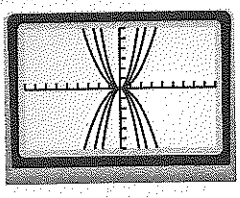
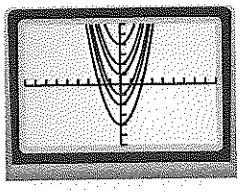
Answers

Lesson 10.1

Teaching Guide

1. 

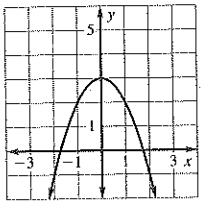
As $|a|$ gets larger, the parabola becomes narrower.

2. 

As c gets larger, the parabola shifts up.

Investigating Algebra Activity

1. D; *Sample answer:* The graph goes through the origin, so it is either C or D. The graph is wider than the graph of $y = x^2$, so the value of a is less than 1.

2. 

Practice Level A

1.

x	−2	−1	0	1	2
y	20	5	0	5	20

2.

x	−2	−1	0	1	2
y	−16	−4	0	−4	−16

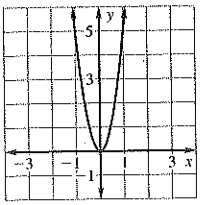
3.

x	−2	−1	0	1	2
y	10	7	6	7	10

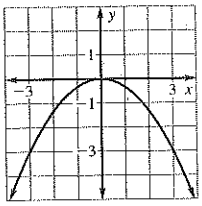
4.

x	−2	−1	0	1	2
y	−4	−7	−8	−7	−4

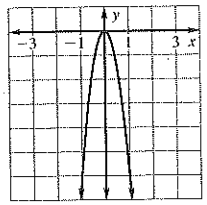
5. C **6.** B **7.** A

8. 

domain: all reals; range: $y \geq 0$; vertical stretch by a factor of 5

9. 

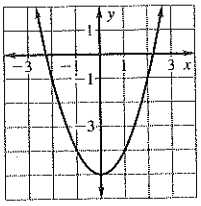
domain: all reals; range: $y \leq 0$; vertical shrink by a factor of $\frac{1}{3}$ and reflection in x-axis

10. 

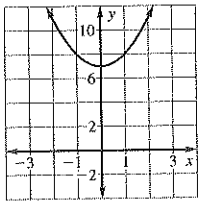
domain: all reals; range: $y \leq 0$; vertical stretch by a factor of 6 and reflection in x-axis

11. (0, 8); $x = 0$ **12.** (0, −4); $x = 0$

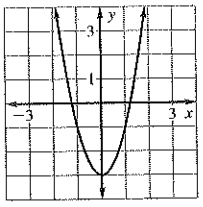
13. (0, −1.5); $x = 0$ **14.** A **15.** C **16.** B

17. 

domain: all reals; range: $y \geq -5$; vertical shift 5 units down

18. 

domain: all reals; range: $y \geq 7$; vertical shift 7 units up

19. 

domain: all reals; range: $y \geq -3$; vertical stretch by a factor of 2 and vertical shift 3 units down

20. 5 units up **21.** vertically stretching; 10

22. a. $-10 \leq x \leq 10$ **b.** $0 \leq y \leq 8$

23. a. $-6 \leq x \leq 6$ **b.** $0 \leq y \leq 2$

Practice Level B

1.

x	−2	−1	0	1	2
y	36	9	0	9	36

2.

x	−2	−1	0	1	2
y	−20	−5	0	−5	−20

3.

x	−4	−2	0	2	4
y	41	11	1	11	41

Lesson 10.1, continued

4.

x	−16	−8	0	8	16
y	−34	−10	−2	−10	−34

5.

x	−2	−1	0	1	2
y	−13	−1	3	−1	−13

6.

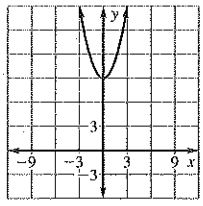
x	−2	−1	0	1	2
y	19	1	−5	1	19

7. F **8.** A **9.** D **10.** B **11.** C **12.** E

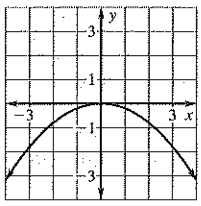
13. shift the graph 8 units down **14.** shift the graph 4 units up and reflect over x-axis

15. stretch vertically by a factor of 2 and shift 3 units up **16.** stretch vertically by a factor of 5, reflect in x-axis, and shift 1 unit up

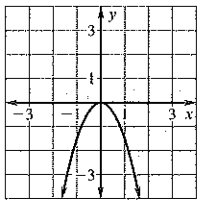
17. shrink vertically by a factor of $\frac{1}{2}$ and shift 2 units down **18.** shrink vertically by a factor of $\frac{3}{4}$, reflect over x-axis, and shift 5 units up

19. 

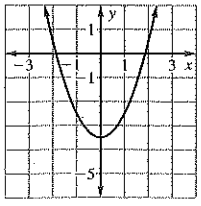
domain: all reals;
range: $y \geq 9$;
vertical shift 9 units up

20. 

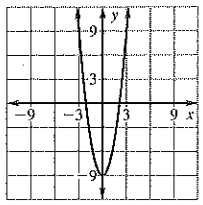
domain: all reals;
range: $y \leq 0$;
vertical shrink by a factor of $\frac{1}{5}$ and reflection in x-axis

21. 

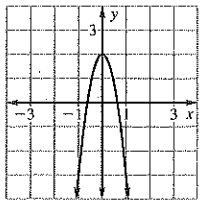
domain: all reals;
range: $y \leq 0$;
vertical stretch by a factor of $\frac{3}{2}$ and reflection in x-axis

22. 

domain: all reals;
range: $y \geq -3.5$;
vertical shift 3.5 units down

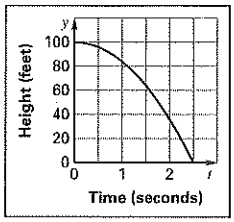
23. 

domain: all reals;
range: $y \geq -9$;
vertical stretch by a factor of 2 and shift 9 units down

24. 

domain: all reals;
range: $y \leq 2$;
vertical stretch by a factor of 5, reflection in x-axis, and vertical shift 2 units up

25. a. $-18 \leq x \leq 18$ **b.** $-4 \leq y \leq 20$

26. a. 

b. $0 \leq t \leq 2.5$; $0 \leq y \leq 100$

c. 84 ft

d. about 1.8 sec

e. 2.5 sec

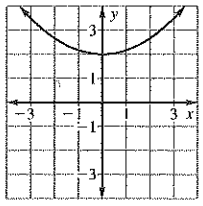
Practice Level C

1.

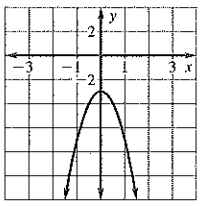
x	−2	−1	0	1	2
y	36	6	−4	6	36

2.

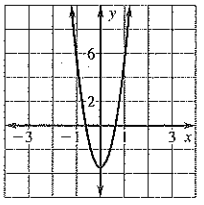
x	−2	−1	0	1	2
y	−3	1.5	3	1.5	−3

3. 

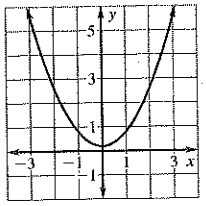
domain: all reals;
range: $y \geq 2$;
vertical shrink by a factor of $\frac{1}{6}$ and vertical shift 2 units up

4. 

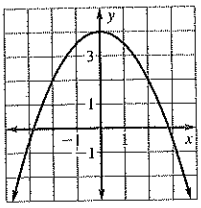
domain: all reals;
range: $y \leq -3$;
vertical stretch by a factor of 4, reflection in x-axis, and shift 3 units down

5. 

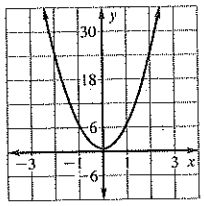
domain: all reals;
range: $y \geq -\frac{7}{2}$;
vertical stretch by a factor of 9 and vertical shift $\frac{7}{2}$ units down

6. 

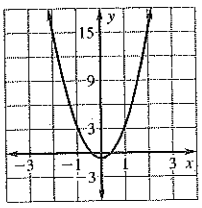
domain: all reals; range: $y \geq \frac{1}{5}$; vertical shrink by a factor of $\frac{3}{5}$ and vertical shift $\frac{1}{5}$ unit up

7. 

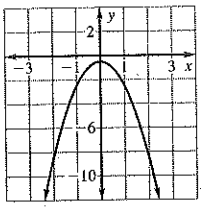
domain: all reals; range: $y \leq 4$; vertical shrink by a factor of $\frac{1}{2}$, reflection in x-axis, and vertical shift 4 units up

8. 

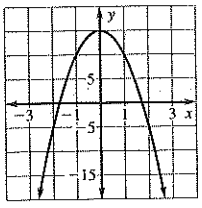
domain: all reals; range: $y \geq \frac{3}{4}$; vertical stretch by a factor of 6 and vertical shift $\frac{3}{4}$ unit up

9. 

domain: all reals; range: $y \geq -\frac{2}{3}$; vertical stretch by a factor of 4 and vertical shift $\frac{2}{3}$ unit down

10. 

domain: all reals; range: $y \leq -\frac{1}{2}$; vertical stretch by a factor of 2, reflection in x-axis, and vertical shift $\frac{1}{2}$ unit down

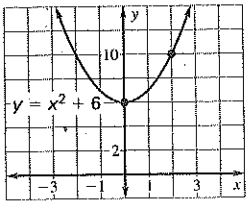
11. 

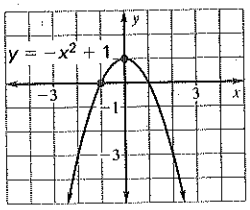
domain: all reals; range: $y \leq 15$; vertical stretch by a factor of 5, reflection in x-axis, and vertical shift 15 units up

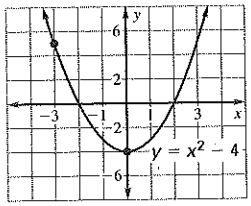
12. shift the graph of f 8 units down **13.** shift the graph of f 5 units down **14.** shift the graph of f 4 units down **15.** shift the graph of f 16 units up

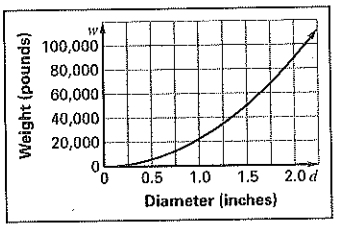
16. stretch the graph of f vertically by a factor of 3

17. shrink the graph of f vertically by a factor of $\frac{1}{2}$

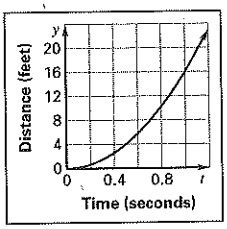
18. 

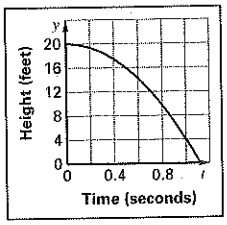
19. 

20. 

21. a. 

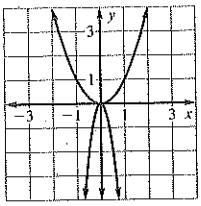
b. about 1.5 in.

22. a. 

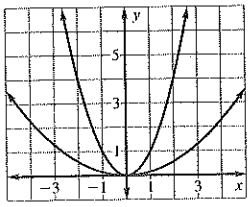
b. 

c. The second graph is a transformation of the first graph. The first graph has been reflected in the x-axis and shifted 20 units up to obtain the second graph. For the first graph, find the value of t when $y = 8$. For the second graph, find the value of t when $y = 12$.

Study Guide

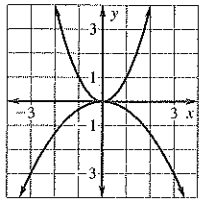
1. 

Both graphs have the same vertex, (0, 0), and the same axis of symmetry, $x = 0$. However, the graph of $y = -8x^2$ is narrower than the graph of $y = x^2$ and it opens down. This is because the graph of $y = -8x^2$ is a vertical stretch (by a factor of 8) of the graph of $y = x^2$ and a reflection in the x-axis of the graph of $y = x^2$.

2. 

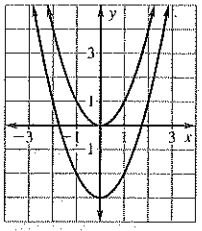
Both graphs have the same vertex, (0, 0), and the same axis of symmetry, $x = 0$. However, the graph of $y = \frac{1}{7}x^2$ is wider than the graph of $y = x^2$. This is because the graph of $y = \frac{1}{7}x^2$ is a vertical shrink $\left(\text{by a factor of } \frac{1}{7}\right)$ of the graph of $y = x^2$.

3.



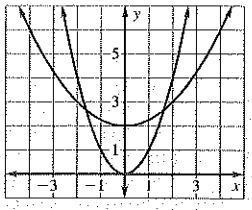
Both graphs have the same vertex, (0, 0), and the same axis of symmetry, $x = 0$. However, the graph of $y = -\frac{1}{3}x^2$ is narrower than the graph of $y = x^2$ and it opens down. This is because the graph of $y = -\frac{1}{3}x^2$ is a vertical shrink $\left(\text{by a factor of } \frac{1}{3}\right)$ of the graph of $y = x^2$ and a reflection in the x-axis of the graph of $y = x^2$.

4.



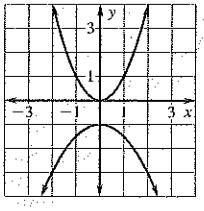
Both graphs have the same axis of symmetry, $x = 0$, and both open up. However, the graph of $y = x^2 - 3$ has a lower vertex than the graph of $y = x^2$. This is because the graph of $y = x^2 - 3$ is a vertical translation of the graph of $y = x^2$.

5.



Both graphs open up, and have the same axis of symmetry, $x = 0$. However, the graph of $y = \frac{1}{4}x^2 + 2$ is wider than the graph of $y = x^2$, and has a higher vertex. This is because the graph of $y = \frac{1}{4}x^2 + 2$ is a vertical shrink $\left(\text{by a factor of } \frac{1}{4}\right)$ and a vertical translation of the graph of $y = x^2$.

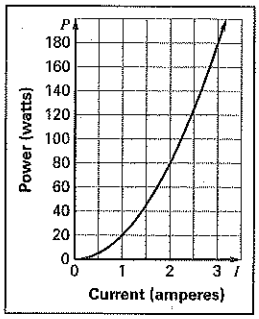
6.



Both graphs have the same axis of symmetry, $x = 0$. However, the graph of $y = -\frac{1}{2}x^2 - 1$ is wider than the graph of $y = x^2$, opens down and has a lower vertex. This is because the graph of $y = -\frac{1}{2}x^2 - 1$ is a vertical shrink $\left(\text{by a factor of } \frac{1}{2}\right)$ and a vertical translation of the graph of $y = x^2$.

Interdisciplinary Application

1.



2. 2 amperes **3.** 3 amperes **4.** By graphing $y = 15x^2$ on the same graph from Exercise 1, it will take more power to generate 80 watts of power with a resistance of 15 ohms.

Challenge Practice

1. $y = 3x^2 + 4$ **2.** $-2x^2 + 1$ **3.** $y = 4x^2 - 10$

4. $y = -x^2 + 5$ **5.** $y = -\frac{1}{2}x^2 + 2$

6. 1 kilogram **7.** 5.2×10^{-7} kilograms

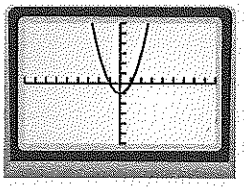
8. 1×10^{10} meters per second

9. 1×10^{-9} kilograms **10.** 3.1 kilograms

Lesson 10.2

Teaching Guide

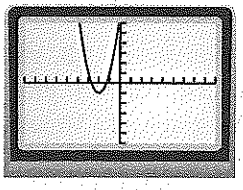
1.



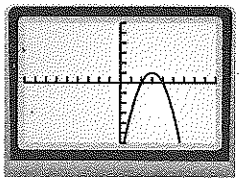
2. $(0, -1)$

3. $x = 0$; the graph is symmetric about $x = 0$.

4.



$(-2, -1)$; $x = -2$; the graph is symmetric about $x = -2$.



$(3, 1)$; $x = 3$; the graph is symmetric about $x = 3$; the graphs of y_1 and y_2 have a point that is lower than all other points and the graph of y_3 has a point that is greater than all other points.

Graphing Calculator Activity

1. maximum; 9.5 **2.** minimum; 4.9

3. minimum; −7.1 **4.** minimum; −3.6

5. maximum; 13.3 **6.** maximum; 6.3

7. minimum; maximum

Practice Level A

1. $a = 7, b = 2, c = 11$ **2.** $a = 3, b = -5, c = 1$

3. $a = 4, b = 2, c = -2$ **4.** $a = -3, b = 9, c = 4$ **5.** $a = \frac{1}{2}, b = -1, c = -5$ **6.** $a = -1, b = 7, c = -6$ **7.** upward; $x = 0$ **8.** downward; $x = 0$ **9.** upward; $x = -3$ **10.** upward; $x = 2$

11. upward; $x = -1$ **12.** downward; $x = 4$

13. upward; $x = -\frac{3}{2}$ **14.** downward; $x = \frac{7}{2}$

15. upward; $x = -1$ **16.** (0, 5) **17.** (0, 3)

18. (−5, −22) **19.** (2, 2) **20.** (−1, −2)

21. (2, 5) **22.** $\left(\frac{1}{2}, \frac{9}{2}\right)$ **23.** $\left(-\frac{1}{2}, \frac{11}{4}\right)$ **24.** $\left(\frac{1}{2}, \frac{3}{4}\right)$

25.

x	1	2	3	4	5
y	3	0	−1	0	3

26.

x	4	5	6	7	8
y	27	30	31	30	27

27.

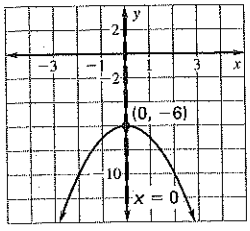
x	−3	−2	−1	0	1
y	23	2	−5	2	23

28.

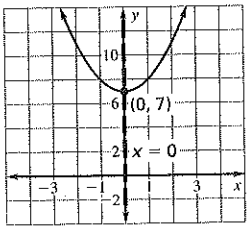
x	−3	−2	−1	0	1
y	−5	1	3	1	−5

29. C **30.** B **31.** A

32.



33.



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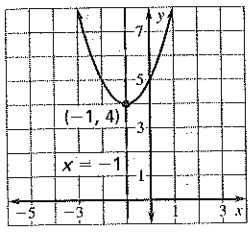
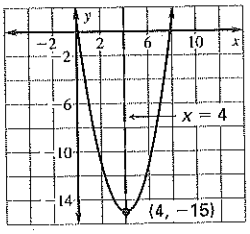


35.



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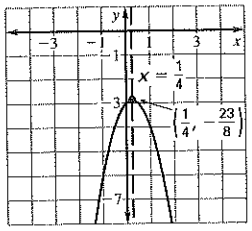
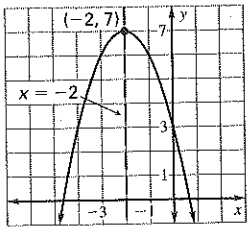


37.



38. minimum value; (0, −7) **39.** maximum value; (0, 9) **40.** minimum value; (−1, −2)

41. 10 ft **42.** 3.5 ft

Practice Level B

1. $a = 6, b = 3, c = 5$ **2.** $a = \frac{3}{2}, b = -1, c = 8$

3. $a = 7, b = -3, c = -1$ **4.** $a = -2, b = 9, c = 0$ **5.** $a = \frac{3}{4}, b = 0, c = -10$ **6.** $a = -8, b = 3, c = -7$ **7.** upward; $x = 0$; (0, −5)

8. downward; $x = 0$; (0, 9) **9.** downward; $x = \frac{3}{2}$; $\left(\frac{3}{2}, \frac{23}{2}\right)$ **10.** upward; $x = 2$; (2, −11)

11. upward; $x = -1$; (−1, −5) **12.** downward; $x = \frac{7}{4}; \left(\frac{7}{4}, -\frac{119}{8}\right)$ **13.** upward; $x = -5; \left(-5, -\frac{33}{2}\right)$

14. downward; $x = 0$; (0, −24) **15.** downward; $x = \frac{3}{2}; \left(\frac{3}{2}, -\frac{5}{4}\right)$ **16.** upward; $x = \frac{1}{3}; \left(\frac{1}{3}, \frac{8}{3}\right)$

17. downward; $x = \frac{7}{4}; \left(\frac{7}{4}, \frac{57}{8}\right)$

18. upward; $x = -\frac{1}{3}; \left(-\frac{1}{3}, -\frac{16}{3}\right)$

19.

x	3	4	5	6	7
y	−18	−21	−22	−21	−18

vertex: (5, −22)

20.

x	1	2	3	4	5
y	3	6	7	6	3

; vertex: (3, 7)

21.

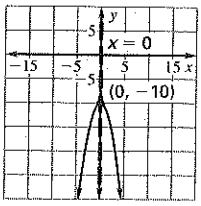
x	−1	0	1	2	3
y	$\frac{17}{2}$	7	$\frac{13}{2}$	7	$\frac{17}{2}$

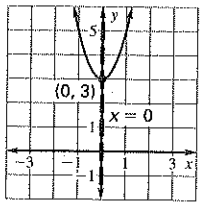
; vertex: $\left(1, \frac{13}{2}\right)$

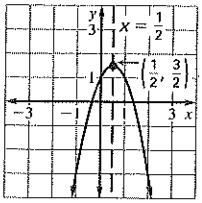
22.

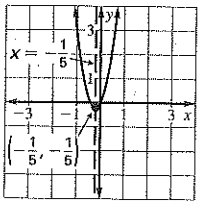
x	1	2	3	4	5
y	$\frac{4}{3}$	$\frac{1}{3}$	0	$\frac{1}{3}$	$\frac{4}{3}$

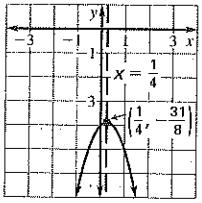
; vertex: (3, 0)

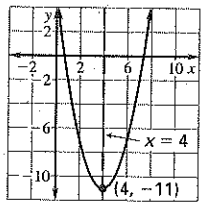
23. 

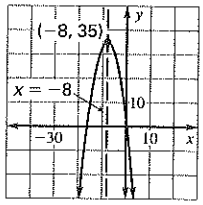
24. 

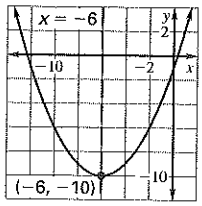
25. 

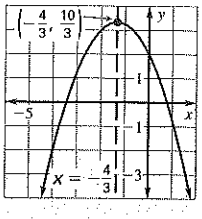
26. 

27. 

28. 

29. 

30. 

31. 

32. minimum; (0, −40) **33.** maximum; (1, 3)

34. minimum; $\left(\frac{1}{4}, \frac{7}{2}\right)$ **35.** 12 ft **36.** 24 in.

Practice Level C

1. downward; $x = \frac{1}{2}$; $\left(\frac{1}{2}, \frac{23}{4}\right)$ **2.** upward; $x = \frac{2}{5}$; $\left(\frac{2}{5}, \frac{3}{5}\right)$ **3.** upward; $x = \frac{1}{8}$; $\left(\frac{1}{8}, \frac{23}{8}\right)$ **4.** downward; $x = \frac{1}{2}$; $\left(\frac{1}{2}, \frac{9}{4}\right)$ **5.** upward; $x = 0$; $(0, -9)$

6. downward; $x = \frac{1}{5}$; $\left(\frac{1}{5}, -\frac{14}{5}\right)$ **7.** upward; $x = 8$; $(8, -8)$ **8.** downward; $x = 0$; $(0, 7)$

9. downward; $x = 1$; $(1, 11)$ **10.** upward; $x = \frac{3}{2}$; $\left(\frac{3}{2}, -1\right)$ **11.** upward; $x = -1$; $(-1, -8)$

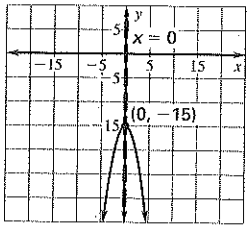
12. downward; $x = \frac{2}{3}$; $\left(\frac{2}{3}, -\frac{22}{3}\right)$

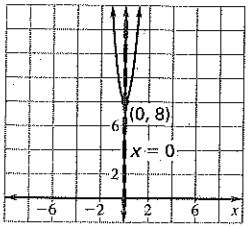
13.

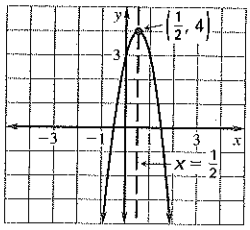
x	2	3	4	5	6
y	2	$\frac{5}{4}$	1	$\frac{5}{4}$	2

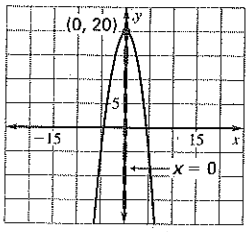
14.

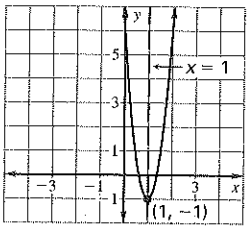
x	0	1	2	3	4
y	−1	$\frac{13}{2}$	9	$\frac{13}{2}$	−1

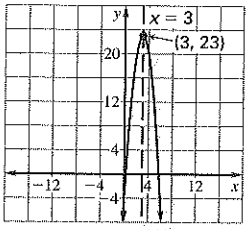
15. 

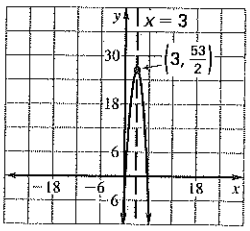
16. 

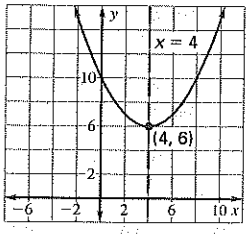
17. 

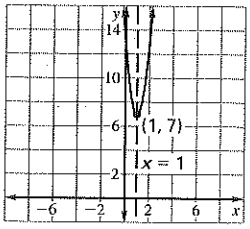
18. 

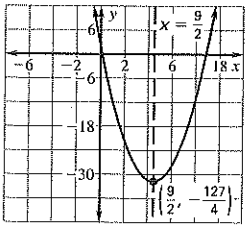
19. 

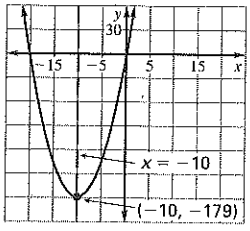
20. 

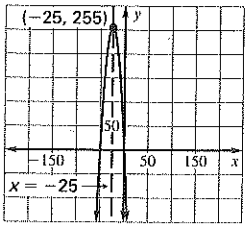
21. 

22. 

23. 

24. 

25. 

26. 

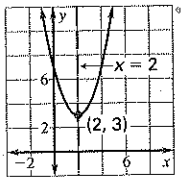
27. minimum; (0, −36) **28.** maximum; (12, 101) **29.** minimum; (4, −17) **30. a.** lamp A: 25 mm; lamp B: 20 mm **b.** 5 mm **31.** 6 ft; Find the maximum of the top part of the window and subtract 1.5 from the result.

Study Guide

1. $x = -2$: (−2, −11) **2.** $x = 6$: (6, −31)

3. minimum value; −19

4.



Problem Solving Workshop: Worked Out Example

1. 215 feet **2.** 28 feet **3.** 8 feet **4.** 2.54 feet

Challenge Practice

1. $y = 2x^2 - 3x + 1$ **2.** $y = -x^2 - x + 4$

3. $y = x^2 - 2x + 3$ **4.** $y = x^2 - 4x + 4$

5. $y = -3x^2 + 6x + 9$ **6.** $f(x) = x^2 - 3x + 2$

7. $f(x) = -2x^2 + 3x + 5$

8. $f(x) = 2x^2 + 5x - 7$

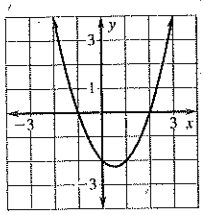
9. $f(x) = -6x^2 + 5x - 1$

10. $f(x) = 3x^2 - 19x + 6$

Lesson 10.3

Teaching Guide

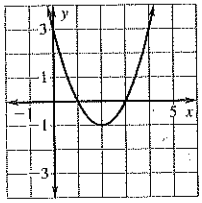
1.



x-intercepts: −1, 2; solutions: −1, 2

The x-intercepts of the graph of the function are the same as the solutions of the equation.

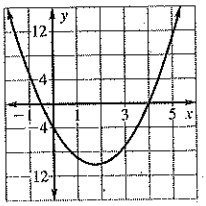
2.



x-intercepts: 1, 3; solutions: 1, 3

The x-intercepts of the graph of the function are the same as the solutions of the equation.

3.



x-intercepts: $-\frac{1}{2}$, 4; solutions: $-\frac{1}{2}$, 4

The x-intercepts of the graph of the function are the same as the solutions of the equation.

4. The x-intercepts of the graph of a quadratic function are the solutions of the related quadratic equation.

Practice Level A

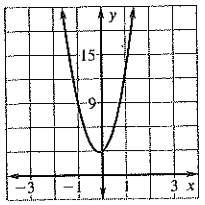
1. $x^2 + 3x + 12 = 0$ **2.** $x^2 - 8x - 14 = 0$

3. $x^2 - 9x + 1 = 0$ **4.** $x^2 + 10x - 6 = 0$

5. $x^2 + 3x - 14 = 0$ **6.** $\frac{1}{2}x^2 + 3x + 7 = 0$

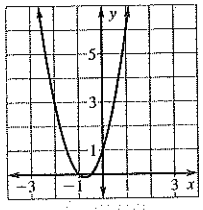
7. not a solution **8.** solution **9.** solution **10.** solution **11.** not a solution **12.** not a solution **13.** no solution **14.** −2, 2 **15.** −3, −1 **16.** −4, 4 **17.** no solution **18.** −4, 2

19.



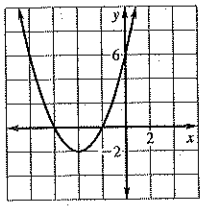
no solution

20.



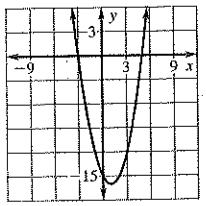
$-1, -\frac{1}{2}$

21.



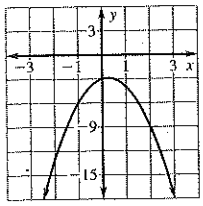
−6, −2

22.



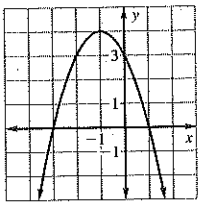
−3, 5

23.



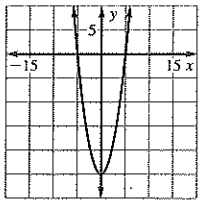
no solution

24.



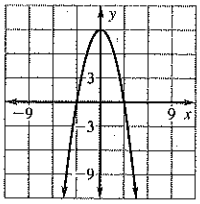
−3, 1

25.



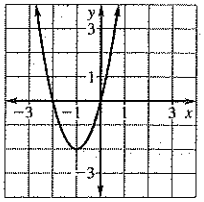
−5, 5

26.



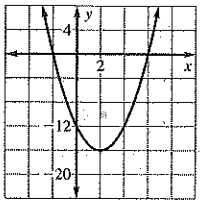
−3, 3

27.



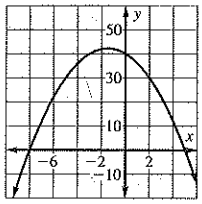
−2, 0

28.



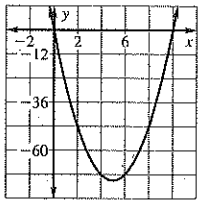
−2, 6

29.



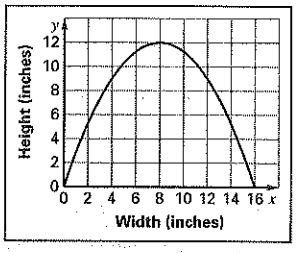
−8, 5

30.



0, 10

31. a.



b. $0 \le x \le 16$; $0 \le y \le 12$

c. 16 in.

d. 12 in.

Practice Level B

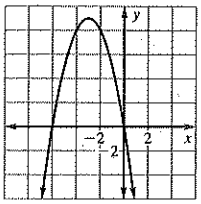
1. not a solution **2.** not a solution

3. not a solution **4.** solution **5.** not a solution

6. solution **7.** −4 **8.** −6, 6 **9.** −8, 3

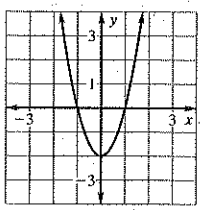
10. −6, −5 **11.** −5, 5 **12.** no solution

13.



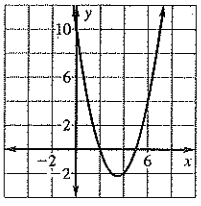
−6, 0

14.



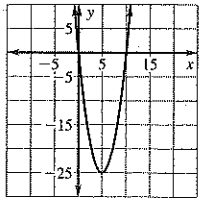
−1, 1

15.



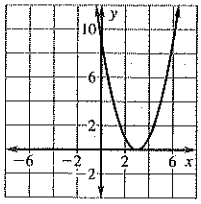
2, 5

16.



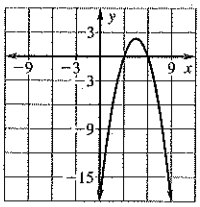
0, 10

17.



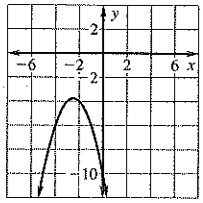
3

18.



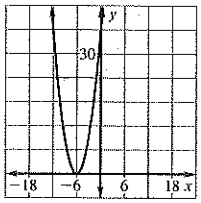
3, 6

19.



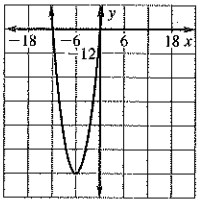
no zeros

20.



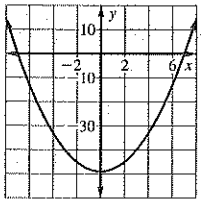
−6

21.



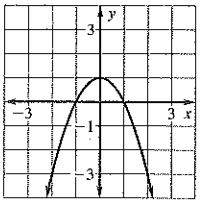
−12, 0

22.



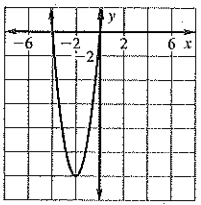
−7, 7

23.



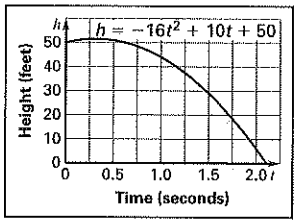
−1, 1

24.



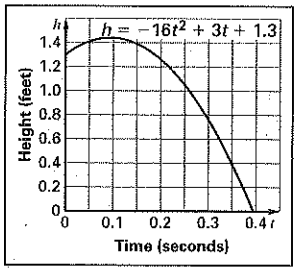
−4, 0

25. a.



b. about 2.1 sec

26. a.

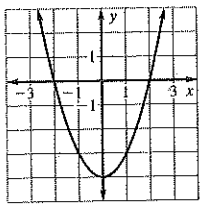


b. about 0.4 sec

c. about 0.34 sec

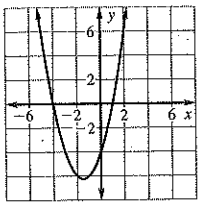
Practice Level C

1.



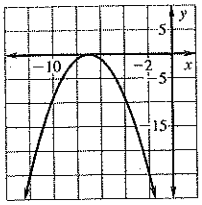
−2, 2

2.



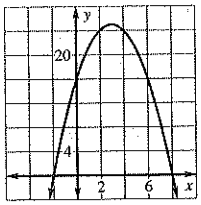
−4, 1

3.



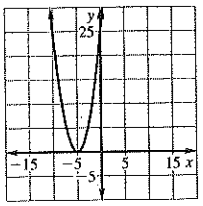
−7

4.



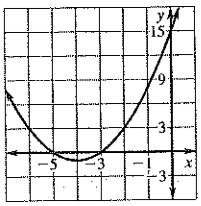
−2, 8

5.



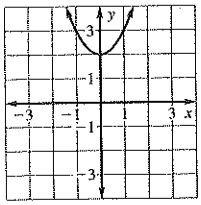
−5

6.



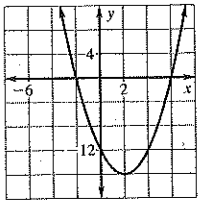
−5, −3

7.



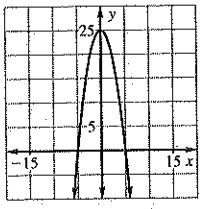
no solution

8.



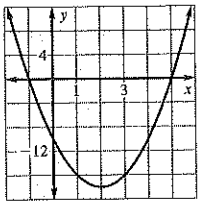
−2, 6

9.



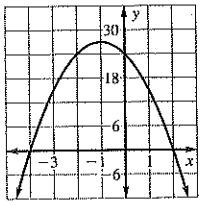
−5, 5

10.



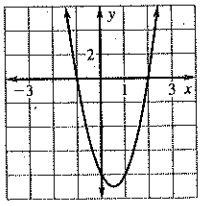
−1, 5

11.



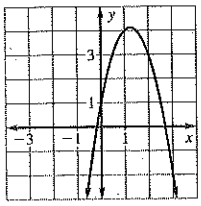
−4, 2

12.



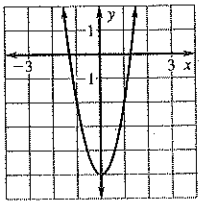
−1, 2

13.



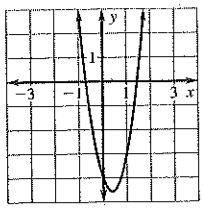
−0.2, 2.7

14.



−1.3, 1.3

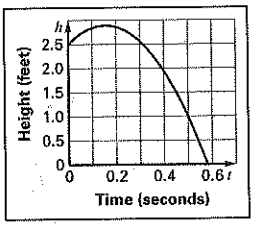
15.



−0.7, 1.4

16. 4.5 in. **17.** 1.9 ft **18.** 9.9 cm

19. a.

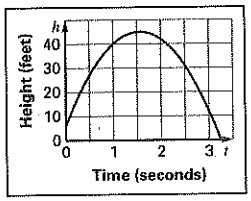


First, write 30 inches in feet and then use the vertical motion model.

b. 1 ft

c. about 0.6 sec

20. a.



b. about 3.2 sec

c. about 3.1 sec; Determine t when $y = 5$.

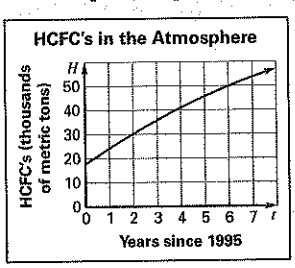
Study Guide

1. −3, 5 **2.** −2 **3.** $-3 + \sqrt{5}, -3 - \sqrt{5}$

4. −2, 2 **5.** −7, 2

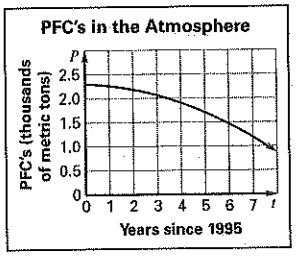
Interdisciplinary Application

1.



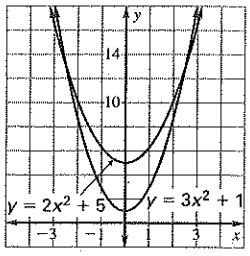
2. 2027

3.

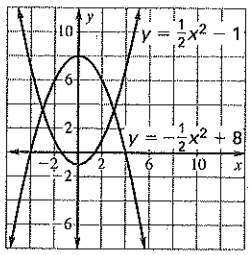


4. 2005

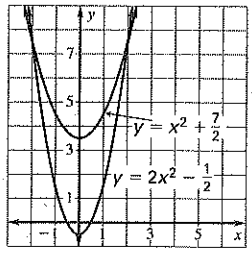
Challenge Practice

1. 

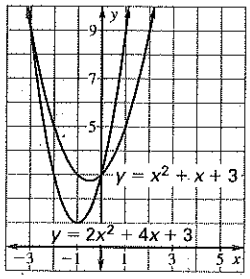
$(-2, 13), (2, 13)$

2. 

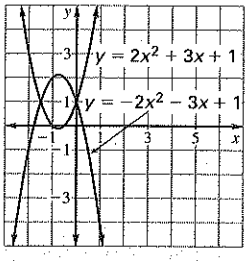
$\left(-3, \frac{7}{2}\right), \left(3, \frac{7}{2}\right)$

3. 

$\left(-2, \frac{15}{2}\right), \left(2, \frac{15}{2}\right)$

4. 

$(-3, 9), (0, 3)$

5. 

$\left(-\frac{3}{2}, 1\right), (0, 1)$

6. The baseball hits the fence. **7.** The baseball hits the ground before the fence. **8.** The baseball clears the fence.

Lesson 10.4

Teaching Guide

1. Answers will vary depending on the measurements given. **2.** Find the number that can be squared to obtain the area. **3.** Answers will vary depending on the measurements given.

Investigating Algebra Activity

1. In the equation $x^2 = d$, if $d > 0$, then $x^2 = d$ has two solutions. The solutions are $x = \pm\sqrt{d}$.

2. In the equation $x^2 = d$, if $d = 0$, then $x^2 = d$ has one solution. The solution is $x = 0$.

3. In the equation $x^2 = d$, if $d < 0$, then $x^2 = d$ has no solution. **4.** no solution **5.** two solutions; $m = 4, -4$ **6.** one solution; $y = 0$

7. two solutions; $k = 6, -6$ **8.** no solution

9. one solution; $x = 0$

Practice Level A

1. 7 **2.** 15 **3.** 10 **4.** $x^2 = 2$ **5.** $x^2 = 3$
6. $x^2 = 4$ **7.** $-6, 6$ **8.** $-3, 3$ **9.** $-2, 2$
10. $-3, 3$ **11.** $-3, 3$ **12.** $0, 4$ **13.** 2.24
14. 3.16 **15.** 3.46 **16.** $-2.83, 2.83$
17. $-1.73, 1.73$ **18.** $-1.41, 1.41$ **19.** 5 m
20. 11 in. **21.** about 9.59 cm
22. about 5.96 knots **23.** 6 in., 7 in., 10 in.

Practice Level B

1. $-2, 2$ **2.** $-4, 4$ **3.** $-6, 6$ **4.** $-7, 7$
5. $-5, 5$ **6.** $-9, 9$ **7.** $-5, 5$ **8.** $-3, 3$
9. $-1, 1$ **10.** $-2.83, 2.83$ **11.** $-1.73, 1.73$
12. no solution **13.** $-2.24, 2.24$ **14.** 0
15. $-2.45, 2.45$ **16.** $-4.12, 4.12$ **17.** $-2.5, 2.5$
18. no solution **19.** 0.76, 5.24 **20.** $-5.16, 1.16$
21. 1.55, 6.45 **22.** 13 m **23.** about 6.16 in.
24. about 13.42 cm **25.** about 3 in.
26. 5 ft, 8 ft, 10 ft

Practice Level C

1. $-3, 3$ **2.** $-7, 7$ **3.** $-4, 4$ **4.** $-2, 2$
5. $-6, 6$ **6.** $-8, 8$ **7.** $-2.24, 2.24$
8. $-3.32, 3.32$ **9.** no solution **10.** $-4.12, 4.12$
11. $-2.45, 2.45$ **12.** 6.27, 9.73 **13.** -11.45, -6.55 **14.** 0.26, 7.74 **15.** $-10.46, -3.54$
16. $-2.32, 10.32$ **17.** $-3.16, 3.16$
18. $-9.83, -4.17$ **19.** $-3, 3$ **20.** $-26, 34$
21. $-1.03, 1.03$ **22.** $-7, 1$ **23.** $-8, 12$
24. $-6, 16$ **25.** 1, 13 **26.** $-2, 4$ **27.** $-8, 0$
28. about 12 cm **29.** about 64 mi/h

Study Guide

1. $-3, 3$ **2.** $-2, 2$ **3.** no solution **4.** $-\frac{11}{16}, \frac{11}{16}$
5. 0 **6.** $-\frac{15}{2}, \frac{15}{2}$ **7.** $-1.73, 1.73$
8. $-2.24, 2.24$ **9.** $-1.12, 1.12$
10. $-1.83, 3.83$ **11.** $-1, -7$ **12.** 2.17, 7.83

Problem Solving Workshop: Mixed Problem Solving

1. a. 1994 **b.** \$3,582,000 **2. a.** 4
b. 48 square inches **3.** Yes; The vertex, which is a maximum, of the parabola occurs at around 1 year after 1998, or 1999. **4.** Answers will vary.

5. 45 **6. a.** $h = -16t^2 + 25t + 6$ **b.** $h = -16t^2 + 30t + 5.5$ **c.** The second throw is in the air longer. Find the x-coordinate of the vertex of each equation and then find the y-coordinate of each equation. The second equation has a larger maximum. **7.** 4

8. a. $R = -5n^2 + 60n + 800$ **b.** (6, 980) **c.** The T-shirts should be sold for \$14 each. The maximum occurs at an x-coordinate of 6, which means that there should be six \$1 increases on the price of a T-shirt. Since the price was \$8, you need to add \$6 to this.

Challenge Practice

1. $x = -12, x = 6$ **2.** $x = -\frac{9}{2}, x = -\frac{1}{2}$

3. $x = -4$ **4.** $x = -\frac{1}{2}, x = \frac{1}{6}$

5. $x = -\frac{13}{7}, x = -\frac{3}{7}$ **6.** 20 min **7.** 12 min

8. 32 min

Lesson 10.5

Teaching Guide

1. $x^2 + 8x$ **2.** 4×4 **3.** $x^2 + 8x + 16$

4. Dimensions: $(x + 4)$ by $(x + 4)$; area: $(x + 4)^2$

Practice Level A

1. B **2.** C **3.** A **4.** $(x + 1)^2$ **5.** $(x - 7)^2$

6. $(x + 9)^2$ **7.** $(x - 2)^2$ **8.** $(x + 11)^2$

9. $(x - 12)^2$ **10.** 25; $(x - 5)^2$ **11.** 16; $(x - 4)^2$

12. 9; $(x - 3)^2$ **13.** 121; $(x + 11)^2$

14. 36; $(x - 6)^2$ **15.** 100; $(x + 10)^2$

16. 225; $(x - 15)^2$ **17.** 169; $(x + 13)^2$

18. 400; $(x + 20)^2$ **19.** $\frac{9}{4}; \left(x + \frac{3}{2}\right)^2$

20. $\frac{121}{4}; \left(x + \frac{11}{2}\right)^2$ **21.** $\frac{49}{4}; \left(x - \frac{7}{2}\right)^2$

22. $-6.32, 0.32$ **23.** $-10.10, 0.10$

24. $-0.65, 4.65$ **25. a.** $64 = -16t^2 + 64t + 32$

b. about 0.59 sec, about 3.41 sec

c. $32 = -16t^2 + 64t + 32$; 0 sec; 4 sec

26. a. 4 ft **b.** 152 ft^2; Subtract the interior area, 28 square feet, from the total area, $12(15) = 180$ square feet.

Practice Level B

1. 36; $(x + 6)^2$ **2.** 625; $(x + 25)^2$

3. 169; $(x - 13)^2$ **4.** 81; $(x - 9)^2$

5. $\frac{169}{4}; \left(x + \frac{13}{2}\right)^2$ **6.** $\frac{81}{4}; \left(x - \frac{9}{2}\right)^2$

7. $\frac{121}{4}; \left(x - \frac{11}{2}\right)^2$ **8.** $\frac{1}{16}; \left(x + \frac{1}{4}\right)^2$

9. $\frac{9}{25}; \left(x - \frac{3}{5}\right)^2$ **10.** $-6.16, 0.16$

11. $-6.12, 2.12$ **12.** $-1.32, 11.32$

13. $-9.10, 1.10$ **14.** $-1.83, 3.83$

15. $-1.55, 13.55$ **16.** $-3.56, 0.56$

17. $-5.54, 0.54$ **18.** $-0.62, 1.62$ **19.** 6

20. 5 **21.** about 272 mi by about 383 mi

22. about 4.05 sec **23. a.** $\ell + 2w = 60$; $\ell w = 400$ **b.** 20 ft by 20 ft, 40 ft by 10 ft

Practice Level C

1. 3.24; $(x + 1.8)^2$ **2.** $\frac{1}{64}; \left(x - \frac{1}{8}\right)^2$

3. $\frac{1}{9}; \left(x + \frac{1}{3}\right)^2$ **4.** $-0.5, 3.5$ **5.** $-10.65, -0.35$

6. $-2.67, 3$ **7.** $-0.82, 9.82$ **8.** $0.21, 4.79$

9. $-6.89, -0.11$ **10.** $-1.27, 6.27$

11. $-17.66, -0.34$ **12.** $0.76, 13.24$

13. $-8.89, -0.11$ **14.** $-1.05, 6.05$

15. $-2.08, 1.08$ **16.** about 4.71 ft **17.** 6

18. $-16, -15$ **19.** about 39 mi/h

20. a. $\ell + 2w = 100$; $\ell w = 1000$

b. about 27.6 ft by 36.2 ft, about 72.4 ft by 13.8 ft

Study Guide

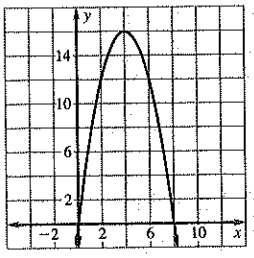
1. $\frac{81}{4}; \left(x - \frac{9}{2}\right)^2$ **2.** $\frac{121}{4}; \left(x + \frac{11}{2}\right)^2$

3. 64; $(x - 8)^2$ **4.** $-0.8, 8.8$

5. $-0.26, -11.74$ **6.** 13.71, 0.29

Real-Life Application

1. 0, 8 **2.**



3. Answers will vary. **4.** 2, 4

5. Answers will vary.

Challenge Practice

1. 14 and 16 **2.** 11 and 13 **3.** 23 and 24

4. 14 and 15 **5.** 17 and 39

Lesson 10.5, continued

6. $x = \frac{-b - \sqrt{b^2 + 28}}{2}, x = \frac{-b + \sqrt{b^2 + 28}}{2}$

7. $x = \frac{5 - \sqrt{37 - 4c}}{2}, x = \frac{5 + \sqrt{37 - 4c}}{2}$

8. $x = \frac{-b - \sqrt{b^2 - 4c}}{2}, x = \frac{-b + \sqrt{b^2 - 4c}}{2}$

9. $x = \frac{-b - \sqrt{b^2 - 4ac}}{2a}, x = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$

10. 17 feet wide by 35 feet long **11.** 2.08 sec

Lesson 10.6

Teaching Guide

1. $a = 1, b = 9, c = 18$; $-6, -3$; $-6, -3$; they are the same.

2. $a = 3, b = 1, c = -2$; $-1, \frac{2}{3}$; $-1, \frac{2}{3}$; they are the same.

$a = 2, b = -9, c = 10$; $\frac{5}{2}, 2$; $\frac{5}{2}, 2$; they are the same.

3. Substituting the values for a, b, and c into the given formula gives the solutions to the quadratic equation $ax^2 + bx + c = 0$.

Practice Level A

1. $a = 5, b = 7, c = 1$ **2.** $a = 2, b = -6, c = 11$ **3.** $a = -1, b = 17, c = -23$ **4.** $a = 10, b = -8, c = -13$ **5.** $a = -3, b = 1, c = -2$

6. $a = 5, b = -18, c = -3$ **7.** B **8.** C **9.** A

10. $-7.36, 1.36$ **11.** $-1.61, 5.61$ **12.** $-1, \frac{3}{5}$

13. $-7.74, -0.26$ **14.** $-9.90, -0.10$

15. no solution **16.** $-2, \frac{1}{3}$ **17.** no solution

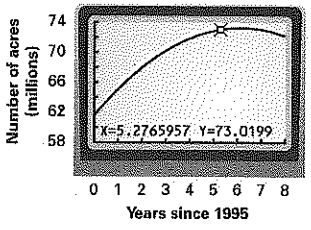
18. $0.42, 3.58$ **19.** no solution **20.** $\frac{1}{3}, 2$

21. no solution

22. a. $300 = 1.55x^2 - 5.1x + 197$; 2000
b. $237 = 1.55x^2 - 5.1x + 197$; 1997

23. a. $73 = -0.31x^2 + 3.8x + 61.6$; 2000, 2002

b.



Practice Level B

1. $-13.10, 6.10$ **2.** $-2.15, 2.48$ **3.** $-1.82, 2.07$

4. $-3.73, -0.27$ **5.** $-3, 4$ **6.** $-2.61, 1.28$

7. $-4.61, -1.39$ **8.** $-13.44, 7.44$

9. $-2.11, 2.36$ **10.** $-1.45, 1.25$ **11.** $-\frac{3}{2}, \frac{1}{3}$

12. no solution **13.** *Sample answer:* Use finding square roots because the equation can be written in the form $x^2 = d$. **14.** *Sample answer:* Use finding square roots because the equation can be written in the form $x^2 = d$. **15.** *Sample answer:* Use factoring because the equation is easily factored.

16. *Sample answer:* Use factoring because the equation is easily factored.

17. *Sample answer:* Use the quadratic formula because the equation cannot be factored easily.

18. *Sample answer:* Use the quadratic formula because the equation cannot be factored easily.

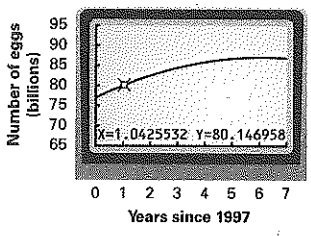
19. $-2.24, 2.24$ **20.** 8 **21.** $-4.70, 1.70$

22. 7 **23.** $-7.80, 1.80$ **24.** no solution

25. a. $500 = 1.36x^2 + 27.8x + 304$; between 1995 and 1996 **b.** $575 = 1.36x^2 + 27.8x + 304$; 1997

26. a. $80 = -0.27x^2 + 3.3x + 77$; 1998

b.



Practice Level C

1. $-\frac{1}{3}, -\frac{1}{5}$ **2.** $\frac{1}{2}, 1$ **3.** $-1.10, 0.10$

4. $-1.90, 7.90$ **5.** $-0.27, 2.77$ **6.** $-3.30, 0.30$

7. $-0.30, 3.30$ **8.** $4.35, 9.65$ **9.** $-0.87, 3.67$

10. no solution **11.** $-0.34, 0.80$

12. $-1.78, 0.28$ **13.** *Sample answer:* Use factoring because the equation is easily factored.

14. *Sample answer:* Use the quadratic formula because the equation cannot be factored easily.

15. *Sample answer:* Use the quadratic formula because the equation cannot be factored easily.

16. $-2.45, 2.45$ **17.** no solution **18.** $-3.30, 0.30$

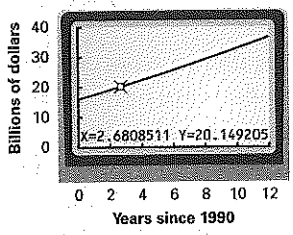
19. no solution **20.** $-7.36, 1.36$ **21.** no solution

22. $-\frac{3}{2}, \frac{3}{2}$ **23.** -3 **24.** $-17, -1$

25. a. between 1992 and 1993

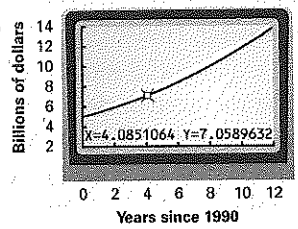
b. between 1999 and 2000

c.



26. a. 1994

b.



Study Guide

1. $-1.07, 13.07$ **2.** $-2.72, 0.52$ **3.** $-0.9, 0.6$ **4.** 2005 **5.** factor or complete the square **6.** quadratic formula **7.** complete the square

Problem Solving Workshop: Using Alternative Methods

1. 2001 **2.** The steps taken are to find the zero of the function and not when 50 million cassettes were shipped. There were 50 million cassettes shipped in 2001. **3.** 1.1 seconds **4.** 2000

Challenge Practice

1. $\frac{3}{2}x^2 + 4x + 1 = 0$ **2.** $\frac{7}{2}x^2 + 6x + \frac{41}{14} = 0$

3. $\frac{3}{2}x^2 - x + \frac{1}{6} = 0$ **4.** $\frac{15}{2}x^2 + 17x + \frac{134}{15} = 0$

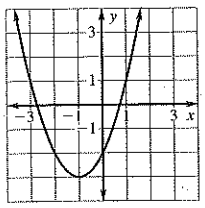
5. $\frac{11}{2}x^2 - 11x + 5 = 0$ **6.** $x = -\frac{5}{6}$

7. $x = 1$ **8.** $x = -\frac{1}{12}$

Lesson 10.7

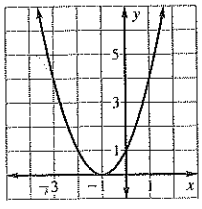
Teaching Guide

1.



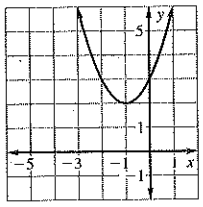
Because the graph has two x-intercepts, the equation $x^2 + 2x - 2 = 0$ has two solutions.

2.



Because the graph has one x-intercept, the equation $x^2 + 2x + 1 = 0$ has one solution.

3.



Because the graph has no x-intercepts, the equation $x^2 + 2x + 3 = 0$ has no solution.

4. *Sample answer*: By changing the value of c, the graph of $y = x^2 + 2x + c$ moves vertically up and down in the coordinate plane. If the graph is moved vertically up enough, it will not have an x-intercept and the equation $x^2 + 2x + c = 0$ will not have a solution. **5.** A quadratic solution can have 0, 1, or 2 solutions.

Practice Level A

1. $a = 2, b = 1, c = -10$ **2.** $a = 4, b = -5, c = 2$ **3.** $a = 1, b = -8, c = 11$ **4.** $a = -1, b = 6, c = -3$ **5.** $a = -1, b = -3, c = 12$ **6.** $a = 3, b = -4, c = 15$ **7.** -15 **8.** -23 **9.** 44 **10.** 4 **11.** -79 **12.** 52 **13.** 84 **14.** -271 **15.** 105 **16.** no solution **17.** two solutions **18.** two solutions **19.** two solutions **20.** two solutions **21.** two solutions **22.** two solutions **23.** no solution **24.** one solution **25.** two **26.** two **27.** two **28.** none **29.** none **30.** one **31. a.** $155 = -x^2 + 5x + 150$ **b.** discriminant: $5 > 0$ **c.** about 1.4 ft; about 3.6 ft **32.** $15 = -16t^2 + 20t + 5.5$; no

Practice Level B

1. no solution **2.** two solutions **3.** two solutions **4.** no solution **5.** two solutions **6.** two solutions **7.** two solutions **8.** no solution **9.** two solutions **10.** no solution **11.** two solutions **12.** one solution **13.** two **14.** two **15.** two **16.** none **17.** two **18.** two **19.** one **20.** none **21.** none **22.** two **23.** one **24.** two **25.** Answers will vary. **26.** Answers will vary. **27.** Answers will vary. **28.** Answers will vary. **29.** Answers will vary. **30.** Answers will vary. **31. a.** $150 = -x^2 + x + 156$ **b.** discriminant: $25 > 0$ **c.** 3 **32.** no

Practice Level C

1. no solution **2.** two solutions **3.** no solution

4. two solutions **5.** no solution

6. two solutions **7.** one solution **8.** no solution

9. two solutions **10.** two **11.** two **12.** none

13. two **14.** one **15.** two **16.** two **17.** two

18. two **19.** Answers will vary.

20. Answers will vary. **21.** Answers will vary.

22. Answers will vary. **23.** Answers will vary.

24. Answers will vary. **25.** below; the graph opens upward and the discriminant is positive

26. on the x-axis; the graph opens upward and the discriminant is 0 **27.** above; the graph opens upward and the discriminant is negative

28. a. $h = -16t^2 + 42t$ **b.** yes; at about 0.9 sec; at about 1.7 sec **29. a.** yes **b.** yes; First write 5 square feet as 720 square inches, substitute 720 for y in the equation and solve.

Study Guide

1. two solutions **2.** no solution **3.** one solution

4. 2 **5.** 0 **6.** 1

Math and History Application

1. 2 solutions **2.** 30; -29 does not make sense for a side length **3.** A good answer should include the fact that Babylonian algebra was used in practical, real-life situations, not abstract theories; Answers will vary.

Challenge Practice

1. $k = -2, k = 2$ **2.** $k = 1$ **3.** $k = \frac{40}{3}, k = 0$

4. $k = 0, k = \frac{1}{4}$ **5.** $k = 0, k = \frac{9}{8}$ **6.** $k > \frac{1}{3}$

7. $k < -\frac{147}{4}$ **8.** $k > \frac{3}{4}$ **9.** $k < \frac{1}{21}$

10. No solution **11.** $10 < x < 20$

Lesson 10.8

Teaching Guide

1. $y = mx + b$

Sample answer: With a linear equation in slope-intercept form, you can model a real-world situation that involves a constant rate of change.

2. $y = ab^x$

Sample answer: Quantities that increase by the same percent in equal periods of time can be represented by an exponential growth model.

3. $y = ax^2 + bx + c$

Sample Answer: Quantities that increase, reach a maximum value, and then decrease or quantities that decrease, reach a minimum value, and then increase can be represented by a quadratic function.

4. *Sample answer*: Linear and exponential functions represent quantities that are strictly increasing or strictly decreasing. However, the increase or decrease in an exponential model is the same percent, while the increase or decrease in a linear model is the same amount. Quadratic functions represent quantities that increase or decrease, reach a maximum or minimum value, and then decrease or increase.

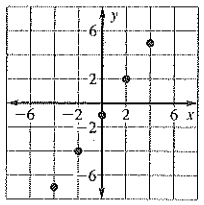
Practice Level A

1. C **2.** A **3.** B **4.** quadratic

5. quadratic **6.** linear **7.** linear

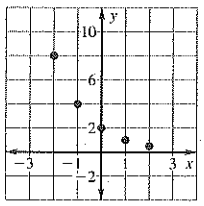
8. exponential **9.** exponential

10.



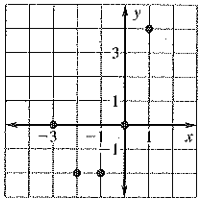
linear

11.



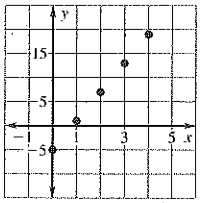
exponential

12.



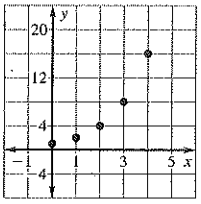
quadratic

13.



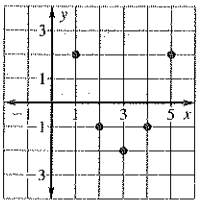
linear

14.



exponential

15.



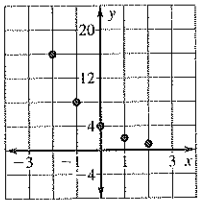
quadratic

16. linear **17.** exponential

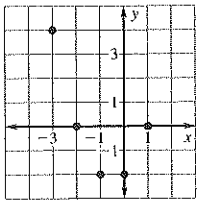
18. quadratic **19.** quadratic **20. a.** quadratic **b.** no; The salaries should not continue to fall; at some point they would rise. **21.** linear

Practice Level B

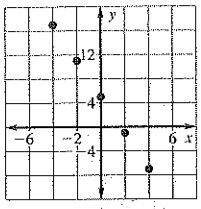
1. B **2.** C **3.** A

4. 

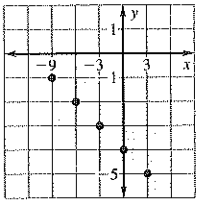
exponential

5. 

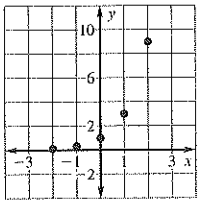
quadratic

6. 

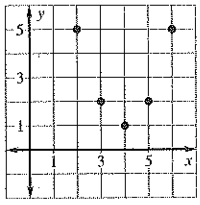
linear

7. 

linear

8. 

exponential

9. 

quadratic

10. exponential **11.** linear **12.** quadratic

13. linear **14.** exponential **15.** quadratic

16. linear **17.** exponential

18. a. exponential; The graph rises quickly.

b.

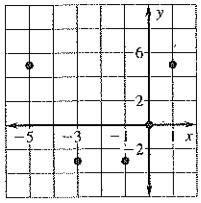
x	0	1	2	3	4
y	1	4	16	64	256

c. $y = 4^x$ **19.** Answers will vary.

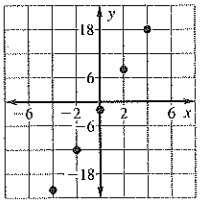
20. linear; $V = -75t + 800$

Practice Level C

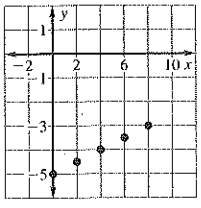
1. C **2.** A **3.** B

4. 

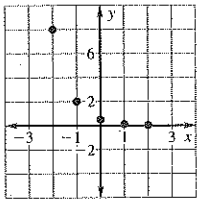
quadratic

5. 

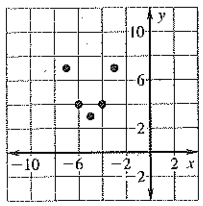
linear

6. 

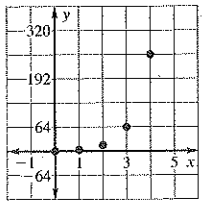
linear

7. 

exponential

8. 

quadratic

9. 

exponential

10. linear **11.** quadratic **12.** exponential

13. linear **14.** quadratic **15.** exponential

16. linear **17.** quadratic

18. a. exponential; The graph falls quickly.

b.

x	−3	−2	−1	0	1
y	64	16	4	1	0.25

c. $y = (0.25)^x$ **19.** linear; $V = -80t + 2000$

20. exponential; $B = 1020.20(1.02)^t$

Study Guide

1. quadratic function **2.** linear function

3. quadratic function: $y = x^2 - 5x + 6$

4. exponential function: $y = (0.25)(2)^x$

Problem Solving Workshop: Mixed Problem Solving

1. a. quadratic function **b.** $y = 20x^2$, where y is the power and x is the current

2. a. $h = -16t^2 + 80t + 6.5$ **b.** 5 seconds

3. a. $h = -16t^2 - 30t + 80$ **b.** 1.5 seconds

4. Answers will vary. **5. a.** The discriminant is positive, so there are two x-values that correspond to $y = 29$. **b.** The average monthly basic rate for cable television reached \$29 in 1999. The other value can be disregarded since it is negative.

6. 8.913 **7. a.** $A = 4x^2 + 136x$ **b.** 3 feet **c.** You can ignore the negative value because a negative width does not make sense.

Challenge Practice

1. linear model **2.** 13 **3.** $y = 2x + 3$

4. exponential model **5.** 34.17188

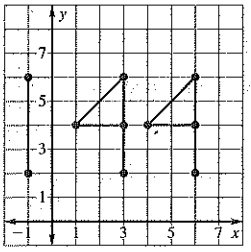
6. $y = 2(1.5)^x$ **7.** quadratic model

8. 361 **9.** $y = 3x^2 - 2$ **10.** about 930 pounds

Review and Project

Review Games and Activities

1. $(-1, 2)$ **2.** $(-1, 6)$ **3.** $(3, 2)$ **4.** $(3, 6)$
5. $(1, 4)$ **6.** $(3, 4)$ **7.** $(6, 2)$ **8.** $(6, 6)$ **9.** $(4, 4)$
10. $(6, 4)$



144 feet

Project: How Warm Is Your City?

1–4. Answers will vary.

Cumulative Review

1. 47 **2.** 12 **3.** 12 **4.** $\frac{1}{16}$ **5.** 45 **6.** 16

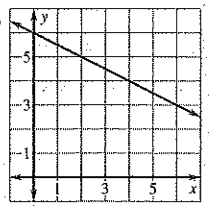
7. $-\frac{1}{2}$ **8.** 4.3 **9.** -3.3 **10.** $\frac{1}{9}$ **11.** -6

12. $\frac{1}{121}$ **13.** -3 **14.** -14 **15.** 3 **16.** 4.5 pints

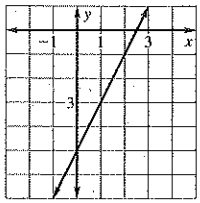
17. 60% **18.** $m = 7; b = 2$ **19.** $m = \frac{2}{3}; b = 3$

20. $m = \frac{9}{5}; b = -9$

21.



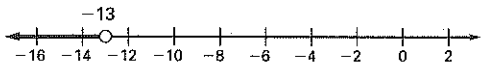
22.



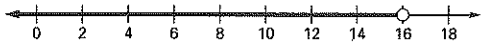
23. $y = -\frac{1}{2}x + 6$ **24.** $y = -3x + 7$

25. $y = 2x$ **26.** $y = -\frac{1}{3}x - 3$

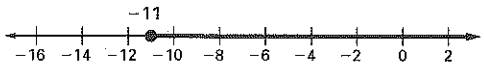
27. $x < -13$;



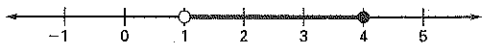
28. $x < 16$;



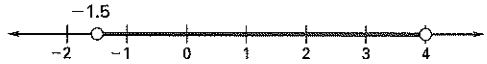
29. $x \geq -11$;



30. $1 < x \leq 4$;

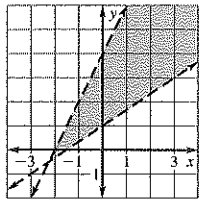


31. $-1.5 < x < 4$;

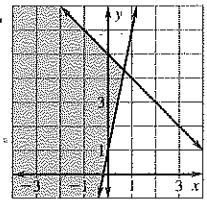


32. no solution **33.** $(4, 6)$ **34.** $(3, -4)$
35. $(2, 6)$

36.



37.



38. 6^3 **39.** 729 **40.** p^{24} **41.** $\frac{16y^8}{9x^6}$

42. 1.521×10^9 **43.** 4.75×10^5
44. 1.656×10^{-2} **45.** $3x^2 + 31x - 22$
46. $49y^2 - 42y + 9$ **47.** $5z^3 + 39z^2 - 2z - 24$

48. $0, \frac{4}{7}$ **49.** $-2, 0, 2$ **50.** $-8, 7$

51. $x = 12$ in.; length $= 56$ in.; height $= 24$ in. **52.** two solutions **53.** one solution **54.** no solution