Graphs of Absolute Value Equations

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CHAPTER 1 Graphs of Absolute Value Equations

Here you'll learn how to make a table of values for an absolute value equation so that you can graph the solutions to the equation.

Suppose you're keeping a math journal and you want to explain how to graph the solutions to an absolute value equation. How would you describe the process? What steps would be involved? In this Concept, you'll learn how to create a table of values for an absolute value equation so that you can graph its solutions. With this knowledge, you can fill your math journal with useful information!

Guidance

Absolute value equations can be graphed in a way that is similar to graphing linear equations. By making a table of values, you can get a clear picture of what an absolute value equation will look like.

Example A

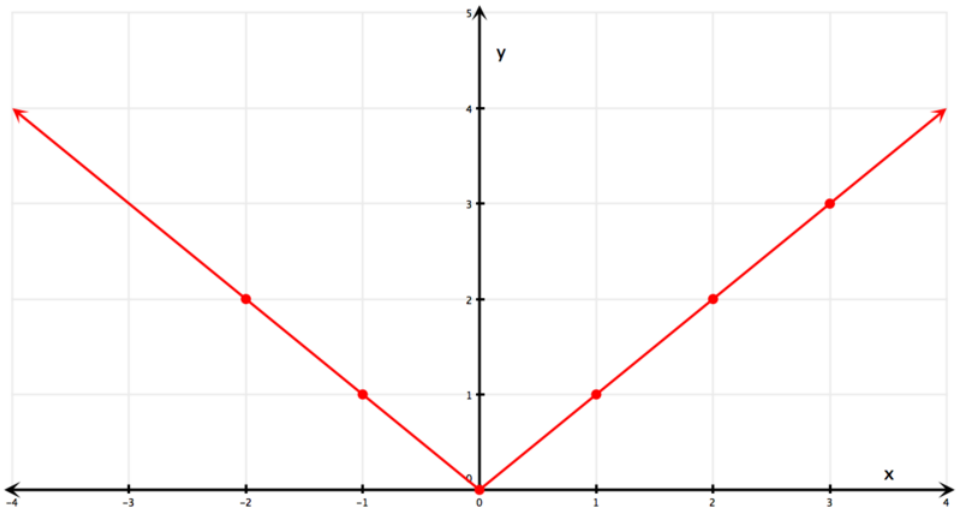
Graph the solutions to $y = |x|$.

Solution:

Make a table of values and graph the coordinate pairs.

TABLE 1.1:

x	$y = \|x\|$
–2	$\|-2\| = 2$
–1	$\|-1\| = 1$
0	$\|0\| = 0$
1	$\|1\| = 1$
2	$\|2\| = 2$
3	$\|3\| = 3$



The Shape of an Absolute Value Graph

Every absolute value graph will make a "V"-shaped figure. It consists of two pieces: one with a negative slope and one with a positive slope. The point of their intersection is called the **vertex**. An absolute value graph is **symmetrical**, meaning it can be folded in half on its **line of symmetry**. The function $y = |x|$ is the parent function, or most basic function, of absolute value functions.

Example B

Graph the solutions to $y = |x - 1|$.

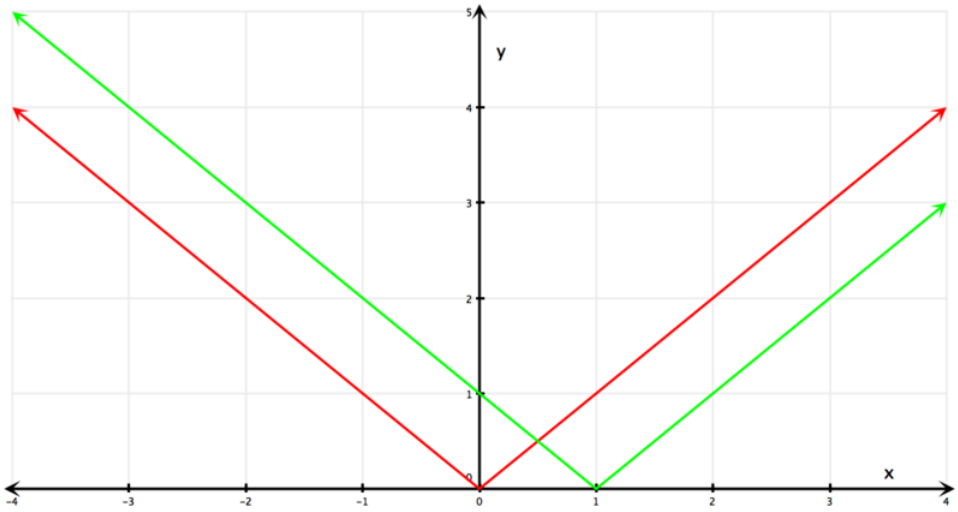
Solution:

Make a table of values and plot the ordered pairs.

TABLE 1.2:

x	$y = \|x - 1\|$
–2	$\|-2 - 1\| = 3$
–1	$\|-1 - 1\| = 2$
0	$\|0 - 1\| = 1$
1	$\|1 - 1\| = 0$
2	$\|2 - 1\| = 1$
3	$\|3 - 1\| = 2$

The graph of this function is seen below in green, graphed with the parent function in red.



Notice that the green function is just the parent function shifted over. The vertex is shifted over 1 unit to the right. This is because when $x = 1$, $|x - 1| = 0$ since $|1 - 1| = 0$. The vertex will always be where the value inside the absolute value is zero.

Graphing by Finding the Vertex

Absolute value equations can always be graphed by making a table of values. However, you can use the vertex and symmetry to help shorten the graphing process.

Step 1: Find the vertex by determining which value of x makes the distance zero.

Step 2: Using this value as the center of the $x-$values, choose several values greater than this value and several values less than this value.

Example C

Graph $y = |x+2|+3$.

Solution:

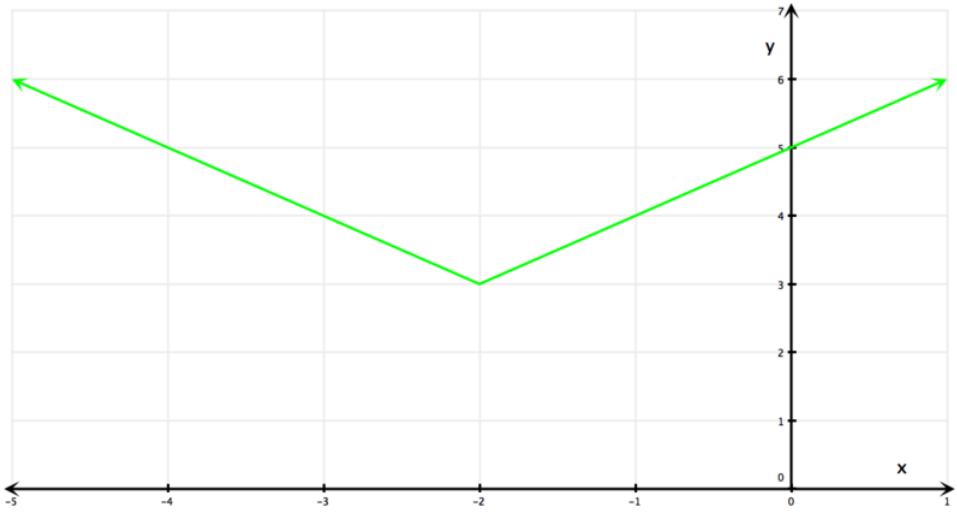
Start by considering where the vertex would be by solving for when the absolute value equals zero:

$0 = |x+2| \Rightarrow x = -2$

The vertex is at $x = -2$. Choose some points on either side of that to make a table of values.

TABLE 1.3:

x	$y = \|x+2\|+3$
–4	$\|-4+2\|+3 = 5$
–3	$\|-3+2\|+3 = 4$
–2	$\|-2+2\|+3 = 3$
–1	$\|-1+2\|+3 = 4$
0	$\|0+2\|+3 = 5$



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Guided Practice

Graph $y = |x+5|$.

Solution:

Determine which $x-$value equals a distance of zero.

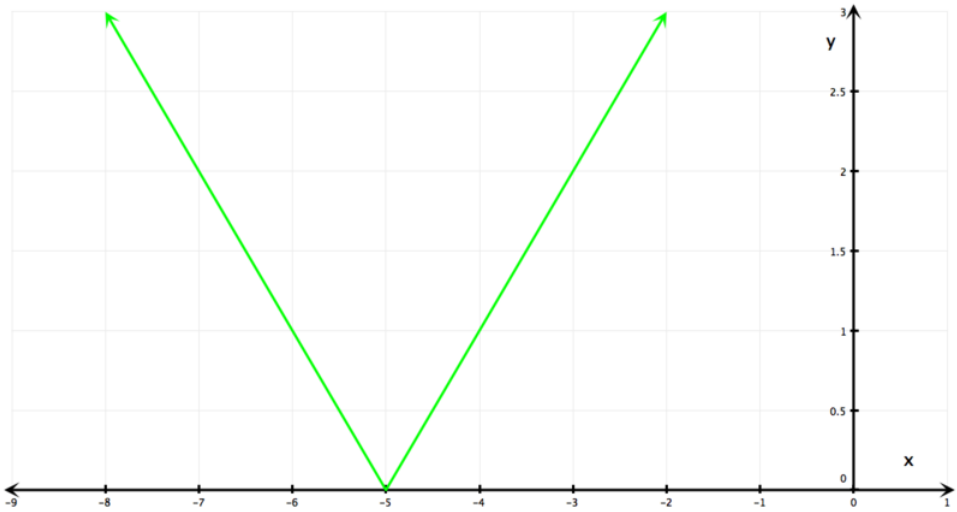
$$0 = |x+5|$$
$$x = -5$$

Therefore, (–5, 0) is the vertex of the graph and represents the center of the table of values.

Create the table and plot the ordered pairs.

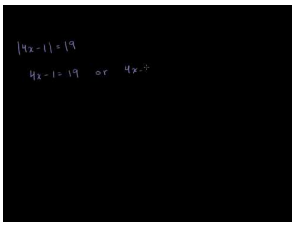
TABLE 1.4:

x	$y = \|x+5\|$
–7	$\|-7+5\| = 2$
–6	$\|-6+5\| = 1$
–5	$\|-5+5\| = 0$
–4	$\|-4+5\| = 1$
–3	$\|-3+5\| = 2$



Explore More

Sample explanations for some of the practice exercises below are available by viewing the following video. Note that there is not always a match between the number of the practice exercise in the video and the number of the practice exercise listed in the following exercise set. However, the practice exercise is the same in both. CK-12 Basic Algebra: Absolute Value Equations (10:41)



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In 1–11, graph the function.

1. $y = |x+3|$
2. $y = |x-6|$
3. $y = |4x+2|$
4. $y = \left|\frac{x}{3}-4\right|$
5. $|x-4| = y$
6. $-|x-2| = y$
7. $y = |x|-2$
8. $y = |x|+3$
9. $y = \frac{1}{2}|x|$
10. $y = 4|x|-2$
11. $y = \left|\frac{1}{2}x\right|+6$

Mixed Review

12. Graph the following inequality on a number line: $-2 \leq w < 6$.
13. Is $n = 4.175$ a solution to $|n-3| > 12$?
14. Graph the function $g(x) = \frac{7}{2}x - 8$.
15. Explain the pattern: 24, 19, 14, 9,....
16. Simplify $(-3)\left(\frac{(29)(2)-8}{-10}\right)$.