Practice Book

3 Practice and Apply

Use Practice Book pp. 243–246

Assignment Guide	
Decelerated	1–6, 10–12, 13–15, 19–21, 25–27, 31–33, 43–44
Average	2–42 Even, 43–44
Accelerated	7–12, 16–18, 22–24, 28–30, 34–44

■ Before assigning the exercises on Practice Book pages 243–246, work with students through the example in the teaching display on page 243. Draw attention to the Think box, and elicit a similar principle for a parabola that opens downward. Invite students to explain how they know that the pictured parabola has a minimum. Ask if it would be possible to sketch the parabola, given the minimum value, the domain, and the range.

■ For exercises 1–9, have students explain how they can tell if the graph of a given quadratic equation opens upward or downward.

Errors Commonly Made

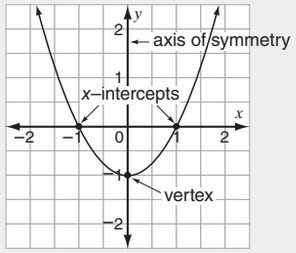
Students may attempt to use the x^2-coefficient from the form of the equation as it is given to determine if the parabola will open upward or downward. Stress the need to first write the equation in standard form, $y = ax^2 + bx + c$, before determining values for a, b, and c. Students may also wish to try graphing several points to check their answers.

■ For exercises 10–18, tell students to be sure to identify the y-value at the vertex as either a maximum or a minimum. Make sure they understand that a parabola that opens upward has a minimum value and a parabola that opens downward has a maximum value.

10-1 Identify Quadratic Functions and Their Graphs

Name _____ Date _____

For the parabola shown, identify the vertex, axis of symmetry, x-intercepts, maximum or minimum value of the function, and the domain and range of the function.



vertex: $(0, -1)$
axis of symmetry: $x = 0$
x-intercepts: -1 and 1.

Think

$f(x) = x^2 - 1$ opens *upward*, so the y-value of the vertex is the *minimum* value of the function.

minimum value: -1
domain: all real numbers
range: $\{y \mid y \geq -1\}$

Tell whether the graph of the quadratic function opens upward or downward. Explain.

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

$y = -x^2 + 3x - 2$
$a = -1; -1 < 0$
The parabola opens downward.

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

$y = -5x^2 + x - 6$
$a = -5; -5 < 0$
The parabola opens downward.

3. $y - 7 = 5x + 4x^2$

$y = 7 + 5x + 4x^2; y = 4x^2 + 5x + 7$
$a = 4; 4 > 0$
The parabola opens upward.

4. $y - 8 = -x + 10x^2$

$y = 8 - x + 10x^2; y = 10x^2 - x + 8$
$a = 10; 10 > 0$
The parabola opens upward.

5. $y + 4 = x^2$

$y = x^2 - 4$
$a = 1; 1 > 0$
The parabola opens upward.

6. $y + 5 = 3x^2$

$y = 3x^2 - 5$
$a = 3; 3 < 0$
The parabola opens upward.

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

$2y = -x^2 - 3; y = -0.5x^2 - 1.5$
$a = -0.5; -0.5 < 0$
The parabola opens downward.

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

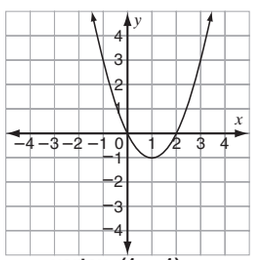
$8y = -3x^2 + 4; y = -0.375x^2 + 0.5$
$a = -0.375; -0.375 < 0$
The parabola opens downward.

9. $0.2y - x = -2x - 0.6x^2$

$0.2y = -x - 0.6x^2; y = -3x^2 - 5x$
$a = -3; -3 < 0$
The parabola opens downward.

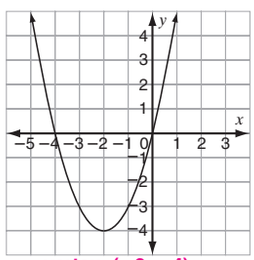
For each parabola shown, identify the vertex. Then give the minimum or maximum value of the function. Explain.

10.



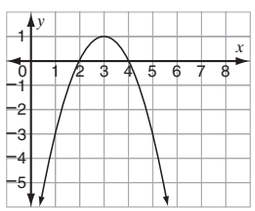
vertex: (1, −1)
parabola opens upward
minimum of the function is −1

11.



vertex: (−2, −4)
parabola opens upward
minimum of the function is −4

12.

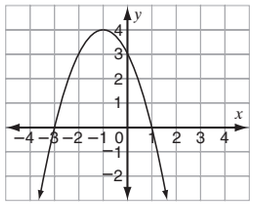


vertex: (3, 1);
parabola opens downward
maximum of the function is 1

Use with SOURCEBOOK Lesson 10-1, pages 246–249.

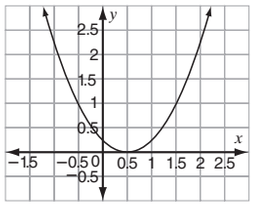
For each parabola shown, identify the vertex. Then give the minimum or maximum value of the function. Explain.

13.



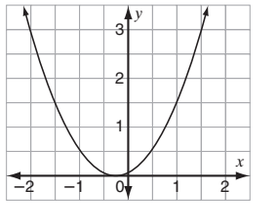
vertex: (−1, 4);
parabola opens downward
maximum of the function is 4

14.



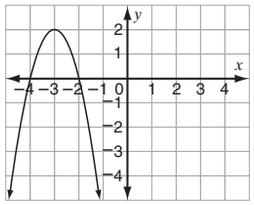
vertex: (0.5, 0);
parabola opens upward
minimum of the function is 0

15.



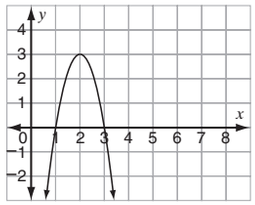
vertex: (−0.25, 0);
parabola opens upward
minimum of the function is 0

16.



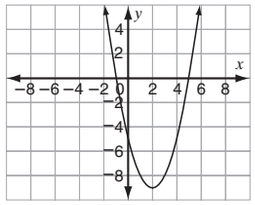
vertex: (−3, 2);
parabola opens downward
maximum of the function is 2

17.



vertex: (2, 3);
parabola opens downward
maximum of the function is 3

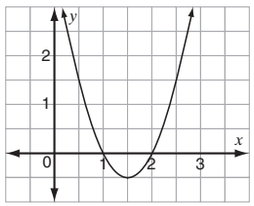
18.



vertex: (2, −9);
parabola opens downward
minimum of the function is −9

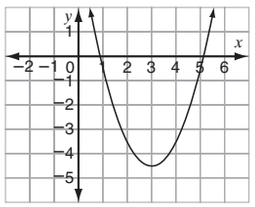
For each parabola shown, identify the domain and range.

19.



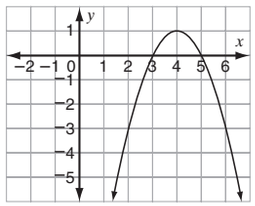
domain: All real numbers
range: $\{y \mid y \geq -0.5\}$

20.



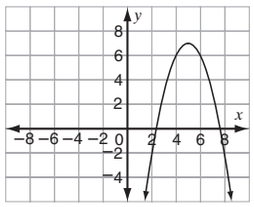
domain: All real numbers
range: $\{y \mid y \geq -4.5\}$

21.



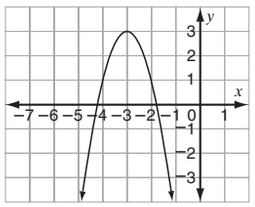
domain: All real numbers
range: $\{y \mid y \leq 1\}$

22.



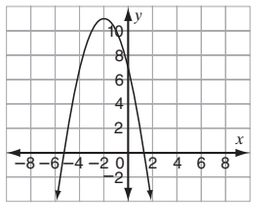
domain: All real numbers
range: $\{y \mid y \leq 7\}$

23.



domain: All real numbers
range: $\{y \mid y \leq 3\}$

24.



domain: All real numbers
range: $\{y \mid y \leq 11\}$

■ In exercises 19–24, students should understand that the domain for each parabola is the entire set of real numbers, not just the x-values of the part of the graph shown. Observe that the ranges of the parabolas are inequalities that are defined using the symbols $\leq$ and $\geq$. Discuss how to use the graph to determine which inequality symbol to use to describe the range. Encourage students to express the inequalities using both interval notation and set-builder notation.

Errors Commonly Made

Students sometimes count the lines of a grid to name the coordinates of a point. Stress the need to also take note of the scale that is used for each axis. For example, point out the scale in exercise 19.

Continue Lesson

■ For exercises 25–30, stress that the axis of symmetry is a vertical line that includes the vertex of the parabola. Review the concept that the x-value remains constant everywhere on a vertical line. Hence, each axis of symmetry has an equation of the form $x = a$.

■ In exercises 31–36, remind students that the x-intercepts are the values of x when y equals 0. Mention that they will learn the significance of the x-intercepts later in this chapter. Note that the graphs may have 0, 1, or 2 x-intercepts.

Problem Solving

■ When they are working on problems 37–42, suggest that students sketch the parabolas described. If necessary, review the terms describing the parts of a parabola.

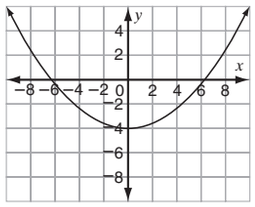
Errors Commonly Made

Students sometimes mistakenly associate an inequality describing a range such as $y \leq a$ with a minimum and $y \geq b$ with a maximum. Examination of a sketch will help them prevent such errors. Suggest that they test points on the graphs to determine which inequality symbol to use.

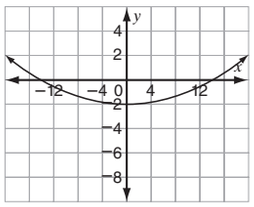
TEST PREPARATION

■ In exercises 43 and 44, invite students to identify the errors in the incorrect answer choices. Ask them what strategies they might use to avoid making these errors.

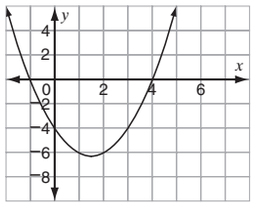
For each parabola shown, identify the axis of symmetry.

25. 

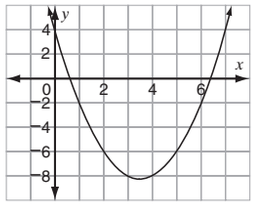
axis of symmetry: x = 0

26. 

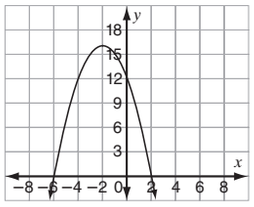
axis of symmetry: x = 0

27. 

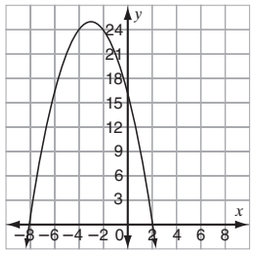
axis of symmetry: x = 1.5

28. 

axis of symmetry: x = 3.5

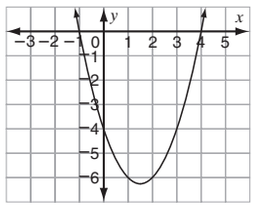
29. 

axis of symmetry: x = −2

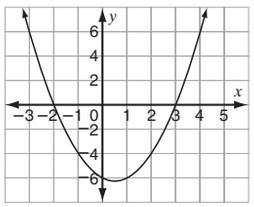
30. 

axis of symmetry: x = −3

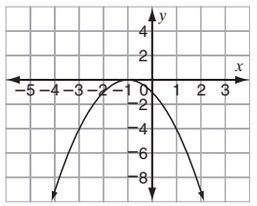
For each parabola shown, identify the x-intercepts.

31. 

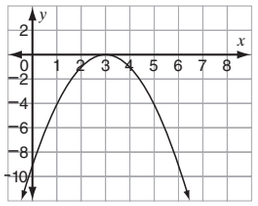
x-intercepts: −1 and 4

32. 

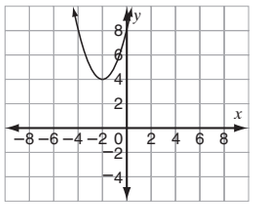
x-intercepts: −2 and 3

33. 

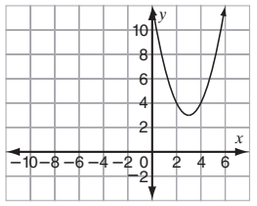
x-intercepts: −1

34. 

x-intercepts: 3

35. 

no x-intercepts

36. 

no x-intercepts

Problem Solving

37. What are the domain and range of any parabola with a vertex of (4, 8) that opens downward? Explain.

Account for all possibilities. Domain: All real numbers. Range: Because the parabola opens downward, the *y*-value of the vertex represents a maximum of the function; so the range is $\{y: y \le 8\}$.

38. What are the domain and range of any parabola with a vertex of (−2, 11) that opens upward? Explain.

Account for all possibilities. Domain: All real numbers. Range: Because the parabola opens upward, the *y*-value of the vertex represents a minimum of the function; so the range is $\{y: y \ge 11\}$.

39. If a quadratic function has a vertex at (5, −3) and *x*-intercepts at 4 and 6, what does the *y*-value of the vertex represent? Explain.

Reason logically. The vertex is in quadrant IV and the *x*-intercepts of the function are located above the vertex. So the parabola opens upward. This implies that the *y*-value of the vertex represents the minimum of the function.

40. If a quadratic function has a vertex at (−1, 8) and *x*-intercepts at −3 and 1, what does the *y*-value of the vertex represent? Explain.

Reason logically. The vertex is in quadrant II and the *x*-intercepts of the function are located below the vertex. So the parabola opens downward. This implies that the *y*-value of the vertex represents the maximum of the function.

41. The axis of symmetry of a parabola is $x = \frac{2}{3}$. The domain is all real numbers and the range is $\left\{y \mid y \le -\frac{1}{2}\right\}$. Does this function have *x*-intercepts? Explain.

Reason logically. No; Because the range of the function is $\left\{y \mid y \le -\frac{1}{2}\right\}$, $-\frac{1}{2}$ represents a maximum value of the function. However, $y = -\frac{1}{2}$ lies below the *x*-axis ($y = 0$), so the function has no *x*-intercepts.

42. The axis of symmetry of a parabola is $x = \frac{2}{3}$. The domain is all real numbers and the range is $\left\{y \mid y \ge \frac{11}{9}\right\}$. Does this function have *x*-intercepts? Explain.

Reason logically. No; Because the range of the function is $\left\{y \mid y \ge \frac{11}{9}\right\}$, $\frac{11}{9}$ represents a minimum value of the function. However, $y = \frac{11}{9}$ lies above the *x*-axis ($y = 0$), so the function has no *x*-intercepts.

TEST PREPARATION

43. The graph of a quadratic function has *x*-intercepts at 0 and 2. Which of the following could be equation of the axis of symmetry?

A. $x = 0$ **C.** $x = 2$
B. $x = 1$ **D.** $x = 3$

44. The graph of a quadratic function has *x*-intercepts at −8 and −4. Which of the following could be equation of the axis of symmetry?

A. $x = -8$ **C.** $x = -4$
B. $x = -6$ **D.** $x = -2$

Additional Resources

ONLINE www.progressinmathematics.com

- Meeting Individual Needs Activities
- Alternative Teaching Models
- Vocabulary Activities
- Audio Glossary
- Virtual Manipulatives

Meeting Individual Needs
See page 245F.

4 Summarize/Assess

Conceptual Thinking

■ To assess whether students have conceptualized the lesson concepts, write the equations $y = x^2 - 5x + 6$ and $y = -x^2 + 5x - 4$ on the board. Lead a discussion in which the class determines whether the graph will open upward or downward, and whether the equations will have maximum or minimum values.

upward; minimum; downward; maximum

■ Sketch a parabola on the board, and point to different parts, such as the vertex, *x*-intercept(s), and axis of symmetry. Have volunteers identify each part as you point to it.

MATH JOURNAL Provide students with the following information:

A parabola's vertex is (−3, 7), and it opens upward. What can you conclude about the axis of symmetry, x-intercept(s), maximum or minimum value, domain, and range?

Suggest that students sketch the parabola to help answer the questions.

axis of symmetry: $x = -3$; no *x*-intercept(s); minimum value is 7; domain: all real numbers; range: $\{y \mid y \ge 7\}$

5 Follow-Up

Reteaching

■ On a sheet of grid paper, have students write *vertex*, *axis of symmetry*, *x*-intercepts, and *maximum or minimum value*, highlighting each term with a different color and writing the definition of each. Then have them sketch several parabolas. Have them highlight and label the parts with the same color as used for the definitions.

ONLINE **See Chapter 10 Alternative Teaching Models.**

End of Lesson