Vocabulary

Review

1. Circle the functions in standard form.

\[ y = 2x^2 - 4x + 2 \quad y = \frac{1}{3}(x - 4) \quad y = -4x + 1 \quad y = \frac{2}{3}x - \frac{5}{3}x + 4 \]

Write each equation in standard form.

2. \( x + 2y = 17 \)
3. \( 2x = 5 \)
4. \( 5 - x = y + 2 \)

Vocabulary Builder

**quadratic** (adjective) kwəd rə drɪk

**Related Words:** parabola, vertex, axis of symmetry

**Definition:** A quadratic function is a function that can be written in the form \( y = ax^2 + bx + c \) where \( a \neq 0 \). The graph of a quadratic function is a parabola.

**Examples:** quadratic functions, \( y = x^2 \), \( y = -3x^2 + 7 \), \( f(x) = 2x^2 + 5x - 4 \), \( g(x) = \frac{1}{2}(x - 4)^2 + 5 \)

**Nonexamples:** not quadratic functions, \( y = \frac{1}{2x^2 + 4x + 5} \), \( y = \frac{x^2 + 5x + 10}{3x} \)

Use Your Vocabulary

5. Circle the graphs of quadratic functions.
Problem 1  Finding the Features of a Quadratic Function

Got It? What are the vertex, axis of symmetry, maximum and minimum values, and range of \( y = -3x^2 - 4x + 6 \)?

6. Circle the graph of \( y = -3x^2 - 4x + 6 \).

7. Draw and label the axis of symmetry on the graph you circled in Exercise 6.

8. Circle and label the maximum or minimum value on the graph.

9. Circle the range of the function.

\[ y \geq 5.0 \quad y \leq 6.0 \quad \text{all real numbers} \leq 7.3 \quad \text{all real numbers} \leq 9.2 \]

Take Note

**Properties Quadratic Function in Standard Form**

- The graph of \( f(x) = ax^2 + bx + c, a \neq 0 \), is a parabola.
- If \( a > 0 \), the parabola opens upward. If \( a < 0 \), the parabola opens downward.
- The axis of symmetry is the line \( x = \frac{-b}{2a} \).
- The \( x \)-coordinate of the vertex is \( \frac{-b}{2a} \). The \( y \)-coordinate of the vertex is \( f\left(\frac{-b}{2a}\right) \).
- The \( y \)-intercept is \((0, c)\).

10. The \( y \)-intercept of the graph of \( f(x) = 5x^2 - 3x - 4 \) is \((\boxed{0}, \boxed{4})\).

Problem 2  Graphing a Function of the Form \( y = ax^2 + bx + c \)

Got It? What is the graph of \( y = -2x^2 + 2x - 5 \)?

11. The axis of symmetry is \( x = \frac{-b}{2a} = \frac{2}{-4} = \boxed{-0.5} \).

12. Substitute to find the \( y \)-coordinate of the vertex.

13. The vertex is \((\boxed{-0.5}, \boxed{-5.5})\)

14. The \( y \)-intercept is \((0, -5)\). The reflection of the \( y \)-intercept across the axis of symmetry is \((\boxed{0.5}, \boxed{-5})\).

15. Plot the points from Exercises 13 and 14. Draw a smooth curve.
Problem 3  Converting Standard Form to Vertex Form

Got It? What is the vertex form of \( y = 2x^2 + 4x + 5 \)?

16. Use the justifications at the right to find the vertex.

\[
\begin{align*}
y &= 2x^2 + 4x + 5 \\
&= 2(x^2 + 2x) + 5 \\
&= 2(x^2 + 2x + 1) - 2 + 5 \\
&= 2(x + 1)^2 + 3
\end{align*}
\]

17. The vertex is \( Q \), \( R \).

18. Use the general form of the equation, \( y = a(x - h)^2 + k \). Substitute for \( a \), \( h \), and \( k \).

\[
y = 2(x - 1)^2 + 3
\]

19. The vertex form of the function is \( y = 2(x - 1)^2 + 3 \).

Problem 4  Interpreting a Quadratic Graph

Got It? The Zhuhai Bridge in China is the oldest known bridge, having been built to 605 a.d. You can model the support with the function \( f(x) = 0.001075x^2 + 0.131148x \), where \( x \) measures in feet. How high is the bridge above its supports?

20. What point on the parabola gives the height of the arch above its supports?

21. Find the x-coordinate of the vertex.

\[
x = \frac{-b}{2a} = \frac{-2}{2(0.001075)} = 92.91
\]

22. The axis of symmetry of the parabola is \( x = 92.91 \).

23. The length of the bridge is \( \) ft.

24. Use the x-coordinate of the vertex to find the y-coordinate.

\[
y = 0.001075(92.91)^2 + 0.131148(92.91) = 122.22
\]

25. The vertex is about \( Q \), \( R \), so the arch is \( \) feet above its support.
Lesson Check • Do you UNDERSTAND?

Error Analysis A student graphed the function \( y = 2x^2 + 4x + 3 \). Find and correct the error.

26. The vertex of \( y = ax^2 + bx + c \) is \( x = \frac{-b}{2a} \). Find the x- and y-coordinates of the vertex of \( y = 2x^2 + 4x + 3 \).

27. Find the y-intercept of \( y = 2x^2 + 4x + 3 \).

28. Describe the student’s error and graph the function correctly.

Math Success

Check off the vocabulary words that you understand.

- [ ] quadratic
- [ ] standard form
- [ ] vertex
- [ ] axis of symmetry
- [ ] y-intercept

Rate how well you can graph quadratic functions written in standard form.

[ ] 0   [ ] 2   [ ] 4   [ ] 6   [ ] 8   [ ] 10