1.3. Function Types

Absolute Value

The definition of the Absolute Value states,

$$|x| = \begin{cases} \ \ \ x, & \text{if } \ x \ge 0 \\ -x, & \text{if } \ x \lt 0 \end{cases}$$

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Examples

For example,

$$|3| = 3.$$

The number 3 is positive, in which case the equality $|3| = 3$ follows from the definition of absolute value for positive numbers,

$$|x| = x \ \ \ \text{when } x \ge 0.$$

On the other hand,

$$\begin{aligned} |-5| = \ & --5 \\ = \ & 5. \end{aligned}$$

The number -5 is negative, in which case the equality $|-5| = 5$ follows from the definition of absolute for negative numbers,

$$|x| = --x \ \ \ \text{when } x \lt 0.$$

Try some examples for yourself.

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Distance to Zero

The Absolute Value of a number can also be thought of as that number's distance to zero when graphing the number on a number line.

Consider the absolute value of 3, where

$$|3| = 3.$$

When graphed on a number line, it is clear that the number 3 is three units from zero.

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Similarly, consider the absolute value of -5, where

$$|-5| = 5.$$

When graphed on a number line, it is clear that the number -5 is five units from zero.

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Try some distance examples for yourself.

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Property 1: $|x| = c$

When the absolute value of a variable x equals a number c, as in

$$|x| = c,$$

then by the definition of the absolute value,

$$x = \pm c,$$

which says that the variable x equals either positive c or negative c.

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Try these examples for yourself.

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When graphing $|x| = c$ on the number line, you are going to label two points on the line, one point on the line for plus c and another point for minus $c.$

Try for yourself.

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Using Property 1

When you see an absolute value expression involving a variable x and constant c, you can solve for the variable using Property 1.

For example, consider the expression

$$|x - 3| = 5.$$

Applying Property 1 to this expression gives you a new expression,

$$x - 3 = \pm 5.$$

You can re-write this new expression into two separate expressions,

$$x - 3 = + 5, \text{ and } x - 3 = - 5.$$

Solve for x for each case:

$$\begin{aligned} x - 3 &= 5 \\ x - 3 + 3 &= 5 + 3 \\ x &= 8, \end{aligned}$$

and

$$\begin{aligned} x - 3 &= - 5 \\ x - 3 + 3 &= - 5 + 3 \\ x &= - 2. \end{aligned}$$

Graphing these two values of x on the number line gives you

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