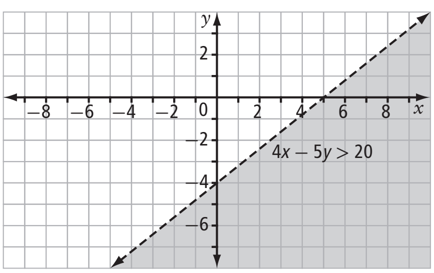
c)



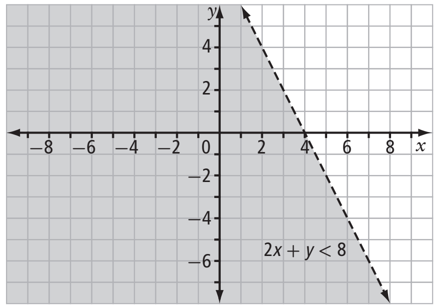
d)



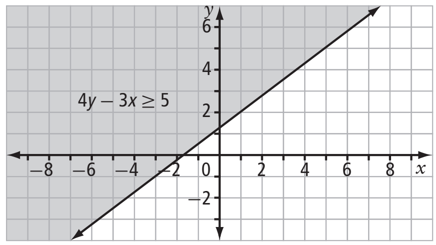
3. **a)**



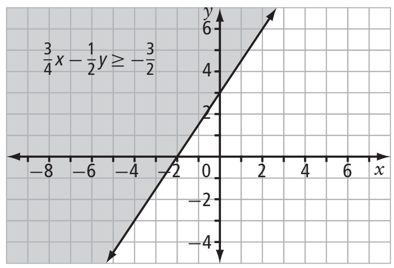
b)



c)

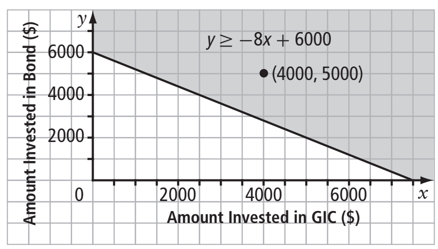


d)



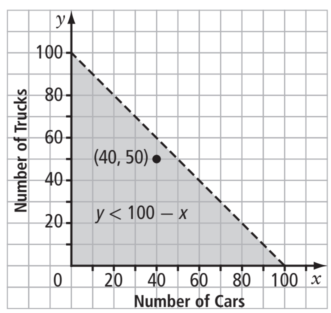
4. **a)** $y \leq 5 - x$ **b)** $y > 6 - x$ **c)** $y \geq -\frac{3}{2}x + 5$

5.

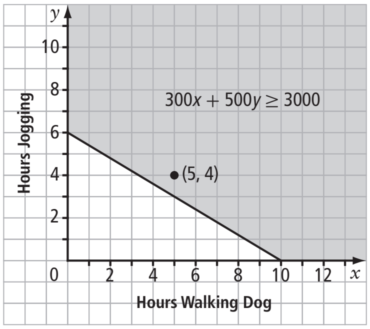


Possible solution: (4000, 5000); Invest \$4000 in the bond and \$5000 in the GIC to earn \$410 interest.

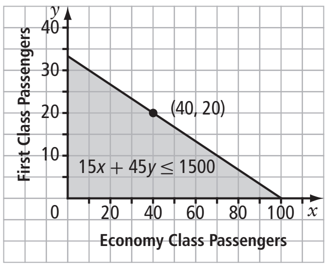
6.



Possible solution: (40, 50); Make 40 cars and 50 trucks.

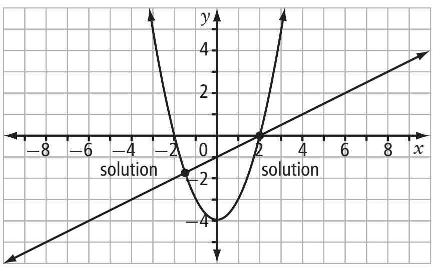
7. 

Possible solution: (5, 4); Barb could walk her dog for 5 hr and jog for 4 hr.

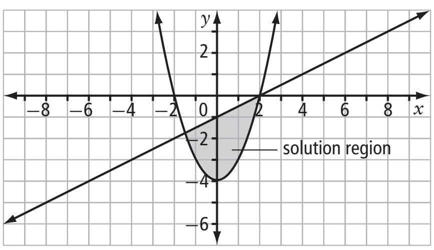
8. 

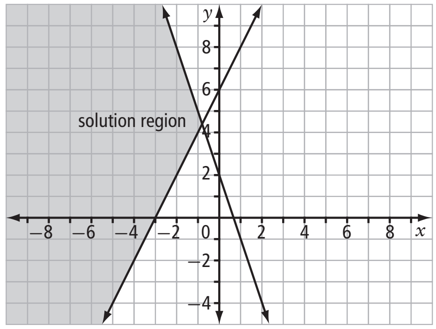
Possible solution: (40, 20); If each passenger brings luggage at their maximum allowable weight, the airplane can carry a maximum of 40 economy class passengers and 20 first class passengers.

9. Example: To solve a system of equations graphically, graph each equation and find the point(s) of intersection. This system would have two solutions as there are two points at which the graphs intersect.



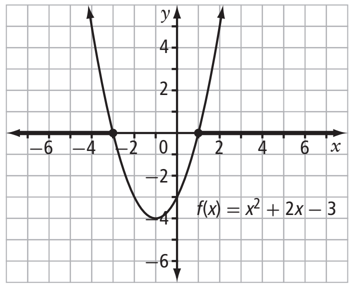
Solving a system of inequalities means finding the intersection; it will be an area of intersection not a point of intersection. Using the same functions but changing them to inequalities, the solution might look like this:



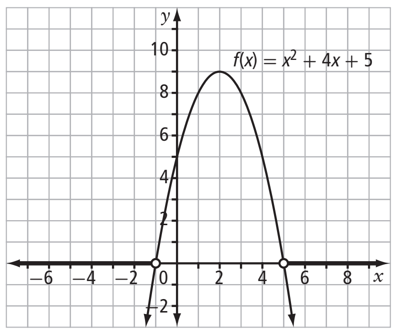
10. 

9.2 Quadratic Inequalities in One Variable, pages 383–388

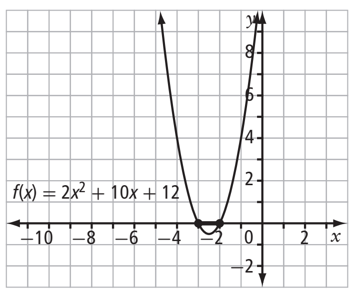
1. **a)** $x < -2$ or $x > 1$ **b)** $-2 \le x \le 1$
c) $-2 < x < 1$ **d)** $x \le -2$ or $x \ge 1$

2. **a)** 

$x \le -3$ or $x \ge 1$

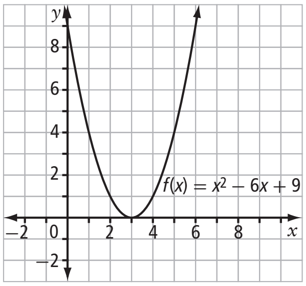
b) 

$x < -1$ and $x > 5$

c) 

$-3 \le x \le -2$

d)



no solution

3. a) $-2 < x < -1$ **b)** $\frac{3}{4} < x < 1$

c) $x \le -\frac{1}{3}$ or $x \ge \frac{1}{2}$ **d)** $x \le -\frac{1}{2}$ or $x \ge 4$

4. $x \ge 7$

5. $-3.7 \le x \le 13.6$ (Note: The number of possible increases is from 0 to 13 since you cannot have a "negative" increase.) The price per ticket could be set at \$10 up to \$23.

6. $36.8 \le x \le 163.2$

7. $10 \le x \le 20$

8. a) Example: $2x^2 - 7x - 4 < 0$ or $(2x + 1)(x - 4) < 0$

b) Example: $8x^2 + 10x - 3 \ge 0$ or $(2x + 3)(4x - 1) \ge 0$

c) Example: $3x^2 - 4x \le 0$ or $(x)(3x - 4) \le 0$

9. Answers may vary.

9.3 Quadratic Inequalities in Two Variables, pages 394–400

1. a) (0, 0) and (2, 1) **b)** (−4, −5) and (−2, 10)

c) (−4, 10) and (0, 36) **d)** (1, 9) and (−1, 17)

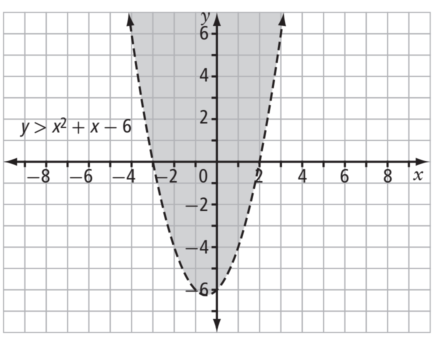
2. a) Example: (−5, −5) is a solution; (0, 5) is not a solution

b) Example: (5, −5) is a solution; (1, −15) is not a solution

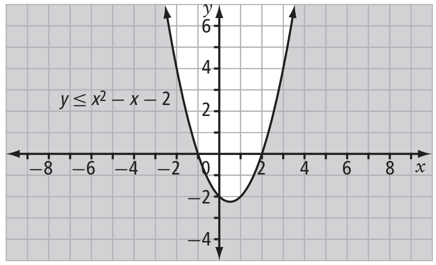
c) Example: (4, −7) is a solution; (−1, 20) is not a solution

d) Example: (−10, −3) is a solution; (0, 0) is not a solution

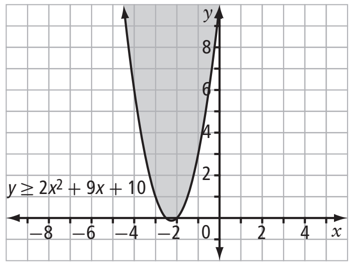
3. a)



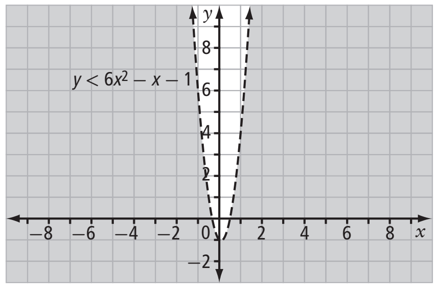
b)



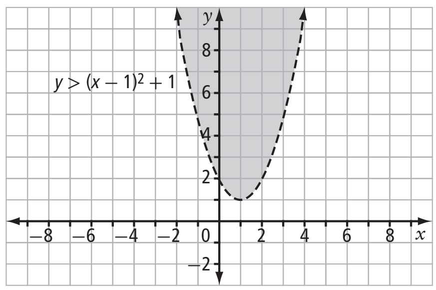
c)



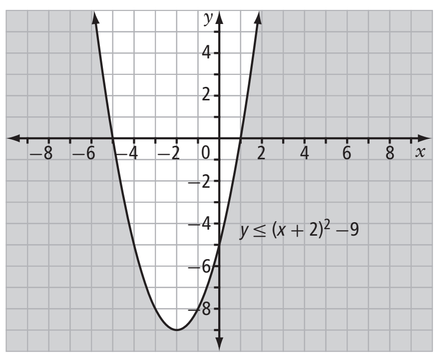
d)



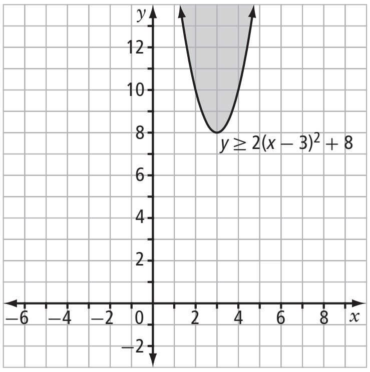
4. a)



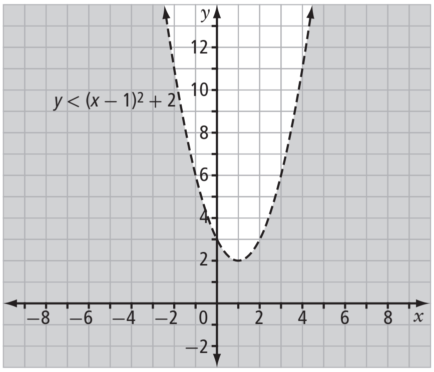
b)



c)



d)



5. a) $y > 2x^2 - 4x - 1$

   b) $y \leq -3x^2 - 4x - 1$

   c) $y > -4x^2 + 5x + 3$

   d) $y \leq 2x^2 - 3x + 2$

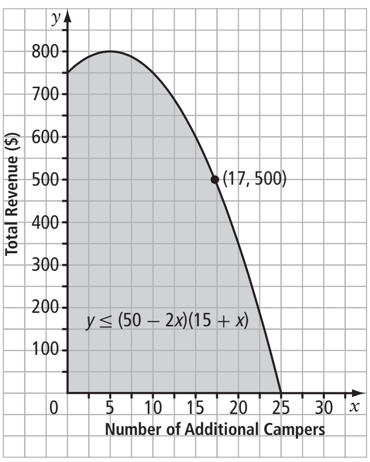
6. a) $y \geq -2(x - 4)^2 + 8$

   b) $y < 1.5(x + 3)^2 - 6$

   c) $y > 0.25(x + 3)^2 - 4$

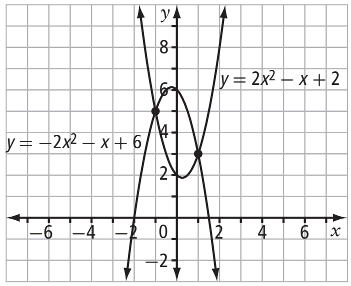
   d) $y \leq -0.5(x + 4)^2 + 2$

7. a)

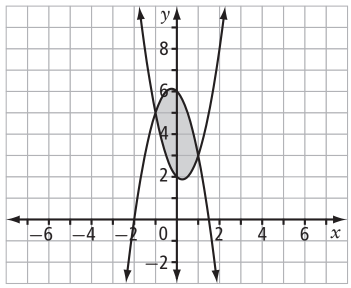


   b) from 0 to 17 additional campers; 15 to 32 campers in total

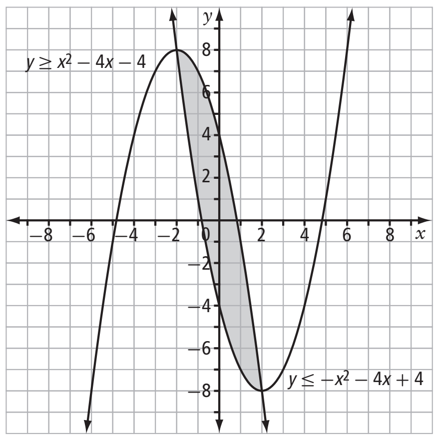
8. Example: To solve a system of *equations* graphically, graph each equation and determine the point(s) of intersection. This system would have two solutions, as there are two points where the graphs intersect.



Solving a system of *inequalities* means determining the intersection; the solution will be an area of intersection, not a point (or points) of intersection. Using the same functions, but changing them to inequalities, the solution might look like this:



9.

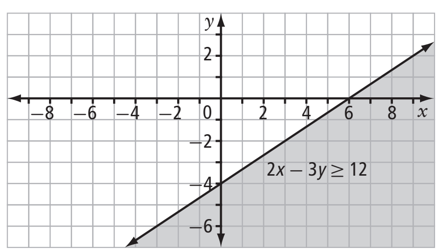


10. Answers may vary.

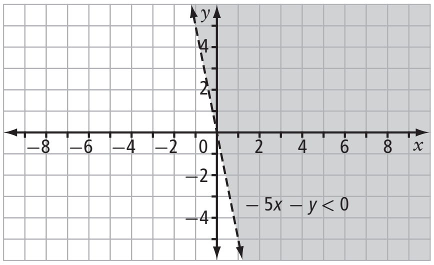
Chapter 9 Review, pages 401–406

1. a) (0, 7), (5, −3) b) (7, 0) (−3, −4) (5, −1)

2. a)

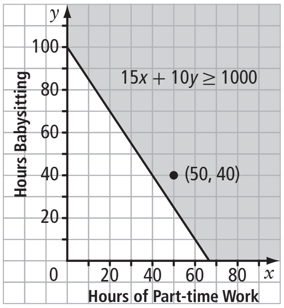


b)



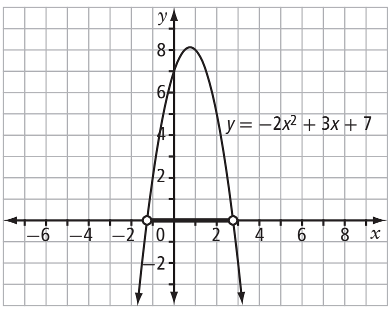
3. **a)** $y > -\frac{3}{4}x - 2$ **b)** $y \leq \frac{4}{5}x + 3$

4.



Possible solution: (50, 40); Amber could work 50 hours at her part-time job and babysit for a total of 40 hours. This would help her save $1150.

5.



$\{x \mid -1.3 < x < 2.8, x \in \mathrm{R}\}$

6. **a)** $0 < x < 1$

b) $x < 0$ or $x > 1$

c) $x \leq 0$ or $x \geq 1$

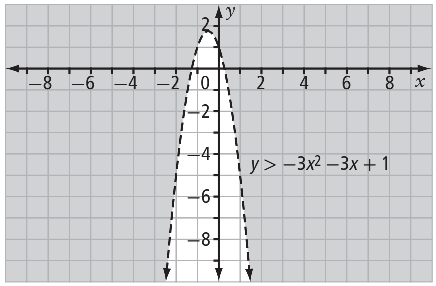
d) $0 \leq x \leq 1$

7. $\{x \mid -3 \leq x \leq 4, x \in \mathrm{R}\}$

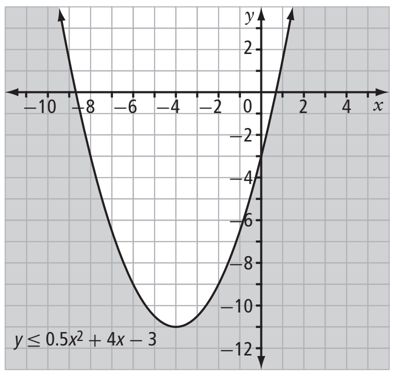
8. **a)** (1, 6), (6, 12)

b) (−1, −2), (3, 4)

9. **a)**



b)



10. **a)** $y < x^2 + 2x - 3$

b) $y \leq -(x - 4)(x + 2)$