Answers for Lesson 5-1 Exercises

1. linear; none, x, 4

2. quadratic; $2x^2$, $-3x$, 5

3. quadratic; $3x^2$, $-6x$, none

4. quadratic; x^2, none, -7

5. quadratic; x^2, $3x$, -10

6. linear; none, $-7x$, 28

7. quadratic; $6x^2$, none, 6

8. linear; none, x, -1

9. quadratic; $-2x^2$, $-8x$, none

10. $(0, -4)$, $x = 0$

11. $(-1, 0)$, $x = -1$

12. $(-1, -4)$, $x = -1$

13. $P'(6, 9)$, $Q'(2, 1)$

14. $P'(1, 5)$, $Q'(-2, 8)$

15. $P'(-1, -1)$, $Q'(-4, -4)$

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

17. $y = x^2 - 5x + 2$

18. $y = 2x^2 - x + 3$

19. $y = x^2 + 2x$

20. $y = -3x^2 + 20$

21. **a.** $y = -16x^2 + 33x + 46$, where x is the number of seconds after release and y is height in feet.

b. 28.5 ft

22. **a.** $y = 0.0236x^2 + 0.907x - 2.09$

b. 58.5%

23. $y = 4x^2$

24. $y = -2x^2 + 3x + 5$

25. no

26. $y = \frac{5}{8}x^2 - \frac{7}{4}x + 1$

27. $\left(-\frac{1}{2}, -\frac{1}{2}\right)$, $x = -\frac{1}{2}$

28. $(-1, 4)$, $x = -1$

29. $\left(\frac{1}{2}, 0\right)$, $x = \frac{1}{2}$

30. **a.** x: 4, 5; y: 6, 10

b. $y = \frac{1}{2}x^2 - \frac{1}{2}x$

c. 45 segments

31. **a.** $y = -0.0112x^2 + 1.24x + 9.97$

b. Answers may vary. Sample: domain, whole numbers from 0 to 50; range, positive whole numbers to 200.

c. 1992

d. Never; the quadratic model reaches a maximum of about 45 cents, so it is useful for only a limited number of years.

32. 3 **33.** 8 **34.** 6

35. $-\frac{11}{8}$ **36.** $\frac{25}{4}$ **37.** -10

38. **a.** $y = 3.157x - 52.34$

b. $y = 0.04243x^2 - 0.04080x + 0.8890$

c. Answers may vary. Sample: Quadratic; the quadratic model comes closer to most data points than the linear model because the data follows a curve.

39. Answers may vary. Sample: $y = -\frac{1}{25}x^2$, $y = \frac{1}{25}x^2 - \frac{2}{5}x$, $y = \frac{1}{5}x^2 - \frac{6}{5}x$

40. Answers may vary. Sample: You need at least 3 points; you are going to substitute x- and y-values into $y = ax^2 + bx + c$ to set up and solve a linear system for finding values of a, b, and c.

41. Answers may vary. Sample: They are similar in that both are symmetric with respect in the y-axis, have only non-negative y-values, lie in Quadrants I and II, and have minimums at $(0, 0)$; they are different in that the graph of $y = x^2$ rises more steeply, while $y = |x|$ rises at a steady rate as $|x|$ increases.

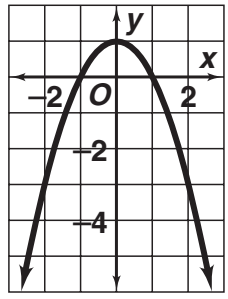
42. $(3, 5)$

43. a. You can find how high the arrow was when it was released.

b. The negative intercept tells you how much earlier you would have to shoot the arrow from a height of zero for its height to be described by the same function. The positive intercept tells you how many seconds after the release the arrow will take to hit the ground.

Answers for Lesson 5-2 Exercises

1.



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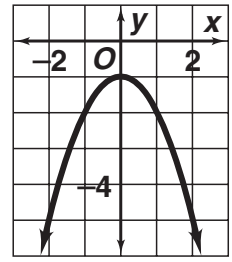

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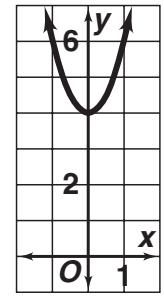

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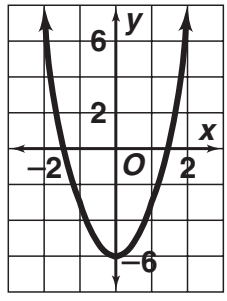

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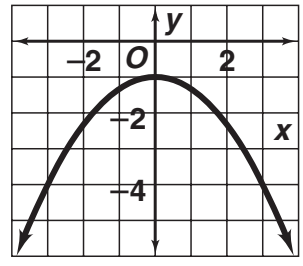

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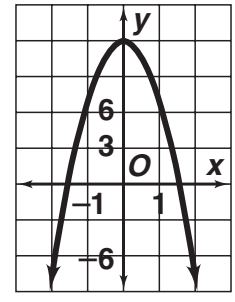

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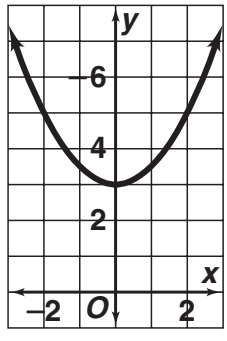

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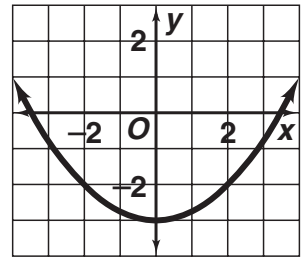

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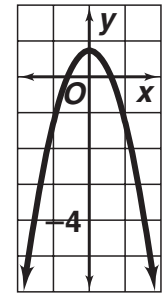

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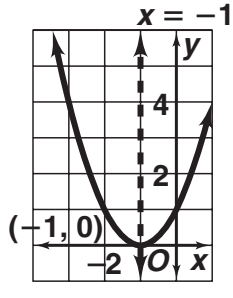

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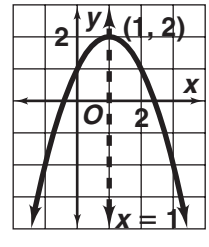

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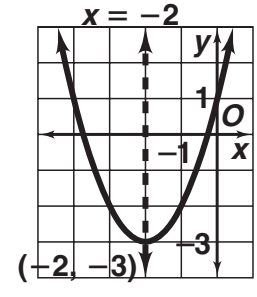

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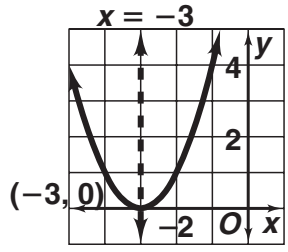

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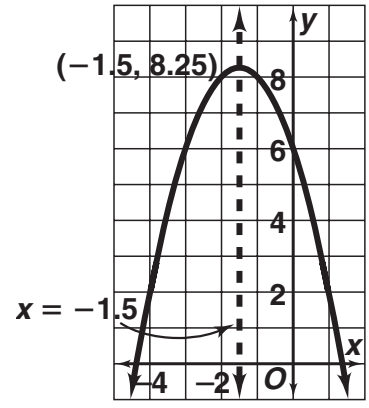

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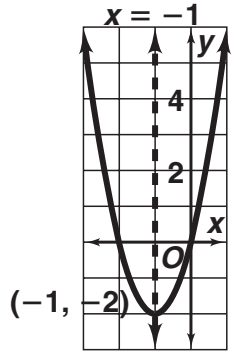

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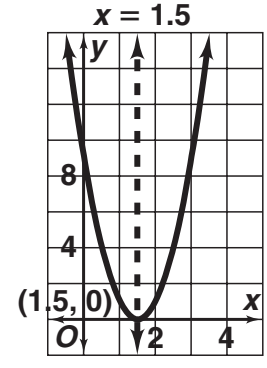

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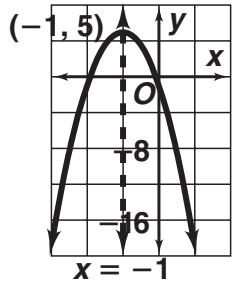

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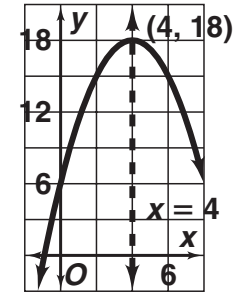

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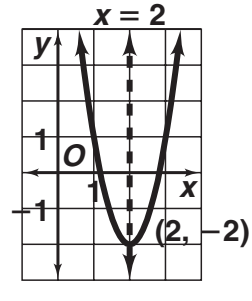

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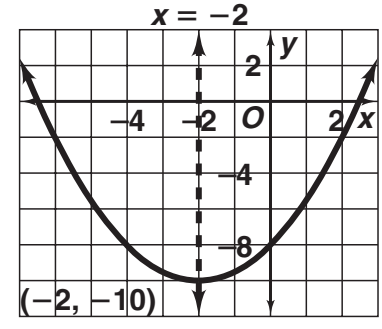
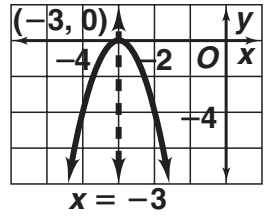
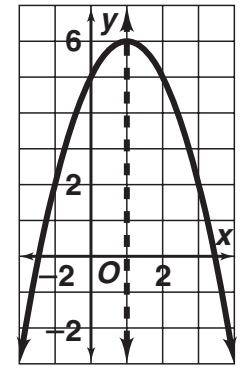
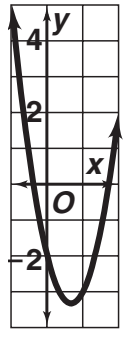


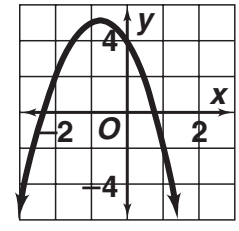
21. 

22. 

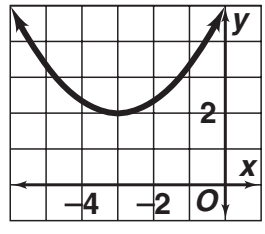
max, 6

23. 

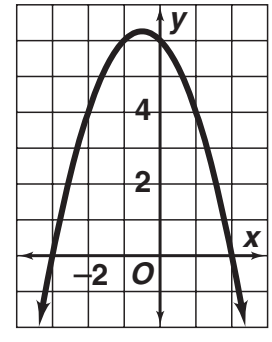
min, $-\frac{10}{3}$

24. 

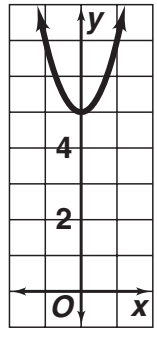
max, $\frac{41}{8}$

25. 

min, 2

26. 

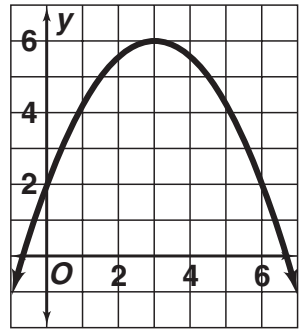
max, $6\frac{1}{4}$

27. 

min, 5

28. \$10; \$13,500 **29.** 2 s; 64 ft **30.** 1000 tires; \$20

31.



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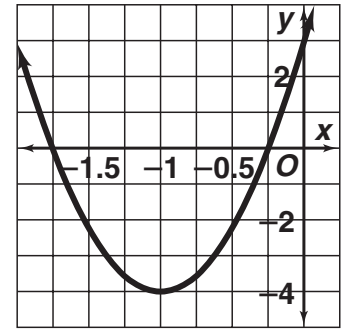

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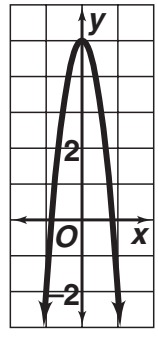

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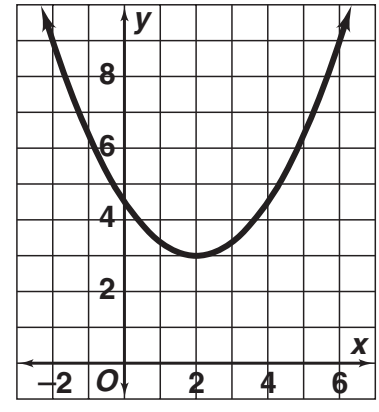


35. 13, 13; 169

36. −5, 5; −25

37. B **38.** C **39.** A

40. Answers may vary. Sample: $y = x^2 + 20x + 96$

41. 2.25 ft by 2.25 ft; 5.0625 ft^2 **42.** $y = -\frac{1}{10}x^2 + 10$

43. length = 9 cm, width = 9 cm

44. 5 **45.** −3 **46.** −2 **47.** 2

48. $y = \frac{1}{3}x^2 + 2$ **49.** $y = -4x^2 - 3$ **50.** $y = \frac{3}{4}x^2 - \frac{1}{2}$

51. $y = 10x^2 - 1$ **52.** $y = -\frac{5}{2}x^2$ **53.** $y = 6x^2 + 8$

54. **a.** \$20

b. \$6050

c. Check students' work.

55. B

56. **a.** Check students' work.

b. 60 bricks by 60 bricks

57. $y = x^2 + 1$; up

58. $y = 5x^2 + 1$; up

59. $y = -\frac{1}{2}x^2 + 1$; down

60. $y = -\frac{1}{2}x^2 + 1$; down

61. $y = \frac{1}{3}x^2 + 1$; up

62. $y = -\frac{1}{5}x^2 + 1$; down

63. $y = -\frac{1}{4}x^2 + 1$; down

64. $y = -\frac{1}{12}x^2 + 1$; down

65. **a.** $y = \frac{1}{14{,}400}x^2$

b. $y = \frac{1}{14{,}400}x^2 - \frac{1}{20}x$

c. $y = \frac{1}{14{,}400}x^2 + \frac{1}{20}x$

66. **a.** Check students' work.

b. Answers may vary. Sample: The widths of $y = ax^2 + bx + c$ and $y = -ax^2 + bx + c$ are the same. As $|a|$ increases, the width of $y = ax^2 + bx + c$ and $y = -ax^2 + bx + c$ decrease.

67. $-6, 24$

68. $1, 2$

69. $3, -12$

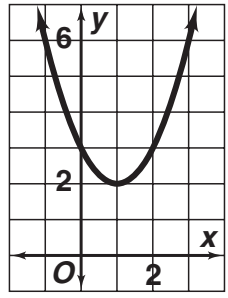
70. $-\frac{2}{9}, -\frac{4}{3}$

71. $10\frac{2}{3}$ square units

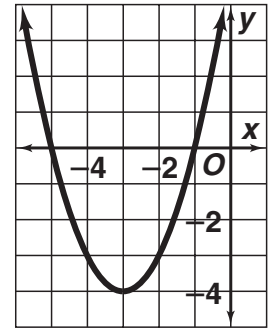
72. $10\frac{2}{3}$ square units

73. $10\frac{2}{3}$ square units

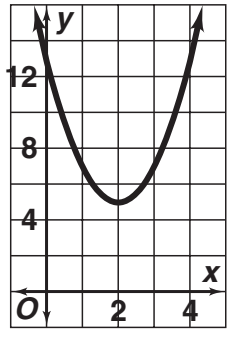
Answers for Lesson 5-3 Exercises

1. 

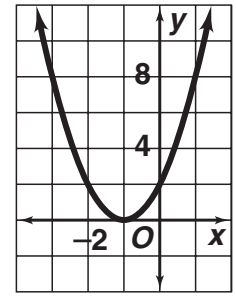
$x = 1$

2. 

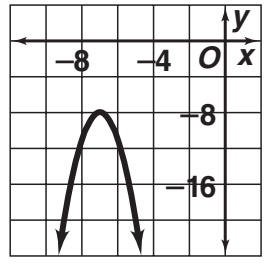
$x = -3$

3. 

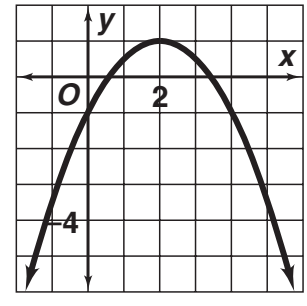
$x = 2$

4. 

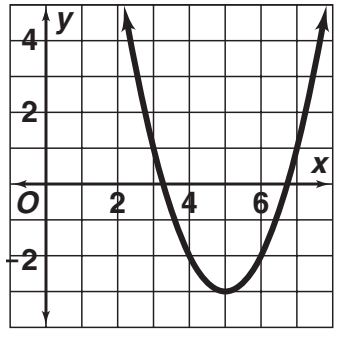
$x = -1$

5. 

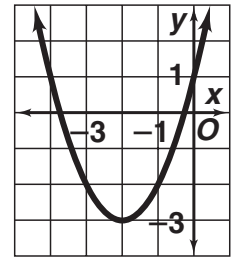
$x = -7$

6. 

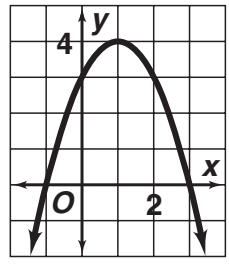
$x = 2$

7. 

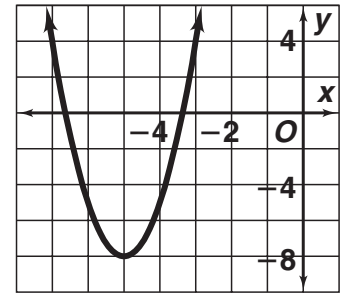
$x = 5$

8. 

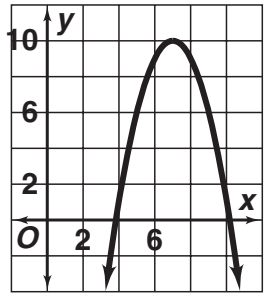
$x = -2$

9. 

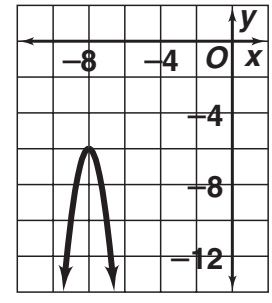
$x = 1$

10. 

$x = -5$

11. 

$x = 7$

12. 

$x = -8$

13. $y = \frac{1}{4}x^2$

14. $y = -x^2 + 4$

15. $y = -(x - 2)^2$

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

17. $y = (x - 2)^2$

18. $y = -2x^2$

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

20. $y = -(x - 1)^2 + 2$

21. $(-20, 0), -600$

22. $(3.2, 0), 1.024$

23. $(-5.5, 0), 726$

24. $(-1, -1), -0.9965$

25. $(4, -25), -41$

26. $(125, 125), 15{,}750$

27. $y = (x - 2)^2 + 2$

28. $y = (x + 1)^2 + 4$

29. $y = 6x^2 - 10$

30. $y = -5x^2 + 12$

31. $y = 4\left(x + \frac{7}{8}\right)^2 - \frac{49}{16}$

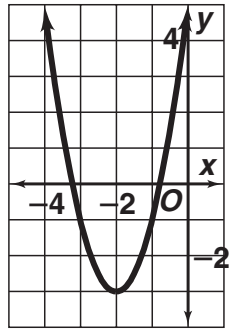
32. $y = 2\left(x + \frac{1}{4}\right)^2 - \frac{1}{8}$

33. $y = 4\left(x - \frac{5}{4}\right)^2 + \frac{71}{8}$

34. $y = -2(x - 2)^2 + 11$

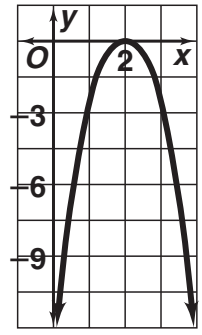
35. $y = \frac{9}{4}\left(x + \frac{2}{3}\right)^2 - 2$

36.



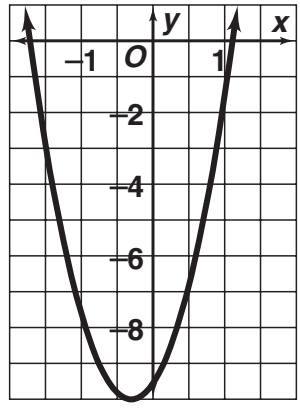
$x = -2$

37.



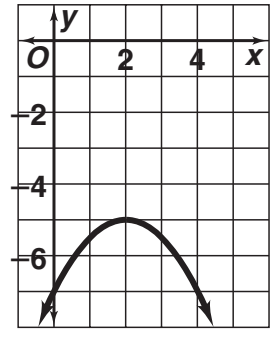
$x = 2$

38.



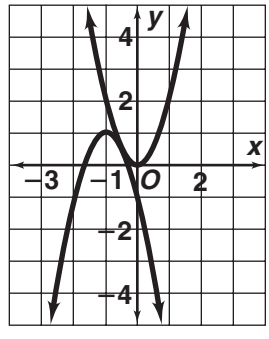
$x = -0.3$

39.

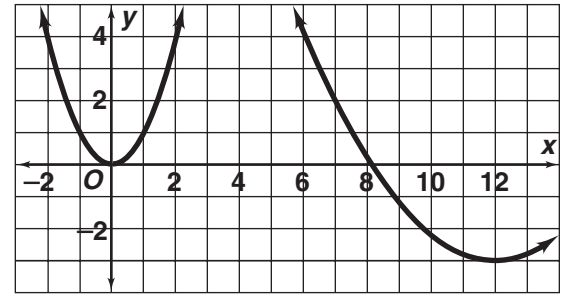


$x = 2$

40.



41.



42. **a.** All nonnegative numbers; a price cannot be negative; it would imply that the bakery pays people to take bread.

b. \$277.50; \$210.00

c. \$0.55

d. \$300.00

43. $y = -7(x - 1)^2 + 2$

44. $y = -\frac{4}{9}(x - 3)^2 + 6$

45. $y = -\frac{1}{2}(x + 3)^2 + 6$

46. $y = \frac{3}{2}(x + 2)^2 + 6$

47. $y = 7(x + 1)^2 - 4$

48. $y = -7x^2 + 5$

49. $y = -10\left(x - \frac{1}{10}\right)^2 - \frac{9}{10}$

50. $y = 8\left(x - \frac{1}{4}\right)^2 - \frac{3}{2}$

51. $y = 25x^2 + 60x + 27$

52. $y = -9x^2 + 24x - 10$

53. $y = 2x^2 + 22x$

54. $y = \frac{1}{2}x^2 - 5x + \frac{35}{2}$

55. $y = -10x^2 - 40x - 40$

56. $y = 16x^2 - 8x + 2$

57. **a.** first: $x = 4$, second: $x = 2.5$

b. For the first spreadsheet the x_1-values 3 and 5 are equidistant from 4 and their y_1-values are both -3. In the second spreadsheet, the x_2-values 2 and 3 are equidistant from 2.5 and their y_2-values are both 2.

c. $y = -4(x - 4)^2 + 1$; $y = 4\left(x - \frac{5}{2}\right)^2 + 1$

58. Each function of the family has (3, 4) as the vertex and $x = 3$ as the line of symmetry. Functions in the family have different stretch factors. So the equation for the family is $fx = a(x - 3)^2 + 4$, where a is any real number.

59. yes

60. yes

61. no; $y = -3\left(x + \frac{1}{3}\right)^2 + \frac{4}{3}$

62. yes

63. no; $y = (x + 1)^2 + 7$

64. yes

65. no; $y = -4\left(x - \frac{3}{4}\right)^2 + \frac{21}{4}$

66. yes

67. no; $y = 100\left(x - \frac{1}{5}\right)^2 + 6$

68. Any real numbers a and k such that $a + k = 1$ will work. However, if $a = 0$ and $k = 1$, the function will be linear rather than quadratic.

69. $a = 3, k = -1$

70. $a = -6, k = 35$

71. $a = \frac{1}{5}, k = 1$

72. $a = -\frac{22}{3}, k = \frac{74}{3}$

73. $a = 1, k = -650$

74. A

75. Check students' work.

76. minimum; 150

77. Answers may vary. Sample: The graph of $y = (x - 6)^2 + 7$ is the graph of $y = (x + 6)^2$ translated right 12 units and up 7 units.

78. **a.** $ah^2 + k$

b. $h = 0$ or $a = 0$ (Note, however, that if $a = 0$, the function will not be quadratic.)

79. $y = \frac{1}{4}x^2$

80. $y = \frac{1}{2}(x + 3)^2$

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

82. $y = -\frac{1}{4}(x - 4)^2$

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

84. $y = -4(x + 3)^2$

Answers for Lesson 5-4 Exercises

1. $3; 3(a^2 + 3)$ **2.** $5; 5(5b^2 - 7)$ **3.** $x; x(x - 2)$

4. $t; t(5t + 7)$ **5.** $7y; 7y(2y + 1)$ **6.** $9p; 9p(3p - 1)$

7. $(x + 1)(x + 2)$ **8.** $(x + 2)(x + 3)$ **9.** $(x + 2)(x + 5)$

10. $(x + 2)(x + 8)$ **11.** $(y + 3)(y + 12)$ **12.** $(x + 2)(x + 20)$

13. $(x - 1)(x - 2)$ **14.** $(x - 12)(x - 1)$ **15.** $(r - 2)(r - 9)$

16. $(x - 4)(x - 6)$ **17.** $(d - 3)(d - 9)$ **18.** $(x - 4)(x - 9)$

19. $(x - 7)(x + 2)$ **20.** $(x + 5)(x - 4)$ **21.** $(x - 8)(x + 5)$

22. $(c + 9)(c - 7)$ **23.** $(x + 15)(x - 5)$ **24.** $(t - 11)(t + 4)$

25. $(3x + 4)(x + 9)$

26. $(x - 8)(2x - 3)$

27. $(r + 2)(5r + 13)$

28. $(m - 3)(2m - 5)$

29. $(t + 4)(5t + 8)$

30. $(x - 12)(2x - 3)$

31. $(x + 4)(3x - 5)$

32. $(y + 4)(5y - 8)$

33. $(x - 2)(7x + 6)$

34. $(z + 4)(2z - 7)$

35. $(x + 4)(3x - 4)$

36. $(4k + 3)(7k - 2)$

37. $(x + 1)^2$

38. $(t - 7)^2$

39. $(x - 9)^2$

40. $(2n - 5)^2$

41. $(3x + 8)^2$

42. $(9z + 2)^2$

43. $(x + 2)(x - 2)$

44. $(c + 8)(c - 8)$

45. $(3x + 1)(3x - 1)$

46. $x^2 - 16; (x + 4)(x - 4)$

47. $5x - 1$ by $5x - 1$

48. $(3x - 17)$ cm

49. $(x + y)^2 - y^2; x(x + 2y)$

50. $(x - 7)$ ft

51. $9(x + 2)(x - 2)$

52. $2(3z + 2)(3z - 2)$

53. $3(2y + 5)(2y - 5)$

54. $16(2t + 1)(2t - 1)$

55. $3(2x + 3)^2$

56. $4(2x - 5)^2$

57. $2(a - 4)^2$

58. $3(x - 9)(x + 1)$

59. $2(3b - 1)(3b + 5)$

60. $4(n - 2)(n - 3)$

61. $3(y + 3)(y + 5)$

62. $-(x - 1)(x - 4)$

63. $2(x - 5)(2x - 1)$

64. $\frac{1}{2}(x + 1)(x - 1)$

65. $-6(z^2 + 100)$

66. $\pi h(R + r)(R - r)$

67. $(x - 70)$ ft

68. Factor 3 from the terms to get $3(x^2 + 2x - 24)$. Look for numbers whose product is -24 and whose sum is 2. The numbers -4 and 6 work. The complete factorization is $3(x - 4)(x + 6)$.

69. Check students' work.

70. The third line should be $x(2x - 5) - (2x - 5)$, and the final line should be $(x - 1)(2x - 5)$.

71. First factor out $4x^2$ to get $4x^2(x^2 + 6x + 8)$.
To factor $x^2 + 6x + 8$, note that the numbers 2 and 4 have a product of 8 and a sum of 6. The complete factorization is $4x^2(x + 2)(x + 4)$.

72. $(0.5t + 0.4)(0.5t - 0.4)$

73. $100(9x - 10)(9x + 10)$

74. $100(6z - 7)(6z + 7)$

75. $(x + 12)(x - 3)$

76. $(x - 10)(x - 9)$

77. $(2x + 9)(3x + 14)$

78. $2(a + 1)(6a - 7)$

Answers for Lesson 5-5 Exercises

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

4. 5 **5.** $-2, -1$ **6.** $-\frac{2}{3}, 6$

7. $-4, 4$ **8.** $-2, 2$ **9.** $-4, 4$

10. $-\frac{5}{3}, \frac{5}{3}$ **11.** $-\sqrt{5}, \sqrt{5}$ **12.** $-2\sqrt{2}, 2\sqrt{2}$

13. $0, 4$ **14.** $-\frac{2}{3}, 0$ **15.** $-\frac{7}{2}, \frac{7}{2}$

16. $-4, 4$ **17.** $0, 4$ **18.** $-2\sqrt{5}, 2\sqrt{5}$

19. **a.** about 6.61 s

b. about 6.89 s

20. $-4.30, -0.70$ **21.** $-1.32, 8.32$ **22.** $-0.78, 1.28$

23. $-1.67, -1.5$ **24.** $-0.59, 2.26$ **25.** $-0.94, 2.34$

26. $-5.53, 0.36$ **27.** $-1, 0.25$ **28.** $-3.12, 5.12$

29. $-1.46, 5.46$ **30.** $-5.16, 1.16$ **31.** $-1.16, 2.16$

32. **a.** Answers may vary. Sample: $\frac{\ell}{w} \approx \frac{7.2 \text{ cm}}{4.4 \text{ cm}} \approx 1.6$

b. the tree trunk

33. B

34. Check students' work.

35. 3 ft

36. $-10, 4$ **37.** $3, 8$ **38.** $-3, 3$

39. $-\frac{1}{2}, 3$ **40.** $-8.69, 0.69$ **41.** $-\frac{3}{2}, -\frac{2}{3}$

42. $-4, \frac{5}{2}$ **43.** $-5.89, 5.89$ **44.** $-3.25, 0.92$

45. $-3.58, 3.58$ **46.** $-4, 0$ **47.** $1, 7$

48. $-5, 3$ **49.** $-10, -1$ **50.** $-1.5, 0.5$

51. $-6, 0$ **52.** $-1, 4$ **53.** $-4, 3.5$

54. $(-1, 1), (2, 4)$ **55.** $(0, -2), (2, 2)$ **56.** $\left(-\frac{5}{3}, -\frac{4}{9}\right), (2, 2)$

57. To find the x-coordinates, set the right side of the first equation equal to the right side of the second equation and solve for x. Then find the corresponding y-values by substituting each solution into the simpler of the two original equations.

58. Answers may vary. Sample: $x^2 - 8x + 15 = 0$

59. Answers may vary. Sample: $x^2 + x - 6 = 0$

60. Answers may vary. Sample: $x^2 + 7x + 6 = 0$

61. Answers may vary. Sample: $6x^2 - 7x + 2 = 0$

62. $x = 4, y = 1$ or $x = -4, y = 9$

63. Answers may vary. Sample: If tables show same-sign values approaching 0, there likely is one solution. If same-sign values never approach 0, there likely are no solutions.

64. Solve $(x - 4)(x - 6) = 0$ to find that the zeros of $y = x^2 - 10x + 24$ are 4 and 6. Average 4 and 6 to get 5. This is the x-coordinate of the vertex. Substitute 5 for x in $x^2 - 10x + 24$ to find that -1 is the y-coordinate of the vertex. The vertex is $(5, -1)$.

65. a. 100 ft

b. 5 s

66. a. Answers may vary. Sample: If $x \neq h$, then $x - h$ will be nonzero, $(x - h)^2$ will be positive, and a$(x - h)^2$ will be positive. Adding a positive to k will always result in a number greater than k. So the point (h, k) is the lowest point when $x = h$ on the graph of $y = (x - h)^2 + k$.

b. No; $(x - h)^3$ can be negative.

Answers for Lesson 5-6 Exercises

1. $2i$ **2.** $i\sqrt{7}$ **3.** $i\sqrt{15}$

4. $9i$ **5.** $5i\sqrt{2}$ **6.** $4i$

7. $4i\sqrt{2}$ **8.** $9i$ **9.** $-10i$

10. $6i\sqrt{2}$ **11.** $2 + i\sqrt{3}$ **12.** $8 + 2i\sqrt{2}$

13. $6 - 2i\sqrt{7}$ **14.** $3 + 2i$ **15.** $7 - 5i$

16. $2 + i$ **17.** $-2 - 5i\sqrt{2}$ **18.** $4 + 6i\sqrt{2}$

19. 2 **20.** 13 **21.** $2\sqrt{2}$

22. $\sqrt{17}$ **23.** $3\sqrt{5}$ **24.** $-4i$

25. $-5 + 3i$ **26.** $-9 - i$ **27.** $3 + 2i$

28. $4 - 7i$ **29.** $6 + 3i$ **30.** $1 - 7i$

31. $7 + 4i$ **32.** $-2 - 3i$ **33.** $10 + 6i$

34. $-7 - 10i$ **35.** 10 **36.** $26 - 7i$

37. $9 + 58i$ **38.** $9 - 23i$ **39.** -36

40. $65 + 72i$ **41.** $\pm 5i$ **42.** $\pm\frac{i\sqrt{2}}{2}$

43. $\pm\frac{8i\sqrt{3}}{3}$ **44.** $\pm i\sqrt{7}$ **45.** $\pm 6i$

46. $\pm\frac{i\sqrt{15}}{5}$ **47.** $-i, -1 - i, i$

48. $-2i, -4 - 2i, 12 + 14i$ **49.** $1 - i, 1 - 3i, -7 - 7i$

50. $\pm i\sqrt{65}$ **51.** $\pm 7i$ **52.** $\pm i$

53. No; the test scores were real numbers. He added the scores and divided by the number of scores. The set of real numbers is closed with respect to addition and division so he should have gotten a real number.

54. **a.** A: -5, B: $3 + 2i$, C: $2 - i$, D: $3i$, E: $-6 - 4i$, F: $-1 + 5i$

b. $5, -3 - 2i, -2 + i, -3i, 6 + 4i, 1 - 5i$

55. B **56.** $-5, 5$ **57.** $288i$

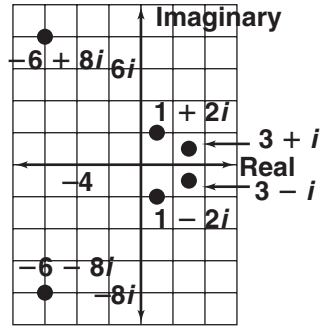
58. $-1 + 5i$ **59.** $10 - 4i$ **60.** $8 - 2i$

61. $11 - 5i$ **62.** $6 + 10i$ **63.** $7 - i$

64. $10 + 11i$ **65.** $-27 + 8i$ **66.** $-13 + i$

67. **a.** row 2: $2, 5, \sqrt{5}, \sqrt{5}$
row 3: $6, 10, \sqrt{10}, \sqrt{10}$
row 4: $-12, 100, 10, 10$

b. Answers may vary. Sample: The sum of a complex number $a + bi$ and its conjugate is $2a$. The product of $a + bi$ and its conjugate is the square of the absolute value of $a + bi$. The absolute values of a complex number and its conjugate are equal.

c. 

They are symmetric images of each other with respect to the real axis.

d. True; the additive inverse of $a + bi$ is $-a - bi$, and the conjugate of $-a - bi$ is $-a + bi$. The conjugate of $a + bi$ is $a - bi$, and the additive inverse of $a - bi$ is $-a + bi$.

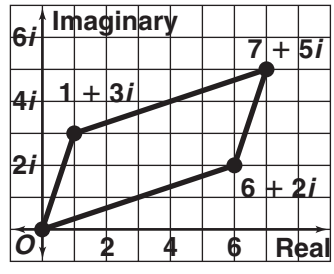
68. $x = -7, y = 3$ **69.** $x = \frac{16}{3}, y = -\frac{19}{8}$ **70.** $x = -7, y = -3$

71. $(a + bi)(a - bi) = a^2 + b^2$; since a and b are real, so is $a^2 + b^2$.

72. $0.383 + 0.11i, 0.517589 + 0.19426i$

73. nonzero real numbers x and y

74. $(3 + 4i)^1 = 3 + 4i$ and $3^2 + 4^2 = 25$;
$(3 + 4i)^2 = -7 + 24i$ and
$(-7)^2 + (24)^2 = 625 = 25^2$; $(3 + 4i)^3 = -117 + 44i$ and
$(-117)^2 + (44)^2 = 15{,}625 = 25^3$;
$(3 + 4i)^4 = -527 - 336i$ and
$(-527)^2 + (-336)^2 = 390{,}625 = 25^4$;
$(3 + 4i)^5 = -237 - 3116i$ and
$(-237)^2 + (-3116)^2 = 9{,}765{,}625 = 25^5$

75. 

If the points for the origin, $a + bi$, $c + di$, and the sum are not collinear, then they form the vertices of a parallelogram.

Answers for Lesson 5-7 Exercises

1. $-4, -2$ **2.** $-8, 12$ **3.** $-1, 3$

4. $-\frac{16}{3}, -\frac{8}{3}$ **5.** $-4, 3$ **6.** $1, 11$

7. 81 **8.** $\frac{1}{4}$ **9.** 144

10. 100 **11.** $\frac{9}{4}$ **12.** 4

13. $-4, 7$ **14.** $-1, 4$ **15.** $-3 \pm 4i\sqrt{2}$

16. $1 \pm i$ **17.** $-1, 9$ **18.** $-3 \pm i\sqrt{13}$

19. $\pm 2i$ **20.** $-1 \pm 2i$ **21.** $1 \pm \sqrt{5}$

22. $\frac{3}{2} \pm \frac{i\sqrt{31}}{2}$ **23.** $2 \pm \frac{\sqrt{15}}{3}$ **24.** $-\frac{5}{4} \pm \frac{i\sqrt{3}}{4}$

25. $-4, \frac{7}{2}$ **26.** $\frac{2}{3} \pm \frac{1}{3}i$ **27.** $-\frac{3}{2}, \frac{1}{2}$

28. $y = (x + 2)^2 - 11$ **29.** $y = -(x - 2)^2 + 3$

30. $y = -2\left(x - \frac{3}{2}\right)^2 + \frac{11}{2}$ **31.** $y = (x + 2)^2 - 3$

32. $y = 2(x - 2)^2 - 7$ **33.** $y = -(x + 1)^2 + 4$

34. $y = -4\left(x + \frac{5}{8}\right)^2 + \frac{73}{16}; \left(-\frac{5}{8}, \frac{73}{16}\right)$

35. $y = \frac{1}{2}(x - 5)^2 - \frac{1}{2}; \left(5, -\frac{1}{2}\right)$

36. $y = -\frac{1}{5}(x - 2)^2 + 3; (2, 3)$

37. **a.** $(60, 5000)$

b. positive rational numbers less than 130; whole numbers up to 5000

c. \$60; \$5000

38. Add -11 to each side of the given equation to obtain $x^2 + 8x = -11$. Then add the square of half the coefficient of x to each side to obtain $x^2 + 8x + 4^2 = -11 + 4^2$, or $x^2 + 8x + 16 = 5$. Rewrite the left side of the last equation as $(x + 4)^2$ to obtain $(x + 4)^2 = 5$.

39. **a.** (59, 36.81)

b. 36.81 ft

c. 7.65 ft

d. about 120 ft

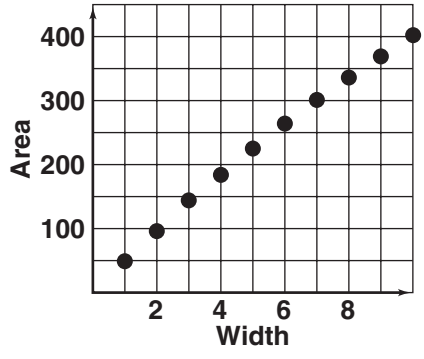
e. Answers may vary. Sample: The path is parabolic. Also, the linear model does not predict that the ball will eventually hit the ground.

40. $-10, 10$ **41.** $-20, 20$ **42.** $-22, 22$

43. $-16, 16$ **44.** $-18, 18$ **45.** $-10, 10$

46. $-1, 1$ **47.** $-12, 12$ **48.** $-12, 12$

49. row 2: 47, 46, 45, 44, 43, 42, 41, 40
row 3: 96, 141, 184, 225, 264, 301, 336, 369, 400

a. 

$A = -w^2 + 50w$

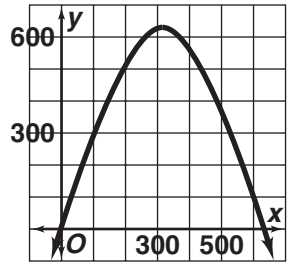
b. Check students' work.

c. The numbers w such that $0 < w < 50$; since the perimeter is 100 the width would have to be less than 50, and since length can't be negative it would have to be greater than 0.

d. 625 units^2; 25 units by 25 units

e. $A = w(50 - w)$; yes; both equations are quadratic and model the same situation.

50. a.



(315, 630)

b. The domain is all real numbers between 0 and 630. The range is all real numbers from 0 to 630.

c. 630 ft

d. 630 ft

51. $-12 \pm 3\sqrt{17}$

52. $-4 \pm 2\sqrt{5}$

53. $\frac{1}{4} \pm \frac{\sqrt{57}}{12}$

54. $-\frac{2}{3}, \frac{1}{3}$

55. $\frac{1}{8} \pm \frac{\sqrt{5}}{8}$

56. $-\frac{3}{8} \pm \frac{\sqrt{41}}{8}$

57. $-\frac{3}{2}a, 2a$

58. $\frac{-a \pm a\sqrt{13}}{6}$

59. $\frac{3}{a}, \frac{1}{a}, a \neq 0$

60. $-\frac{3}{2a}, -\frac{1}{2a}, a \neq 0$

61. $3, -\frac{3a}{a+3}, a \neq -3$

62. $-\frac{2}{3a}, \frac{5}{2a}, a \neq 0$

63. $-5 + 3\sqrt{2}, 5 + 3\sqrt{2}$

Answers for Lesson 5-8 Exercises

1. $1, 3$

2. $-6, -2$

3. $-\frac{7}{2}, 1$

4. $-1, \frac{1}{3}$

5. -5

6. $-\frac{5}{2}, 1$

7. $\frac{3 \pm \sqrt{5}}{2}$

8. $-3 \pm \sqrt{14}$

9. $\frac{2 \pm \sqrt{10}}{3}$

10. $-\frac{1}{2}, \frac{3}{4}$

11. $1, 4$

12. $-\frac{5}{3}, \frac{1}{3}$

13. $3 \pm i\sqrt{2}$

14. $1 \pm 2i$

15. $-\frac{3}{2} \pm \frac{i\sqrt{11}}{2}$

16. $-2 \pm i\sqrt{2}$

17. $1 \pm i\sqrt{2}$

18. $-\frac{2}{3} - \frac{i\sqrt{26}}{3}$

19. $\frac{5}{2} \pm \frac{i\sqrt{3}}{2}$

20. $\frac{7}{4} \pm \frac{i\sqrt{15}}{4}$

21. $-\frac{1}{15} \pm \frac{i\sqrt{14}}{15}$

22. $-\frac{1}{2}, 3$

23. $\frac{5}{3} \pm \frac{\sqrt{10}}{3}$; $0.61, 2.72$

24. $-\frac{2}{3} \pm \frac{\sqrt{13}}{3}$; $-1.87, 0.54$

25. $-\frac{1}{6}, 1$

26. $\frac{1}{14} \pm \frac{\sqrt{337}}{14}$ $-1.24, 1.38$

27. $-\frac{4}{5} \pm \frac{\sqrt{71}}{5}$ $-2.49, 0.89$

28. $-\frac{1}{2} \pm \frac{\sqrt{23}}{2}$ $-2.90, 1.90$

29. $\frac{5}{4} \pm \frac{\sqrt{33}}{4}$ $-0.19, 2.69$

30. $-\frac{1}{4} \pm \frac{\sqrt{5}}{4}$; $-0.81, 0.31$

31. -4; two, imaginary

32. 36; two, real

33. 0; one, real

34. -223; two, imaginary

35. 169; two, real

36. -116; two, imaginary

37. 1; two, real

38. 0; one, real

39. 0; one, real

40. no

41. $1, 10$

42. $0, 42$

43. $-\frac{3}{2}, \frac{1}{2}$

44. $-3.45, 1.45$

45. $1 \pm i$

46. $-1.70, 4.70$

47. $-7, 7$

48. $-8.47, 0.47$

49. $3 \pm i\sqrt{2}$

50. $-\frac{1}{2}, \frac{3}{2}$

51. $-1, 6$

52. $-5.41, 2.41$

53. **a.** $w(18 - w) = 36$

b. 2.29 in. by 15.71 in.

54. 3 or $-\frac{11}{3}$

55. Answers may vary. Sample: Assume the coefficients are real numbers. If the discriminant is negative, then there are 2 imaginary solutions. If the discriminant is 0, then there is 1 real solution. If the discriminant is positive, then there are 2 real solutions.

56. **a.** Answers may vary. Sample:
Graph $y = 0.0721x^2 - 2.8867x + 117.061$ and $y = 100$. Where they intersect is the year when 100 million tons were released in the air.
Wherever $y = 0.0721x^2 - 2.8867x + 117.061$ is below $y = 100$ is where less than 100 million tons were released.

b. Answers may vary. Sample:
Where $y = 0.0721x^2 - 2.8867x + 117.061 < 100$ is the solution. Subtract 100 from both sides and you get $y = 0.0721x^2 - 2.8867x + 17.061 < 0$. You then use the quadratic formula to solve.

c. Check students' work.

57. two **58.** one **59.** none

60. two **61.** two **62.** two

63. **a.** 12 or -12

b. k such that $|k| < 12$

c. k such that $|k| > 12$

64. **a.** k such that $|k| < 6$

b. k such that $|k| > 6$

c. $6, -6$

65. Imaginary solutions always come in pairs because they are the positive and negative solution of the square root of a negative number.

66. **a.** II

b. III

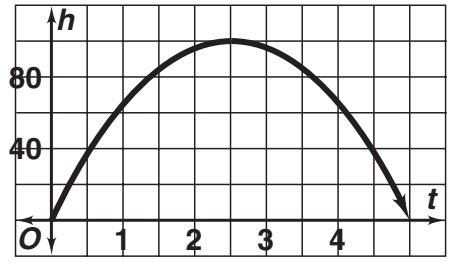
c. I

67. **a.** $x^2 = 100\pi$

b. 17.72 cm

68. **a.** yes

b.



c. $0 < t < 5$

69. Answers may vary. Sample: $x^2 - 3x + 1 = 0$

70. Answers may vary. Sample: $x^2 + 5x + 3 = 0$

71. Answers may vary. Sample: $x^2 - 5x + 7 = 0$

72. $\frac{3 \pm i}{2a}$ **73.** $\frac{5 \pm \sqrt{85}}{5a}$ **74.** $-a \pm a\sqrt{26}$

75. **a.** $\frac{-b + \sqrt{b^2 - 4ac}}{2a} + \frac{-b - \sqrt{b^2 - 4ac}}{2a} = \frac{-2b}{2a} = -\frac{b}{a}$

b. $\left(\frac{-b}{2a} + \frac{\sqrt{b^2 - 4ac}}{2a}\right) \times \left(\frac{-b}{2a} - \frac{\sqrt{b^2 - 4ac}}{2a}\right) =$
$\left(\frac{-b}{2a}\right)^2 - \left(\frac{\sqrt{b^2 - 4ac}}{2a}\right)^2 = \frac{4ac}{4a^2} = \frac{c}{a}$