

2-7

Absolute Value Functions and Graphs



Vocabulary

Review

Simplify each *absolute value* expression.

- $|3(5 - 7)| =$
- $-|-8| =$
- $|4| - |9| =$
- $|2 - |5|| =$
- Absolute values are always negative / non-negative / zero .

Vocabulary Builder

symmetry (noun) SIM uh tree

Related Words: axis of symmetry, symmetrical, symmetric

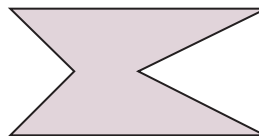
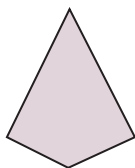
Definition: Symmetry is a correspondence in size, shape, and relative position of parts on opposite sides of an axis of symmetry.

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

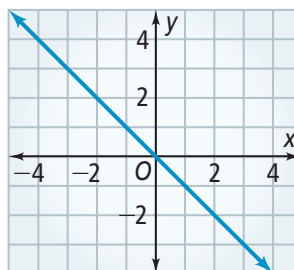
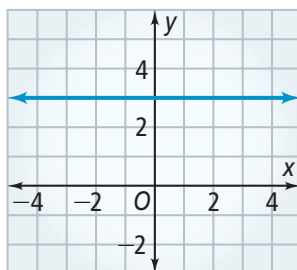
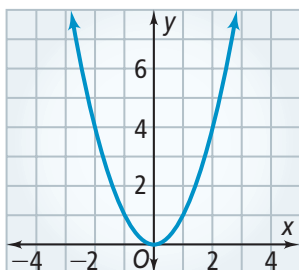
The Ms in **SYMMETRY** are *symmetric*.

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.





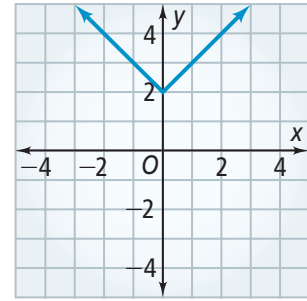
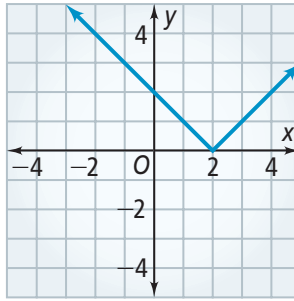
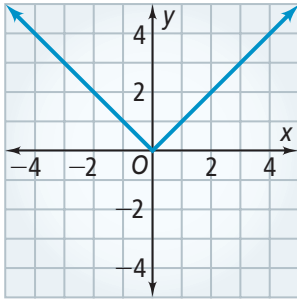
Problem 1 Graphing an Absolute Value Function

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.

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



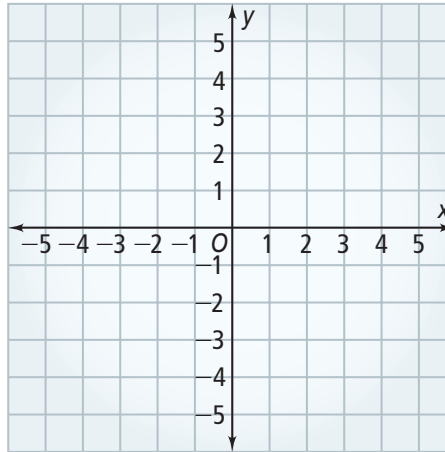
Problem 3 Vertical Stretch and Compression

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.



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 $y = 1$ / $x = 0$ / $y = -3$ / $x = 1$.

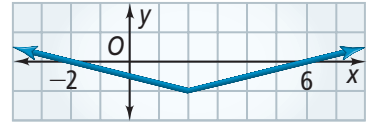
18. The function is translated 1 / 2 / 3 unit(s) to the right and 1 / 2 / 3 unit(s) up / down.

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.

$y = -|x|$ $y = |-x|$ $y = |x| - 1$ $-y = -|x|$

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

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



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*.

