

Writing Absolute Value as Piecewise

Absolute value functions can be written as two separate lines.

Piecewise function: A function made up of pieces of other functions. i.e. $f(x) = \begin{cases} 2x - 1, & x < 1 \\ x^2 & , x \geq 1 \end{cases}$

Use the point-slope formula $y - y_1 = m(x - x_1)$ and common sense to write the absolute value as piecewise.

Write $f(x) = |x - 1| + 2$ as a piecewise function.

First find the vertex: $(1, 2)$ and the slopes: 1 and -1

Use the vertex and slopes in the point-slope formula:

Positive Slope

$$y - y_1 = m(x - x_1)$$

$$y - 2 = 1(x - 1)$$

$$y - 2 = x - 1$$

$$y = x + 1$$

Negative Slope

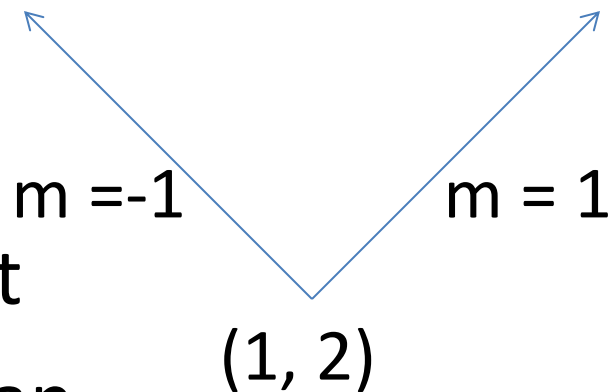
$$y - y_1 = m(x - x_1)$$

$$y - 2 = -1(x - 1)$$

$$y - 2 = -x + 1$$

$$y = -x + 3$$

The graph of $f(x) = |x - 1| + 2$ opens upward so the graph looks like this:



The negative slope is to the left of the vertex (when x is less than or equal to 1). The positive slope is to the right of the vertex (when x is greater than or equal to 1).

$$f(x) = \begin{cases} -x + 3, & x \leq 1 \\ x + 1, & x \geq 1 \end{cases}$$

Write $f(x) = -|3x + 9| + 5$ as a piecewise function.

Factor the 3: $f(x) = -|3(x + 3)| + 5$

Find the vertex: $(-3, 5)$ and the slopes: 3 and -3

Use the vertex and slopes in the point-slope formula:

Positive Slope

$$y - y_1 = m(x - x_1)$$

$$y - 5 = 3(x - -3)$$

$$y - 5 = 3(x + 3)$$

$$y - 5 = 3x + 9$$

$$y = 3x + 14$$

Negative Slope

$$y - y_1 = m(x - x_1)$$

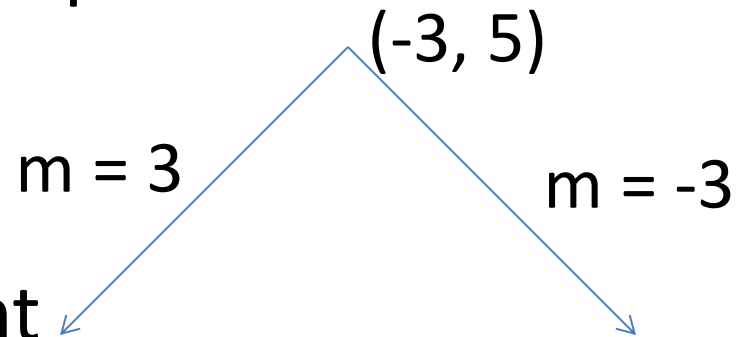
$$y - 5 = -3(x - -3)$$

$$y - 5 = -3(x + 3)$$

$$y - 5 = -3x - 9$$

$$y = -3x - 4$$

The graph of $f(x) = -|3x + 9| + 5$ opens downward so the graph looks like this:



The negative slope is to the right of the vertex (when x is less than or equal to -3). The positive slope is to the left of the vertex when x is greater than or equal to -3 .

$$f(x) = \begin{cases} 3x + 14, & x \leq -3 \\ -3x - 4, & x \geq -3 \end{cases}$$

Write $f(x) = 5|3 - x|$ as a piecewise function.

Factor the -1: $f(x) = 5|-x + 3| \rightarrow f(x) = 5|-(x - 3)|$

Find the vertex: $(3, 0)$ and the slopes: 5 and -5

Use the vertex and slopes in the point-slope formula:

Positive Slope

$$y - y_1 = m(x - x_1)$$

$$y - 0 = 5(x - 3)$$

$$y = 5x - 15$$

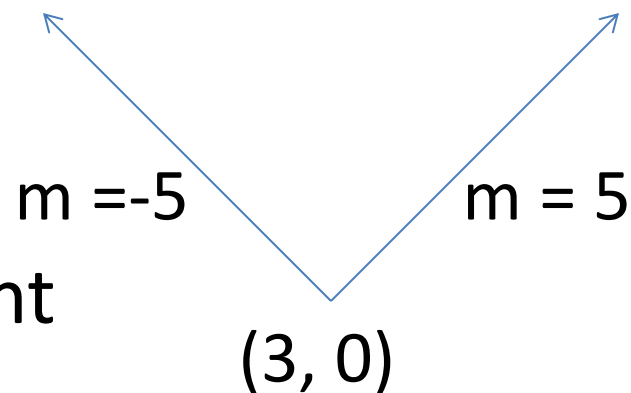
Negative Slope

$$y - y_1 = m(x - x_1)$$

$$y - 0 = -5(x - 3)$$

$$y = -5x + 15$$

The graph of $f(x) = 5|3 - x|$ opens up so the graph looks like this:



The negative slope is to the right of the vertex (when x is less than or equal to 3). The positive slope is to the left of the vertex when x is greater than or equal to 3.

$$f(x) = \begin{cases} -5x + 15, & x \leq 3 \\ 5x - 15, & x \geq 3 \end{cases}$$