NAME CLASS DATE

Algebra 1 Unit 5 Practice

LESSON 29-1

1. Model with mathematics. Kathleen has 70 feet of fencing to make a rectangular pen for her dog.

a. Complete the table below for rectangles with the given side lengths.

Length (ft)	Width (ft)	Perimeter (ft)	Area (ft^2)
5		70	
10		70	
15		70	
20		70	
25		70	
30		70	
l		70	

b. Let x represent the length of the pen and let y represent the area. Make a graph using the data from the table in part a.

c. Write a function $A(x)$ that gives the area of the pen in terms of its length. Write your function in standard form and identify the values of a, b, and c.

d. Simon is also making a rectangular pen for his dog, but he has more fencing than Kathleen. How will a graph of Simon's situation differ from Kathleen's graph in part b? Explain.

2. Which shows a quadratic function in standard form?

A. $y = 3 - 2x - 3x^2$

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

C. $y = -\frac{1}{2}x^2 + 2x - 3$

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

3. Write $f(x) = 3 + x^2 - 2x(x + 1)$ in standard form and identify the values of a, b, and c.

4. Explain why each function is not quadratic.

a. $y = -3x^3 + 4x - 1$

b. $y = \frac{3}{x^2} + \frac{1}{3}x$

c. $y = x^{-2} + 2x^{-1} + 2$

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LESSON 29-2

5. Which statement about quadratic functions is NOT true?

A. The domain of a quadratic function describes the possible values of x and the range describes the possible values of y.

B. The graph of a quadratic function is a parabola.

C. The minimum or maximum value of a quadratic function is the y-coordinate of the graph's vertex.

D. The y-intercepts of a parabola occur when $f(x) = 0$.

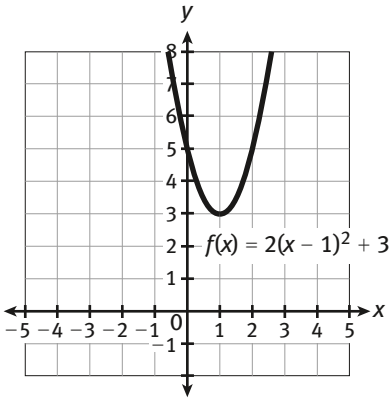
6. Consider the function $f(x) = (x + 2)(x - 4)$.

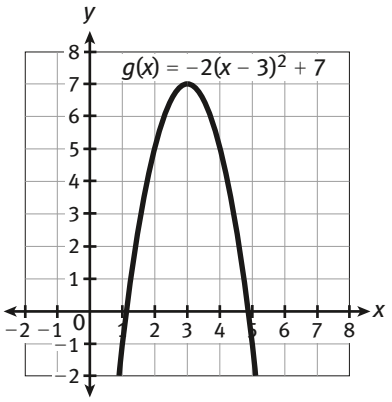
a. Create a table of values and graph the function.

b. Identify the maximum or minimum value of the function.

c. Explain how to identify the x-intercepts using the graph and using the function's equation. What are the x-intercepts?

Use the graphs for Items 7 and 8.





7. Make use of structure. Explain how to use the maximum or minimum value of each quadratic function to find the function's range. Identify the range for each function.

8. a. For each function, identify the values of x for which the function is increasing.

b. For each function, identify the values of x for which the function is decreasing.

c. Describe the relationship between the maximum or minimum value of the function and the intervals for which the function is increasing and decreasing.

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LESSON 30-1

For Items 9–11, use the functions $f(x) = x^2$, $g(x) = (x + 2)^2$, and $h(x) = x^2 - 4$.

9. Describe the transformation from the graph of $f(x)$ to the graph of $h(x)$.

10. Which statement is NOT true?

A. The domain of each function is all real numbers.

B. The graph of $h(x)$ has the same axis of symmetry as the graph of $f(x)$.

C. The vertex of the graph of $g(x)$ is (2, 0).

D. The range of $g(x)$ is the same as the range of $f(x)$.

11. What is the equation of the axis of symmetry of the graph of $g(x)$? Explain the relationship between the axis of symmetry and the vertex.

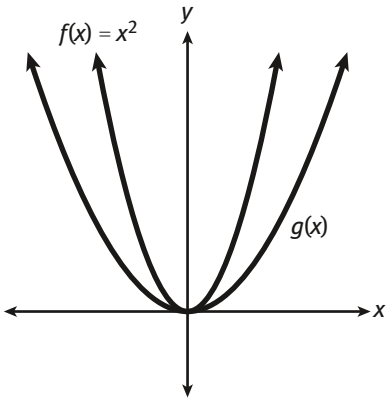
12. Give an example of a quadratic function whose range is $y \geq 3$.

13. a. Attend to precision. Write the equation of a function whose graph has been translated 2 units up from the graph of $y = x^2$.

b. Write the equation of a function whose graph has been translated 3 units to the left from the graph of $y = x^2$.

LESSON 30-2

14. The graphs of $f(x) = x^2$ and $g(x)$ are shown below. Which could be the equation of $g(x)$?



a. $g(x) = \frac{1}{3}x^2$ **b.** $g(x) = 2x^2$

c. $g(x) = x^2 - 3$ **d.** $g(x) = -(x - 3)^2$

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For Items 15–17, use the functions $f(x) = x^2$, $g(x) = \frac{1}{3}x^2$, and $h(x) = 2x^2$.

15. Describe the transformation from the graph of $f(x)$ to the graph of $h(x)$.

16. Why is it true that the graphs of the three functions have the same vertex?

17. a. Write a quadratic function $q(x)$ whose graph is wider than the graph of $g(x)$.

b. How many different quadratic functions have graphs wider than the graph of $g(x)$? Explain.

18. Critique the reasoning of others. Roger says that the graph of $g(x) = \frac{5}{2}x^2$ is a vertical shrink of the graph of $f(x) = x^2$ because $\frac{5}{2}$ is a fraction. Do you agree with Roger? Explain why or why not.

LESSON 30-3

For Items 19–21, use the functions below.

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

$h(x) = 3(x + 1)^2 - 2$

$k(x) = -2(x + 3)^2 + 4$

19. Which ordered pair represents the vertex of the graph of $g(x)$?

A. $(-2, 4)$ **B.** $(2, 4)$

C. $(4, -2)$ **D.** $(4, 2)$

20. Tell whether each statement is true or false. Explain your answers.

a. Of the three graphs, the vertex of $k(x)$ is farthest to the left in the coordinate plane.

b. $g(x)$ and $k(x)$ have the same range.

c. The minimum value of $h(x)$ is 2.

d. Of the three functions, $k(x)$ is the only function with a maximum value.

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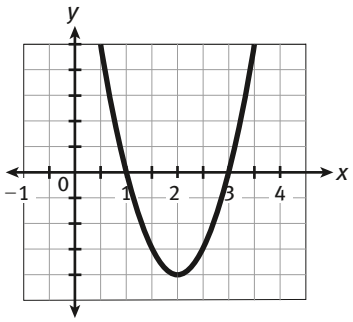
21. Persevere in solving problems. Use the equation of $g(x)$ to show that the graph has no x-intercepts.

22. Write the equation of the quadratic function shown in the graph in standard form.



LESSON 31-1

23. Solve each quadratic equation.

a. $16x^2 - 24x + 9 = 0$

b. $-2 = 3x^2 + 7x$

24. Which statement about the two roots of $x^2 + 10x - 24 = 0$ is NOT true?

A. One root is negative and the other is positive.

B. Both roots are integers.

C. The roots are equal to the zeros of $y = x^2 + 10x - 24$.

D. The roots can be found by solving the equation $(x - 6)(x + 4) = 0$.

25. a. Write a quadratic equation in standard form whose roots are -3 and 12.

b. Is there more than one correct answer to part a? Justify your response.

26. Critique the reasoning of others. Carmine solved the quadratic equation $x^2 + 3x - 28 = 12$ as shown below. Identify Carmine's error. What is the correct solution?

$$x^2 + 3x - 28 = 12$$
$$(x + 7)(x - 4) = 12$$
$$x + 7 = 12 \text{ or } x - 4 = 12$$
$$x = 5 \quad \text{or} \quad x = 16$$

LESSON 31-2

27. Which expression can be simplified to find the axis of symmetry of the graph of $f(x) = 2x^2 - 3x + 4$?

A. $\frac{-3}{2(2)}$ **B.** $\frac{-4}{2(2)}$

C. $\frac{-(-3)}{2(4)}$ **D.** $\frac{-(-3)}{2(2)}$

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28. For each quadratic function, identify the vertex of its graph.

a. $y = -x^2 - 4x + 5$

b. $f(x) = 5x^2 + 15x + 6$

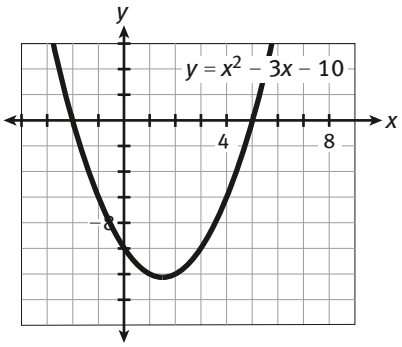
29. a. The height in feet of the water in a large fountain is given by the function $f(x) = -\frac{1}{2}x^2 + 10x$. What is the maximum height that the water reaches?

b. The height of the water in another fountain can be modeled by the function $g(x) = -\frac{1}{2}x^2 + 10x + c$. The maximum height of the water in this fountain is less than the maximum height in part a. What must be true about the value of c? Explain.

30. Make use of structure. A quadratic function has two zeros. One zero is 6. The axis of symmetry of this function's graph is $x = 2$. What is the other zero of this function?

LESSON 31-3

Use the graph for Items 31–33.



31. Give the coordinates of the x-intercepts. Show how to use the x-intercepts to find the equation of the axis of symmetry.

32. Why is it difficult to give the coordinates of the vertex? What additional information would allow you to find the coordinates of the vertex? Explain.

33. Which point is the reflection of the y-intercept over the axis of symmetry?

A. $(-1, -6)$ **B.** $(0, -10)$

C. $(3, -10)$ **D.** $(4, -6)$

34. Graph each quadratic function. Label the x-intercepts, the axis of symmetry, and the vertex.

a. $y = x^2 - 6x + 5$

b. $f(x) = x^2 + 5x + 6$

c. $y = 4x^2 - 8x + 3$

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35. Model with mathematics. The height of an arched entry is given by the quadratic function $h(x) = -\frac{1}{4}x^2 + 3x$, where x represents the distance in feet from the left of the entryway.

a. Graph this function.

b. Find the width of the entry and the greatest height of the entry. What parts of the graph represent these characteristics?

LESSON 32-1

36. Which equation has no real solutions?

A. $x^2 - 25 = 0$

B. $x^2 + 25 = 0$

C. $(x - 25)^2 = 0$

D. $(x + 25)^2 = 0$

37. Solve each equation.

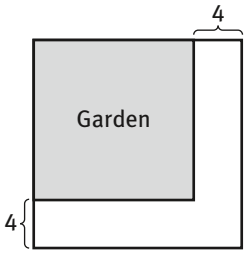
a. $4x^2 = 25$

b. $5x^2 - 30 = 0$

c. $(x + 4)^2 = 2$

d. $x^2 - 6x + 9 = 5$

38. Irene is designing a square garden that has a 4-foot walkway on two sides. The total area of the garden and the walkway will be 225 square feet.



a. What are the dimensions of the garden?

b. Irene decides to change the width of the walkway. She still wants the total area of the garden and the walkway to be 225 square feet. Give the dimensions of two possible square gardens and corresponding walkway widths — one in which the walkway width is less than 4 feet and one in which the walkway width is greater than 4 feet. Explain your reasoning.

39. Reason abstractly. Rita was asked to find a value of c for which the equation $(x - 1)^2 = c$ has no real solutions. She says that there are infinitely many possible answers.

Phil was asked to find a value of c for which the equation $(x - 1)^2 = c$ has exactly one solution. He also says that there are infinitely many possible answers.

Do you agree with Rita and Phil? Explain why or why not.

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LESSON 32-2

40. What number should be added to both sides of the equation $x^2 - 10x = 3$ to complete the square?

A. -100 **B.** -25

C. 25 **D.** 100

41. Identify the missing values in each equation. Explain whether there is more than one possible answer.

a. $x^2 + 8x + \square = (x + \square)^2$

b. $x^2 - 12x + \square = (x + \square)^2$

c. $x^2 + \square x + \square = (x + \square)^2$

42. Solve by completing the square.

a. $x^2 - 4x - 6 = 0$

b. $x^2 - 14x = -13$

c. $x^2 = 7 - 6x$

d. $2x^2 + 7x + 23 = x^2 - 5x - 9$

43. Analyze the quadratic function $g(x) = x^2 - 5x + 4$.

a. Complete the square.

b. Use your new version of the function to describe the transformation(s) from the graph of $f(x) = x^2$ to the graph of $g(x)$.

c. Describe the graph of $g(x)$. Include in your description the vertex, the direction that the parabola opens, the axis of symmetry, and the number of x-intercepts. How do your answers to parts a and b allow you to describe the graph of $g(x)$ without actually graphing?

d. Claudia was asked to find the y-intercept of $g(x)$ without graphing. She substituted $x = 0$ into the equation she found in part a. Is this a correct method? Is there a better way to find the y-intercept without graphing? Explain.

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44. Persevere in solving problems. Andrés has 160 feet of fencing to make a play yard for his young nephew. He can model the area with the function $A(w) = -w^2 + 80w$ when w represents the width of the play yard. Show how to complete the square to find the maximum area Andrés can enclose as well as the length and width he would use to achieve that area.

LESSON 32-3

45. Tranh is using the quadratic formula to solve $4x^2 = 2 - 3x$. He uses the values $a = 4$, $b = -3$, and $c = 2$. Is Tranh correct? If so, explain why. If not, explain why not and identify the correct values of a, b, and c.

46. Solve using the quadratic formula.

a. $2x^2 - 7x - 60 = 0$

b. $12 = 6x + x^2$

c. $x^2 - 10x + 23 = 0$

47. Which of the following shows how to use the quadratic formula to solve $2x^2 - 3x - 8 = 0$?

A. $\dfrac{-3 \pm \sqrt{(-3)^2 - 4(2)(-8)}}{2(2)}$

B. $\dfrac{3 \pm \sqrt{(-3)^2 - 4(2)(-8)}}{2(2)}$

C. $\dfrac{-3 \pm \sqrt{-3^2 - 4(2)(-8)}}{2(2)}$

D. $\dfrac{3 \pm \sqrt{-3^2 - 4(2)(-8)}}{2(2)}$

48. Attend to precision. The equation $h(t) = -16t^2 + 60$ gives the height in feet of a stick t seconds after it has been dropped from a 60-foot bridge.

a. Write an equation you can solve to find how long it takes the stick to fall half the distance to the ground.

b. Use the quadratic equation to solve your equation. How many solutions did you find? Do all of your solutions make sense? Explain.

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LESSON 32-4

49. Make use of structure. You have learned several ways to solve a quadratic equation: factoring, using square roots, completing the square, and using the quadratic formula. For each quadratic equation below, tell what method you would use to solve it. Explain your choices.

a. $2x^2 + 3x - 5 = 0$

b. $x^2 = 100$

c. $2x^2 + 4x = 0$

d. $x^2 - 4x + 1 = 0$

e. $x^2 + 6x - 7 = 0$

f. $x^2 + 3x = 5$

50. What is the discriminant of $3x^2 - 6x - 4 = 0$?

A. -84 **B.** -12

C. 12 **D.** 84

51. Use the discriminant to determine the number of real solutions.

a. $4x^2 + 12x + 9 = 0$

b. $0 = 5x^2 - 7x - 6$

c. $x^2 - x + 5 = 0$

52. What will be true about the discriminant if the solutions of a quadratic equation are rational? Explain.

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LESSON 32-5

53. Which expression shows $\sqrt{-48}$ in simplest form?

A. $-4i\sqrt{3}$ **B.** $-2i\sqrt{3}$

C. $2i\sqrt{3}$ **D.** $4i\sqrt{3}$

54. Solve each equation.

a. $x^2 + 121 = 0$

b. $x^2 + 4x + 5 = 0$

55. How many ways can you show that the quadratic equation $x^2 - 10x + 29 = 0$ has two complex solutions? Describe at least three different methods.

56. a. Express regularity in repeated reasoning. Write i^1, i^2, i^3, i^4, i^5, i^6, i^7, i^8, i^9, i^{10}, i^{11}, and i^{12} in simplest form.

b. Use your results from part a to find i^{57}. Explain how you found your answer.

LESSON 33-1

A business advisor is helping the owner of a chain of restaurants decide how to price the restaurants' food. The advisor made the following table to show how much profit each restaurant is likely to make from sales of pancakes depending on the price of the pancakes. Use the table for Items 57–61.

Weekly Profit from Pancakes per Restaurant

Price ($)	Profit ($)
4	120
5	200
6	240
7	240
8	200

57. a. Graph the data from the table. Do the data appear to be linear? Explain.

b. Describe how increasing the price of pancakes affects the profit from pancakes. Does this relationship make sense? Why or why not?

58. Use appropriate tools strategically. Use a graphing calculator to determine a quadratic function $p(d)$ that models the weekly profit in dollars when the pancakes are priced at d dollars.

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59. Based on the quadratic model in Item 58, about how much profit will each restaurant earn per week from pancake sales if the pancakes are priced at $8.50?

A. $120 **B.** $165

C. $180 **D.** $195

60. Based on the quadratic model in Item 58, what is the maximum weekly profit each restaurant can earn from pancake sales? At what price does the maximum profit occur?

61. The restaurant owner wants the profit to be greater than $0. What is a reasonable domain for the quadratic model? Explain your reasoning.

LESSON 33-2

A physics class built a device that launches tennis balls into the air. The function $h(t) = -4.9t^2 + 20t + 4$ models the height above ground in meters of one of the tennis balls t seconds after it is launched. Use this information for Items 62–66.

62. Ruben stated that the height of the tennis ball above the ground when it is launched is 4 meters. Do you agree? If so, explain why. If not, explain why not and find the correct height of the tennis ball when it is launched.

63. Approximately how long is the tennis ball in the air?

A. 0.2 second **B.** 2.04 seconds

C. 4.27 seconds **D.** 8.55 seconds

64. Write a quadratic equation that can be used to determine when the tennis ball will be at a height of 3 meters. Then solve the equation.

65. How many solutions does your quadratic equation from Item 64 have? Why is it important to keep the context in mind when solving a real-world problem? Explain.

66. Make sense of problems. Determine the times when the height of the tennis ball will be greater than 20 meters. Explain how you determined your answer, and round times to the nearest hundredth of a second.

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LESSON 34-1

Tilly posted two videos online: one of her cat jumping in and out of a box and one of her dog fetching a pickle. The table shows how many people watched each video over the past 6 weeks. Use the table for Items 67–70.

Tilly's Videos

Week	Viewers of Cat Video	Viewers of Dog Video
1	62	35
2	68	52
3	70	64
4	71	80
5	63	93
6	57	107

67. Examine the data in the table to determine which type of function (linear, quadratic, or exponential) best models the number of viewers for each video for the first 6 weeks. Explain how you made your choices.

68. Model with mathematics. Use the regression function of a calculator to write functions that model the number of viewers for each video for the first 6 weeks. Round coefficients and constants to the nearest thousandth.

69. Graph the functions from Item 68 on separate coordinate grids.

70. Compare and contrast the two functions. Describe the similarities and differences between the reasonable domains, maximum or minimum values (if any), and rates of change.

71. An online skateboard store has started selling a new style of skateboard. The table shows the number of skateboards in the new style sold during the first 6 weeks.

New Skateboards

Week	Number Sold
1	5
2	9
3	22
4	40
5	79
6	162

Which function best models the number of skateboards in the new style sold in week w for the first 6 weeks?

A. $n(w) = 3.5w^2$

B. $n(w) = 2.4(2^w)$

C. $n(w) = 29w - 49$

D. $n(w) = 10w^2 - 30w + 30$

LESSON 34-2

72. Make use of structure. Which function has a maximum value?

A. $f(x) = 6(3^x)$

B. $f(x) = -5x + 12$

C. $f(x) = -2x^2 + 4x$

D. $f(x) = (x - 2)^2 + 1$

The function $f(t) = 1200 + 36t$ gives the amount in dollars in Fatima's savings account after t years. The function $m(t) = 1100(1.03^t)$ gives the amount in dollars in Mason's savings account after t years. Use this information for Items 73 and 74.

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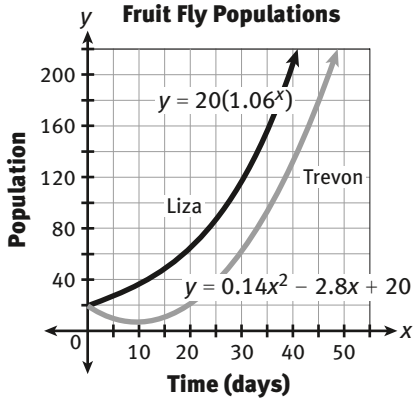
73. How much more did Fatima initially have in her account than Mason did? Explain how you know.

74. Will the amount in Mason's account ever exceed the amount in Fatima's account? Justify your response.

Liza and Trevon are raising fruit flies in biology class. The graph models each student's fruit fly population over time. Use the graph for Items 75 and 76.

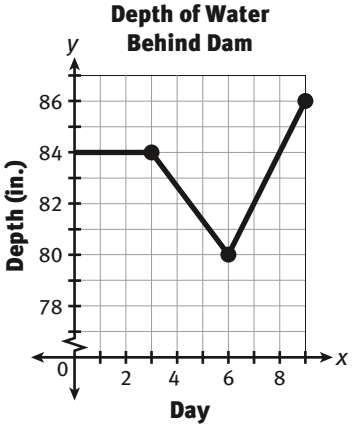


75. Whose fruit fly population appears to be modeled by an exponential function? Explain how the graph supports your answer.

76. Eugene says that the range for both functions is $y \geq 0$ because y represents the number of fruit flies and therefore negative range values do not make sense. Is Eugene correct? Explain why or why not.

LESSON 34-3

The graph shows how the depth of the water behind a small irrigation dam has changed over the past several days. Use the graph for Items 77–79.



77. Which piecewise function is shown in the graph?

A. $y = \begin{cases} 84 & \text{when } 0 \leq x < 3 \\ -\frac{4}{3}x + 88 & \text{when } 3 \leq x < 6 \\ 2x + 68 & \text{when } x \geq 6 \end{cases}$

B. $y = \begin{cases} 84 & \text{when } 0 \leq x < 3 \\ \frac{3}{4}x + 88 & \text{when } 3 \leq x < 6 \\ 2x + 80 & \text{when } x \geq 6 \end{cases}$

C. $y = \begin{cases} 84x & \text{when } 0 \leq x < 3 \\ -\frac{4}{3}x + 88 & \text{when } 3 \leq x < 6 \\ 2x + 68 & \text{when } x \geq 6 \end{cases}$

D. $y = \begin{cases} 84x & \text{when } 0 \leq x < 3 \\ -\frac{4}{3}x & \text{when } 3 \leq x < 6 \\ 2x + 80 & \text{when } x \geq 6 \end{cases}$

78. Describe how the depth of the water behind the dam changes over time.

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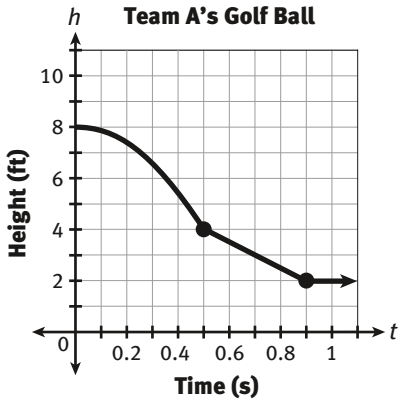
79. Critique the reasoning of others. Fay claims that after day 6, the depth of the water is increasing by a factor of 2 each day. Is Fay's claim correct? Explain.

Teams of students are building machines. As part of Team A's machine, a golf ball falls on a platform and the platform descends. The graph below shows the golf ball's height over time. Use the graph for Items 80 and 81.



80. Describe how the height of Team A's golf ball changes over time. Be sure to discuss the rate of change for each part of the graph, and identify the maximum and minimum heights of the ball.

81. As part of Team B's machine, a golf ball falls into a cup. The piecewise function

$$h(t) = \begin{cases} -16t^2 + 6 & \text{if } 0 \le t < 0.5 \\ 2 & \text{if } t \ge 0.5 \end{cases}$$

models the height in feet of Team B's golf ball after t seconds. Compare and contrast any patterns you observe in the height of Team A's ball over time and the height of Team B's ball over time.

LESSON 35-1

82. Solve the following system of equations by graphing. How can you check your answer?

$y = -3x + 10$
$y = 2^x$

83. A nonlinear system consists of one linear equation and one quadratic equation. The system has exactly one solution. Sketch a possible graph of this system.

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A park has two jogging trails. On a coordinate map of the park, the park entrance is at (0, 0), and each unit represents 1 meter. One jogging trail is represented on the map by the function $f(x) = -0.02x^2 + 3.2x + 32$. The second trail is represented by a linear function whose graph passes through the points (0, 122) and (170, 54). Use this information for Items 84 and 85.

84. Which function represents the second jogging trail?

A. $g(x) = 122 - 2.5x$

B. $g(x) = 122 - 0.4x$

C. $g(x) = 122 + \frac{2}{5}x$

D. $g(x) = 122 + \frac{5}{2}x$

85. Use a graph to determine the point(s) on the map where the jogging trails intersect.

86. Make sense of problems. Two invasive plants are growing on the surface of a small pond. The percent of the surface covered by Plant A doubles each month, and the percent of the surface covered by Plant B increases by 2% each month. At the beginning of April, Plant A covers 1% of the pond's surface, and Plant B covers 10% of the pond's surface. In what month will the percent of the surface covered by Plant A be equal to the percent of the surface covered by Plant B? Explain how you determined your answer, and use a system of equations in your explanation.

LESSON 35-2

87. Solve the following system of equations algebraically.

$y = -x^2 + 8x - 12$
$y = -2x + 9$

A construction worker is climbing a ladder to the roof of a house at the same time as a box of nails falls from the roof. The function $h(t) = -16t^2 + 28$ models the height in feet of the box t seconds after it falls. When $t = 0$, the worker's hands are 9 feet above the ground and his height above the ground is increasing at a constant rate of 3 feet per second. Use this information for Items 88–90.

88. Write an equation for $w(t)$ to model the height in feet of the worker's hands t seconds after the box falls.

89. The worker catches the box when it is at the same height as his hands. How long after the box falls does the worker catch it? Explain how you determined your answer.

90. At the time that the worker catches the box, which statement is true?

A. The worker has climbed 12 feet and the box has fallen 12 feet.

B. The worker has climbed 12 feet and the box has fallen 16 feet.

C. Both the box and the worker's hands are 16 feet above the ground.

D. Both the box and the worker's hands are 12 feet from the roof.

91. Construct viable arguments. Without graphing or solving, show that the nonlinear system $x + y = 5$ and $x^2 + y = 3$ has no real solutions.

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