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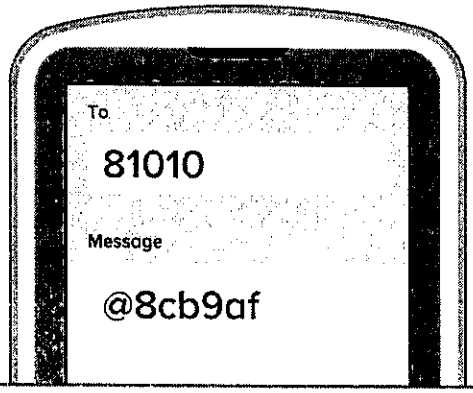

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Warm Up

Solve each equation by factoring. *(Lesson 6-3)*

52. $4x^2 + 8x = 0$ **53.** $x^2 - 5x = 14$ **54.** $3x^2 + 10 = 17x$

Notes

Key Concept **Quadratic Formula**

The solutions of a quadratic equation of the form $ax^2 + bx + c = 0$, where $a \neq 0$, are given by the following formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Example 1 – Solve $r^2 - 7r = 18$ by using the quadratic formula.

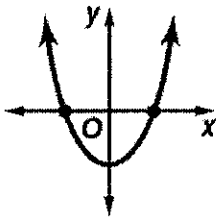
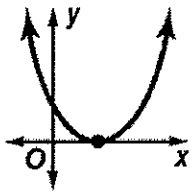
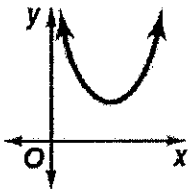
Example 2 – Solve $x^2 + 9x - 11 = 0$ by using the quadratic formula.

Example 3 – Solve $-3x^2 + 4x - 4 = 0$ by using the quadratic formula.

Example 4 – A car is traveling at 26 meters per second (m/s) and accelerating at -13 m/s^2. After traveling 26 meters, the driver brings the car to a complete stop. The equation $26 = 26t - \frac{13}{2}t^2$, where t is the time it takes to stop, can be used to represent this situation. How long did it take the driver to stop the car?

Key Concept — **Discriminant**

Consider $ax^2 + bx + c = 0$.

Value of Discriminant	Type and Number of Roots	Example of Graph of Related Function
$b^2 - 4ac > 0$; $b^2 - 4ac$ is a perfect square.	2 real, rational roots	
$b^2 - 4ac > 0$; $b^2 - 4ac$ is *not* a perfect square.	2 real, irrational roots	
$b^2 - 4ac = 0$	1 real, rational root	
$b^2 - 4ac < 0$	2 complex roots	

Example 5 – Find the value of the discriminant for each quadratic equation. Then describe the nature of the roots.

(a) $x^2 - 8x + 16 = 0$

(b) $5x^2 + 42 = 0$

(c) $x^2 - 5x - 50 = 0$

(d) $2x^2 - 9x + 8 = 0$

Concept Summary — Solving Quadratic Equations

Method	Can be Used	When to Use
Graphing	sometimes	Use only if an exact answer is not required. Best used to check the reasonableness of solutions found algebraically.
Factoring	sometimes	Use if the constant term is 0 or if the factors are easily determined. **Example** $x^2 - 3x = 0$
Square Root Property	sometimes	Use for equations in which a perfect square is equal to a constant. **Example** $(x + 13)^2 = 9$
Completing the Square	always	Useful for equations of the form $x^2 + bx + c = 0$, where b is even. **Example** $x^2 + 14x - 9 = 0$
Quadratic Formula	always	Useful when other methods fail or are too tedious. **Example** $3.4x^2 - 2.5x + 7.9 = 0$

Check for Understanding

Complete parts a–c for each quadratic equation.

a. Find the value of the discriminant.

b. Describe the number and type of roots.

c. Find the exact solutions by using the Quadratic Formula.

14. $x^2 + 3x - 3 = 0$

15. $x^2 - 16x + 4 = 0$

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

17. $x^2 - x + 6 = 0$

18. $-12x^2 + 5x + 2 = 0$

19. $-3x^2 - 5x + 2 = 0$

20. $x^2 + 4x + 3 = 4$

21. $2x - 5 = -x^2$

22. $9x^2 - 6x - 4 = -5$

23. $25 + 4x^2 = -20x$

24. $4x^2 + 7 = 9x$

25. $3x + 6 = -6x^2$

26. $\frac{3}{4}x^2 - \frac{1}{3}x - 1 = 0$

27. $0.4x^2 + x - 0.3 = 0$

Warm Up

1. Solve $x^2 - 2x - 35 = 0$ by using the quadratic formula.

2. Solve $m^2 + 3m - 180 = 0$ by completing the square.

3. Graph the function $f(x) = x^2 + 8x - 5$. Name the vertex and axis of symmetry.

4. Simplify $\sqrt{108} - \sqrt{48} + (\sqrt{3})^3$

5. Factor $4x^2 - 9$

Notes

If the roots of $ax^2 + bx + c = 0$ **with** $a \neq 0$**, then** $s_1 + s_2 = \frac{-b}{a}$ **and** $s_1 \cdot s_2 = \frac{c}{a}$

Example 1 – Write a quadratic equation that has roots ¾ and -12/5

Example 2 – Write a quadratic equation that has roots 7 – 3i and 7 + 3i.

Example 3 – Solve $2x^2 - 7x + 3 = 0$ by any method.

Check for Understanding

Write a quadratic equation with the given roots. Write the equation in the form $ax^2 + bx + c = 0$, where a, b, and c are integers.

34. 4, 5

35. −2, 7

36. 4, −5

37. −6, −8

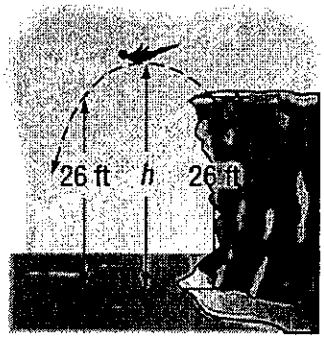
38. $\frac{1}{2}$, 3

39. $\frac{1}{3}$, 5

40. $-\frac{2}{3}, \frac{3}{4}$

41. $-\frac{3}{2}, -\frac{4}{5}$

42. DIVING To avoid hitting any rocks below, a cliff diver jumps up and out. The equation $h = -16t^2 + 4t + 26$ describes her height h in feet t seconds after jumping. Find the time at which she returns to a height of 26 feet.



43. NUMBER THEORY Find two consecutive even integers whose product is 224.

44. PHOTOGRAPHY A rectangular photograph is 8 centimeters wide and 12 centimeters long. The photograph is enlarged by increasing the length and width by an equal amount in order to double its area. What are the dimensions of the new photograph?

Warm Up

Find the value of the discriminant for each quadratic equation. Then describe the number and type of roots for the equation. *(Lesson 6-5)*

57. $3x^2 - 6x + 2 = 0$ **58.** $4x^2 + 7x = 11$ **59.** $2x^2 - 5x + 6 = 0$

Solve each equation by completing the square. *(Lesson 6-4)*

60. $x^2 + 10x + 17 = 0$ **61.** $x^2 - 6x + 18 = 0$ **62.** $4x^2 + 8x = 9$

Find each quotient. *(Lesson 5-3)*

63. $(2t^3 - 2t - 3) \div (t - 1)$ **64.** $(t^3 - 3t + 2) \div (t + 2)$

65. $(n^4 - 8n^3 + 54n + 105) \div (n - 5)$ **66.** $(y^4 + 3y^3 + y - 1) \div (y + 3)$

Notes

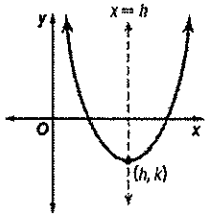
Example 1 – Name the vertex and axis of symmetry for the graph of $f(x) = (x+6)^2 - 3$. Then graph the function. How is this graph different from the graph of $f(x) = x^2$?

Concept Summary *Quadratic Functions in Vertex Form*

The vertex form of a quadratic function is $y = a(x - h)^2 + k$.

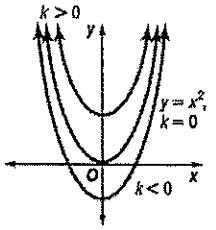
h and k

Vertex and Axis of Symmetry



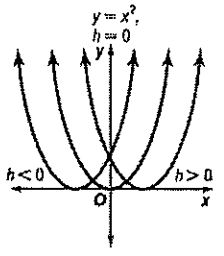
k

Vertical Translation



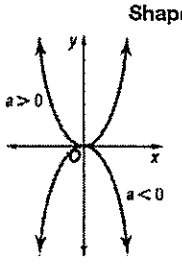
h

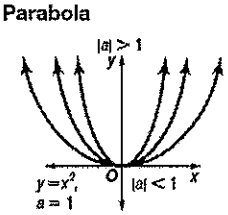
Horizontal Translation



a

Direction of Opening and Shape of Parabola





Example 2 – Graph $f(x) = -5x^2 + 80x - 319$. Name the vertex, axis of symmetry, and direction of opening for the graph.

Example 3 – Analyze $y = (x+2)^2 + 1$. Then, draw its graph.

Example 4 – Write $f(x) = x^2 + 8x - 5$ in vertex form. The, analyze the function.

Example 5 – Write $y = -3x^2 + 6x - 1$ in vertex form. The, analyze the function.

Example 6 – Write an equation for the parabola whose vertex is at (-1, 4) and passes through the point (2, 1).

Check for Understanding

Write each quadratic function in vertex form, if not already in that form. Then identify the vertex, axis of symmetry, and direction of opening.

15. $y = -2(x+3)^2$
16. $y = \frac{1}{3}(x-1)^2 + 2$
17. $y = 5x^2 - 6$
18. $y = -8x^2 + 3$
19. $y = -x^2 - 4x + 8$
20. $y = x^2 - 6x + 1$
21. $y = -3x^2 + 12x$
22. $y = 4x^2 + 24x$
23. $y = 4x^2 + 8x - 3$
24. $y = -2x^2 + 20x - 35$
25. $y = 3x^2 + 3x - 1$
26. $y = 4x^2 - 12x - 11$

Graph each function.

27. $y = 4(x+3)^2 + 1$
28. $y = -(x-5)^2 - 3$
29. $y = \frac{1}{4}(x-2)^2 + 4$
30. $y = \frac{1}{2}(x-3)^2 - 5$
31. $y = x^2 + 6x + 2$
32. $y = x^2 - 8x + 18$
33. $y = -4x^2 + 16x - 11$
34. $y = -5x^2 - 40x - 80$
35. $y = -\frac{1}{2}x^2 + 5x - \frac{27}{2}$
36. $y = \frac{1}{3}x^2 - 4x + 15$

37. Write one sentence that compares the graphs of $y = 0.2(x+3)^2 + 1$ and $y = 0.4(x+3)^2 + 1$.

38. Compare the graphs of $y = 2(x-5)^2 + 4$ and $y = 2(x-4)^2 - 1$.

Write an equation for the parabola with the given vertex that passes through the given point.

39. vertex: (6, 1)
point: (5, 10)
40. vertex: (−4, 3)
point: (−3, 6)
41. vertex: (3, 0)
point: (6, −6)
42. vertex: (5, 4)
point: (3, −8)
43. vertex: (0, 5)
point: (3, 8)
44. vertex: (−3, −2)
point: (−1, 8)

TOD

Standardized Test Practice

55. If $f(x) = x^2 - 5x$ and $f(n) = -4$, then which of the following could be n?
(A) −5 (B) −4 (C) −1 (D) 1

56. The vertex of the graph of $y = 2(x-6)^2 + 3$ is located at which of the following points?
(A) (2, 3) (B) (6, 3) (C) (6, −3) (D) (−2, 3)

Warm Up

Write each equation in vertex form. Then identify the vertex, axis of symmetry, and direction of opening. *(Lesson 6-6)*

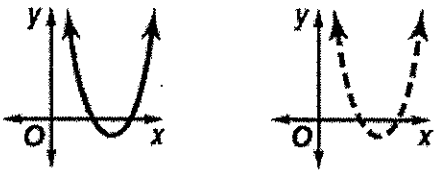
59. $y = x^2 - 2x + 9$ **60.** $y = -2x^2 + 16x - 32$ **61.** $y = \frac{1}{2}x^2 + 6x + 18$

Notes

GRAPH QUADRATIC INEQUALITIES

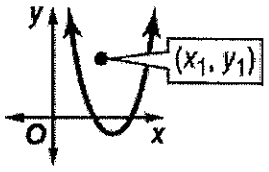
You can graph **quadratic inequalities** in two variables using the same techniques you used to graph linear inequalities in two variables.

Step 1 Graph the related quadratic equation, $y = ax^2 + bx + c$. Decide if the parabola should be solid or dashed.



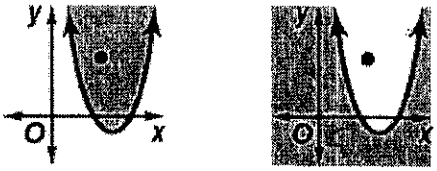
$\leq$ or $\geq$ $<$ or $>$

Step 2 Test a point (x_1, y_1) inside the parabola. Check to see if this point is a solution of the inequality.



$y_1 \stackrel{?}{\geq} a(x_1)^2 + b(x_1) + c$

Step 3 If (x_1, y_1) is a solution, shade the region *inside* the parabola. If (x_1, y_1) is *not* a solution, shade the region *outside* the parabola.



(x_1, y_1) is a solution. (x_1, y_1) is not a solution.

Example 1 – Graph $y \leq x^2 - 6x + 2$.

Example 2 – Solve $0 > x^2 - 6x - 7$.

Example 3 – Solve $x^2 - x - 12 > 0$.

Example 4 – Solve $x^2 + x > 6$.

Example 5 – Solve $0 \geq 3x^2 - 2x - 1$ by graphing.

Example 6 – Solve $x^2 + 2x - 3 > 0$ by graphing.

Example 7 – Graph $y > -x^2 - 6x - 7$

Check for Understanding

Graph each inequality.

14. $y \geq x^2 + 3x - 18$

15. $y < -x^2 + 7x + 8$

16. $y \leq x^2 + 4x + 4$

17. $y \leq x^2 + 4x$

18. $y > x^2 - 36$

19. $y > x^2 + 6x + 5$

20. $y \leq -x^2 - 3x + 10$

21. $y \geq -x^2 - 7x + 10$

22. $y > -x^2 + 10x - 23$

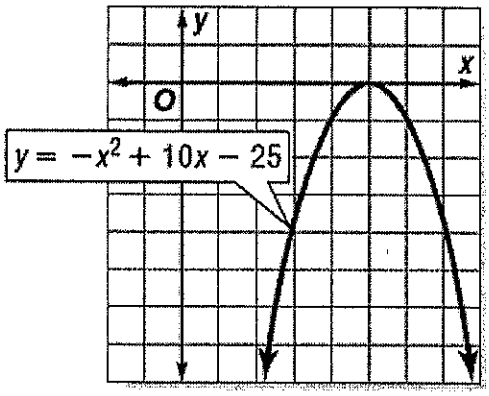
23. $y < -x^2 + 13x - 36$

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

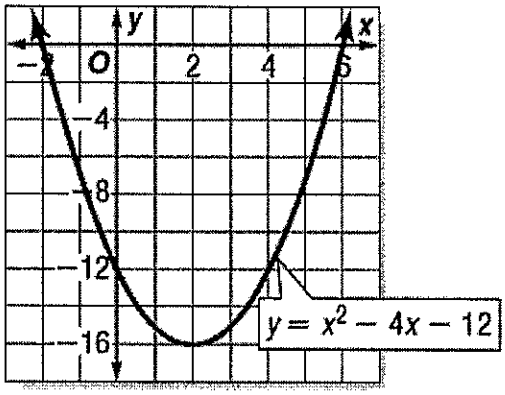
25. $y \geq 2x^2 + x - 3$

Use the graph of its related function to write the solutions of each inequality.

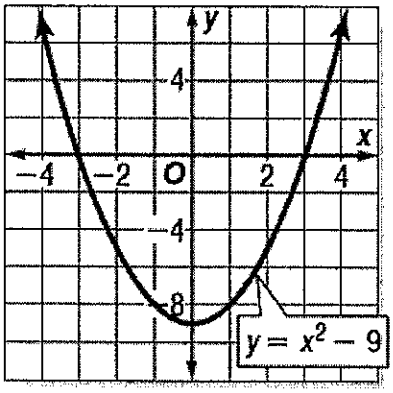
26. $-x^2 + 10x - 25 \geq 0$



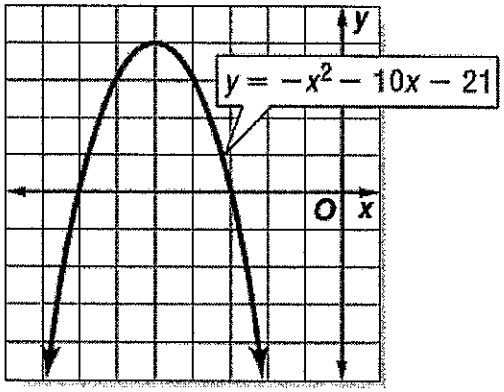
27. $x^2 - 4x - 12 \leq 0$



28. $x^2 - 9 > 0$

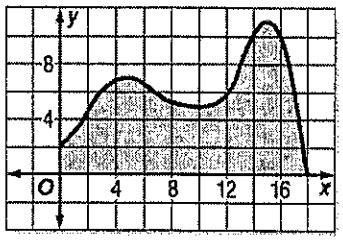


29. $-x^2 - 10x - 21 < 0$



TOD *Standardized Test Practice*

51. Which is a reasonable estimate of the area under the curve from $x = 0$ to $x = 18$?



(A) 29 square units
(B) 58 square units
(C) 116 square units
(D) 232 square units

52. If $(x + 1)(x - 2)$ is positive, then

(A) $x < -1$ or $x > 2$.
(B) $x > -1$ or $x < 2$.
(C) $-1 < x < 2$.
(D) $-2 < x < 1$.

Algebra 2 Practice Test 4

1. An arrow is shot upward with an initial velocity of 50 feet per second. The height of the arrow h(t) in terms of the time t since the arrow was released is $h(t) = 50t - 16t^2$. How long after the arrow is released does it reach its maximum height?

2. The height h in feet of a golf ball after t seconds is given by $h(t) = 84t - 16t^2$. Find the height of the ball after 2 seconds.

3. Name the vertex for the following quadratic function $f(x) = x^2 - 10x + 1$

4. The following quadratic equation $3x^2 - 2x - 1 = 0$ can be solved by factoring. Find the complete factorization of this quadratic equation.

5. The graph of a quadratic function, $f(x) = ax^2 + bx + c$, has x-intercepts at (3, 0) and (-7, 0). Using this information, solve $ax^2 + bx + c = 0$.

6. If a metal ball is dropped from a water tower, its height h in feet above the ground after t seconds is given by $h(t) = -t^2 + 4t + 5$. Using the solving by factoring method, determine how long it takes the ball to hit the ground, $h(t) = 0$.

7. Find the value of c that makes the trinomial a perfect square. Then write the trinomial as a perfect square.
$x^2 - 8x + c$

8. Solve the equation by completing the square $x^2 - 6x + 1 = 0$

9. Consider the equation $x^2 + 2x + 9 = 0$. Calculate the discriminant, and determine the number of real solutions.

10. If the graph of a quadratic function has only 1 x-intercept, then what does that mean the discriminant is equal to? If the graph of a quadratic function has 2 x-intercepts, then what does that mean the discriminant is equal to?

11. If the graph of a quadratic function has no x-intercepts, then what does that mean the discriminant is equal to?

12. Solve the following quadratic equation by any method $x^2 - 3x - 1 = 0$.

13. Solve the following quadratic equation by any method $x^2 + 2x + 5 = 0$.

14. Solve the following quadratic equation by any method $x^2 + x - 7 = 0$.

15. Identify the vertex of the following quadratic function $y = -x^2 + 4x - 8$.

16. Identify the vertex, direction of opening, and axis of symmetry for the function $y = \frac{1}{2}(x-2)^2 + 1$

17. Write an equation for the parabola with a vertex at (5, 1) that passes through the point (2, 4).

18. Write an equation for the parabola whose vertex is at (-1, 3) and passes through the point (2, 1).

19. Solve the following quadratic inequality $x^2 + x - 12 < 0$

20. Solve the following quadratic inequality $(x+10)(x-2) < 0$

FRQ

1. A golf ball is driven so that its height in feet after t seconds is $h(t) = -16t^2 + 64t + 10$.

   a) Calculate the value of h(1). Include appropriate units of measure. Interpret your answer.

   b) Identify the vertex, axis of symmetry, and direction of opening for the function h(t).

   c) When will the golf ball hit the ground? Round your answer to the nearest thousandths. Include appropriate units of measure.

2. Let $P(x) = 5x^3 - 4x^2 + 11x - 2$, $Q(x) = x + 2$, $R(x) = 4x + 7$, and $S(x) = 3x^2 + 2x - 3$.

   a) Find $Q(x) \cdot S(x)$

   b) Find $Q(x) - R(x)$

   c) Find $P(x) \div Q(x)$

3. Let $A = \begin{bmatrix} x & 5 \\ y & 3 \end{bmatrix}$ and $B = \begin{bmatrix} -2 \\ 1 \end{bmatrix}$

   a) Find the value of the determinant for matrix A

   b) Find A^{-1}

   c) Find the product of AB