

Introduction to Absolute Value

ID: 11300

Time Required
45 minutes

Activity Overview

In this activity students will explore the definition of absolute value using a number line, plot points to graph $y = |x|$, and use sliders to perform transformations with absolute value functions. As an extension, students can explore the general absolute value equation, $y = a |bx + d| + c$.

Topic: Absolute Value

- *Definition of absolute value*
- *Transformation of an absolute value function*
- *Piecewise, or compound, functions*

Teacher Preparation and Notes

- *The student worksheet provides instructions and questions to guide the inquiry and focus the observations.*
- *The file `IntroAbsValue_Extension.tns` is intended to be used as an extension for the day after. In this extension, students will discover the relationship between continuous piecewise and absolute value functions. They will also use piecewise functions to model situations.*
- ***To download the student TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter “11300” in the quick search box.***

Associated Materials

- *IntroAbsValue_Student.doc*
- *IntroAbsValue.tns*
- *IntroAbsValue_Extension.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

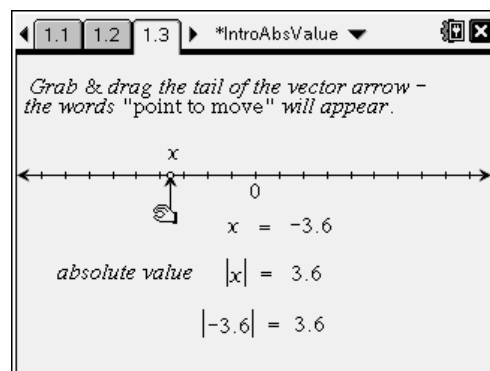
- *What's My Absolute Value (TI-Nspire technology) — 8742*
- *Introducing Absolute Value (TI-Nspire technology) — 8743*
- *Absolutely! (TI-Nspire technology) — 8791*
- *What's the Equation? Absolute Value Functions (TI-Nspire technology) — 9185*
- *Absolute Value Equations (TI-Nspire technology) — 10132*

Problem 1 – Definition and Plotting Absolute Value

Students explore the number line and answer some general and specific questions.

Explain to students that the absolute value function defines a number to be positive. They should understand that $y = |x|$ means that if x is greater than zero, then $y = x$; if x is less than zero, then $y = -x$; if $x = 0$, then $y = 0$. Using the piecewise notation, absolute

value can be defined as $|x| = \begin{cases} x, & x \geq 0 \\ -x, & x < 0 \end{cases}$



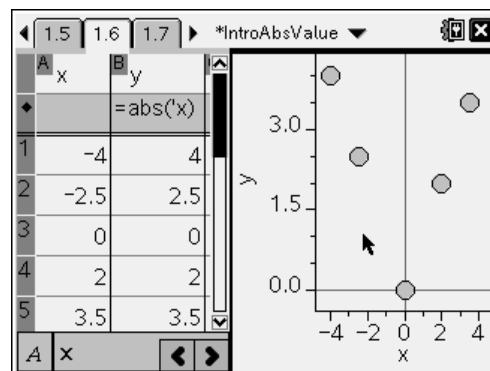
Solutions:

1. Even when the number line is moved to the negative numbers, the absolute value stays positive
2. a. 10.5 b. 12

On page 1.6, students are to enter values in Column A, titled x . The values will be plotted on the *Data & Statistics* application on the right. Students should drag a point to explore its behavior.

Solutions:

3. The shape is a line with a negative slope. The y -values are positive for every negative x -value.
4. The point moves in line with the other points.
5. The shape of the graph is a V.



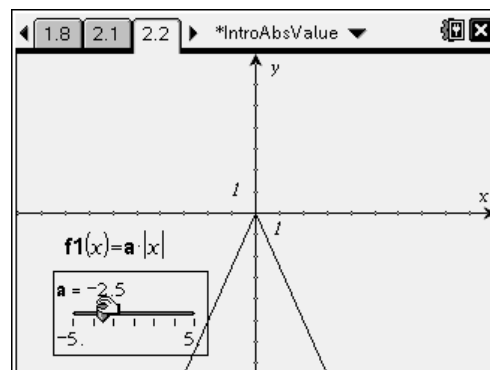
Problem 2 – Exploring Functions With Absolute Value

In the problem, the variables, coefficients and constants are explored to see how they affect the shape of the graph. The slope and the vertex are especially considered.

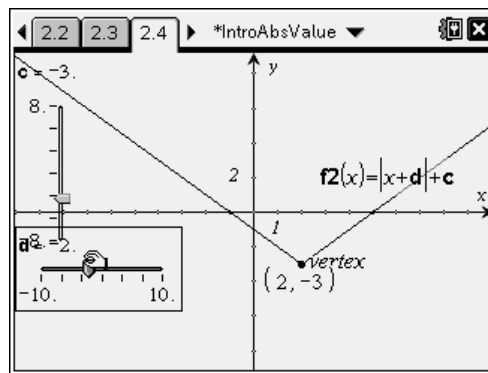
To use the slider, students can click slider bar and press the left and right arrows (◀▶) or they can grab and drag the ticker on the slider bar.

Solutions:

6. When a is negative the V is upside down, when a is positive the V is right side up.
7. In general, a affects the slope of the graph and if the V is pointing up or down.



8. a. When d is positive, the function moves to the left and when d is negative, the function moves right.
- b. When c is positive, the function moves up and when c is negative, the function moves down.
- c. $(-d, c)$.

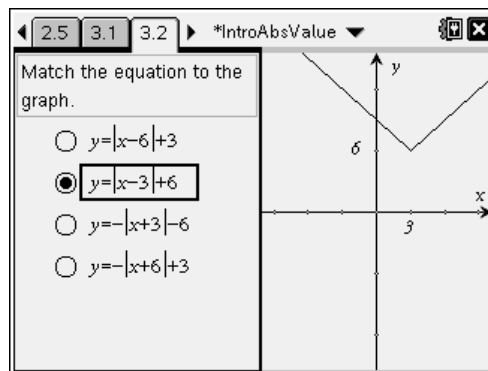


Problem 3 – Matching Equations to Graphs

On pages 3.2 to 3.5, students are to use what they have learned in the previous problems to determine the equation of the graph shown. If students are having trouble, tell them to identify the vertex first.

Solutions:

9. $(3, 6)$; $y = |x - 3| + 6$
10. $(-6, 3)$; $y = |x - 6| + 3$
11. $(-3, -6)$; $y = -|x + 3| - 6$
12. $(6, 3)$; $y = -|x + 6| + 3$



Same Day Extension – General Absolute Value Function

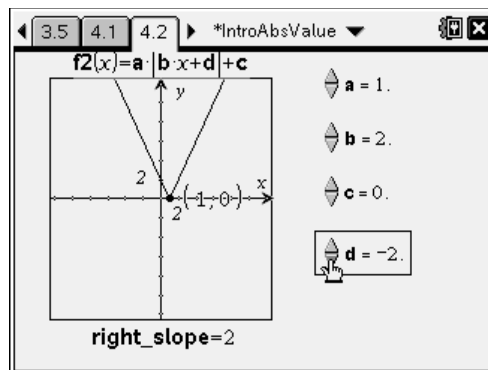
Students will explore all four variables that make up the general absolute value function. Note that b is included here, but was not explored in the previous problems.

Solutions:

13. When either a or b is zero, the graph is the horizontal line $y = c$. This happens because the x is eliminated and all that is left is a constant.
14. Answers will vary. The teacher can point out some things to look at. For example, ask them to increase a and decrease b and observe the effect.

The slope is the product of a and b .

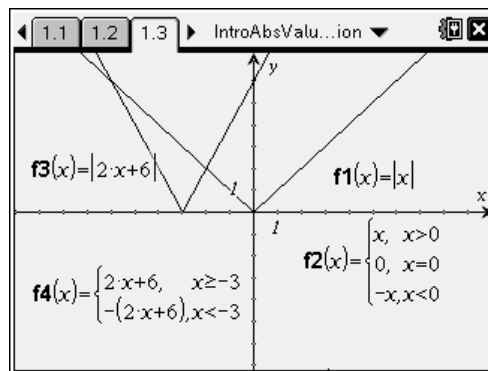
The vertex is $(-d/b, c)$. (Why? Consider that the minimum or maximum point will occur when the expression inside the absolute value is zero.)



Next Day Extension – Graphing With Piecewise Functions

Students are to graph the four functions given. They will need to use the math templates ($\frac{\square}{\square}$). The greater than or equal to symbol can be found by pressing $\text{ctrl} + \text{=}$ ($\text{[}\geq\text{]}$).

For Example 2, explain to students that $x < -3$ was determined by solving $2x + 6 = 0$ for x .

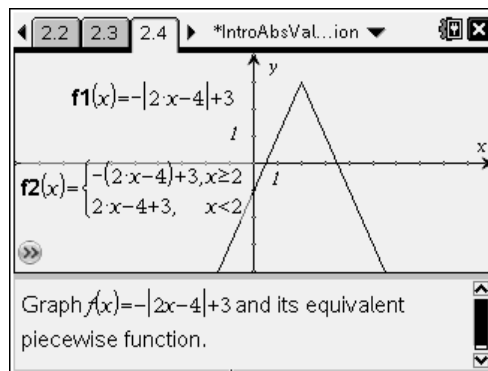


Page 2.1/2.2:
$$y = \begin{cases} \frac{1}{2}x - 3, & x \geq 6 \\ -\left(\frac{1}{2}x - 3\right), & x < 6 \end{cases}$$

For page 2.3, after determining the vertex coordinates, which way the function opens, and the slopes of the sides, students should be able to construct a piecewise function.

The vertex is (2, 3). It opens down. The slope is -2 on the left and 2 on the right.

$$y = \begin{cases} -(2x - 4) + 3, & x \geq 2 \\ 2x - 4 + 3, & x < 2 \end{cases}$$



For the first application problem, on page 3.2, students should determine that the time interval is incorrect and the graph does not increase in slope.

For the second application problem, on page 4.3, the solution is shown in the screenshot at the right. If students forget to use the 'less than or equal to' symbol, the teacher could ask if their function is continuous.

