

# 2-7

## Absolute Value Functions and Graphs



### Vocabulary

#### Review

Simplify each *absolute value* expression.

1.  $|3(5 - 7)| = \square$     2.  $-|-8| = \square$     3.  $|4| - |9| = \square$     4.  $|2 - |5|| = \square$

5. Absolute values are always **negative / non-negative / zero**.

#### Vocabulary Builder

**symmetry** (noun) SIM uh tree

**Related Words:** axis of symmetry, symmetrical, symmetric

**Definition:** Symmetry is a correspondence in size, shape, and relative position of parts on opposite sides of an axis of symmetry.

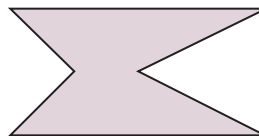
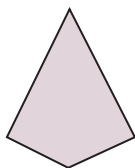
**Math Usage:** The graph of  $y = |x|$  is a mirror image of itself over its *axis of symmetry*,  $x = 0$ .

The Ms in **SYMMETRY** are *symmetric*.

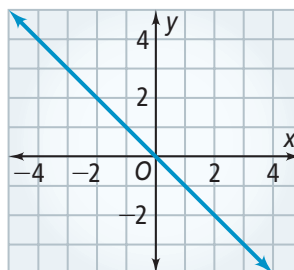
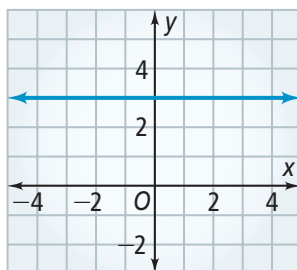
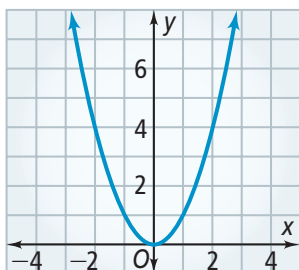


#### Use Your Vocabulary

6. Draw a line of *symmetry* through each figure.



7. Cross out the graph that does NOT show *symmetry* around the y-axis.





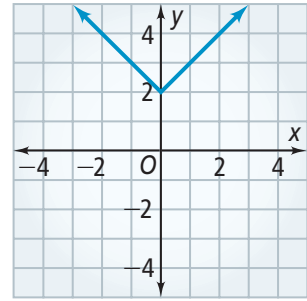
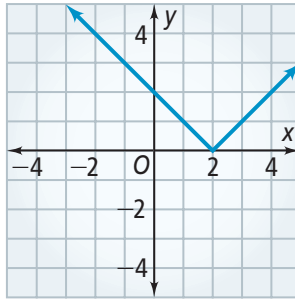
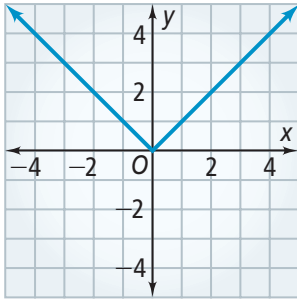
## Problem 1 Graphing an Absolute Value Function

**Got It?** What is the graph of the function  $y = |x| + 2$ ? How is this graph different from the parent function  $f(x) = |x|$ ?

8. Complete the table of values.

x	-3	-1	0	1	3
y	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

9. Use the table from Exercise 8. Circle the graph of  $y = |x| + 2$ .



10. Describe how the graph of  $y = |x| + 2$  differs from the graph of the parent function.

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### Take note

#### Key Concept The Family of Absolute Value Functions

Parent Function  $y = |x|$

##### Vertical Translation

Translation up  $k$  units,  $k > 0$

$$y = |x| + k$$

Translation down  $k$  units,  $k > 0$

$$y = |x| - k$$

##### Horizontal Translation

Translation right  $h$  units,  $h > 0$

$$y = |x - h|$$

Translation left  $h$  units,  $h > 0$

$$y = |x + h|$$

##### Vertical Stretch and Compression

Vertical stretch,  $a > 0$

$$y = a|x|$$

Vertical compression,  $0 < a < 1$

$$y = a|x|$$

##### Reflection

In the  $x$ -axis

$$y = -|x|$$

In the  $y$ -axis

$$y = |-x|$$

11. Place a  $\checkmark$  in the box if the statement describes a transformation of the parent function  $y = |x|$  for  $g(x) = -\frac{1}{3}|x + 5| + 2$ . Place an  $\times$  if it does not.

translation right 5 units

translation left 5 units

compression by a factor of  $\frac{1}{3}$

reflection in the  $x$ -axis

translation up 2 units

reflection in the  $y$ -axis



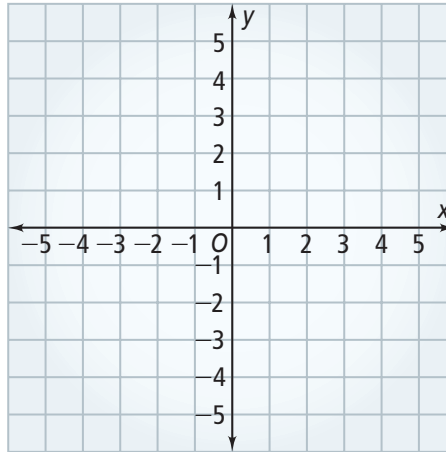
### Problem 3 Vertical Stretch and Compression

**Got It?** What is the graph of the function  $y = 2|x|$ ?

12. Complete the table of values.

x	y
-2	<input type="text"/>
-1	<input type="text"/>
0	<input type="text"/>
1	<input type="text"/>
2	<input type="text"/>

13. Plot the points and connect them.



14. **Error Analysis** A student compares the shapes of the graphs of  $y = |x| + 2$  and  $y = 2|x|$ . She concludes that when a graph is compressed, the value of its slope increases. Explain her error.

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### Problem 4 Identifying Transformations

**Got It?** What are the vertex, axis of symmetry, and transformations of the function  $y = -2|x - 1| - 3$ ?

15. Compare  $y = -2|x - 1| - 3$  with the general form  $y = a|x - h| + k$ . Write the values of  $a$ ,  $h$ , and  $k$ .

$a =$         $h =$         $k =$

**Underline the correct equation, point, value, or word to complete each sentence.**

16. In the function  $y = -2|x - 1| - 3$ , the vertex is (1, 3) / (0, 0) / (1, -3).

17. The axis of symmetry is  $y = 1$  /  $x = 0$  /  $y = -3$  /  $x = 1$ .

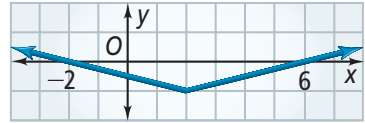
18. The function is translated 1 / 2 / 3 unit(s) to the right and 1 / 2 / 3 unit(s) up / down.

19. The function is stretched / compressed by a factor of 1 / 2 / -2 and reflected across the x-axis / y-axis.



## Problem 5 Writing an Absolute Value Function

**Got It?** What is the equation of the absolute value function?



20. Complete the model to write the equation.

1 Identify the stretch or compression.

$$a = \square$$



2 Identify the vertex.

$$(h, k) = (\square, \square)$$



3 Substitute the values of  $a$ ,  $h$ , and  $k$  into the general form,  $y = a|x - h| + k$ .

$$y = \square |x - \square| + \square$$

21. The equation of the absolute value function is .



## Lesson Check • Do you UNDERSTAND?

Is it true that, without making a graph of an absolute value function, you can describe its position on a graph? Explain with an example.

Circle each function.

22. The function  $y = |x|$  reflected across the  $x$ -axis.

$$y = -|x| \quad y = |-x| \quad y = |x| - 1 \quad -y = -|x|$$

23. The function  $y = |x|$  translated 3 units to the left and 2 units up.

$$y = |x - 2| + 3 \quad y = |x + 2| - 3 \quad y = |x + 3| + 2 \quad y = |x - 3| - 2$$



## Math Success

Check off the vocabulary words that you understand.

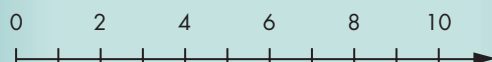
absolute value function

axis of symmetry

vertex

Rate how well you can *graph absolute value functions*.

Need to review



Now I get it!