Math 3 Name: Key

Unit 1 Day 4 Notes – Absolute Value Functions Date:_____

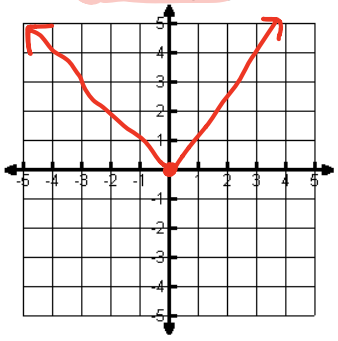
Absolute value variable equations are written as:

- $f(x) = |mx + b| + c$ → $a|mx+b|+c$
- Graph looks like a right side up or upside down "V"
  - Opens up if the coefficient in front of the absolute value symbols is positive.

    $f(x) = 4|x + 2| + 3$ opens up
  - Opens down if the coefficient in front of the absolute value symbols is negative.

    $f(x) = -4|x + 2| + 3$ opens down
- The vertex of the graph will be $\left(-\frac{b}{m}, c\right)$. You can use your calculator to find it!!

Let's start with $f(x) = |x|$ and graph the equation. This is called the parent function.



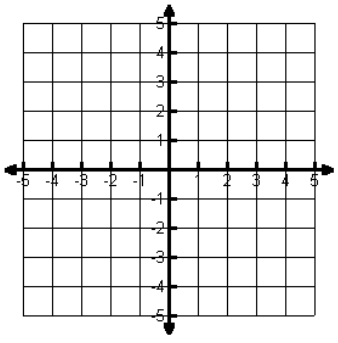
What's the vertex? (0,0)

Does it open up or down? Up

Domain: $(-\infty, \infty)$ Range: $[0, \infty)$

(x) ↔ (y) ↕

You try $f(x) = |x+2|$. How is it different from the parent graph? shifted left 2 units



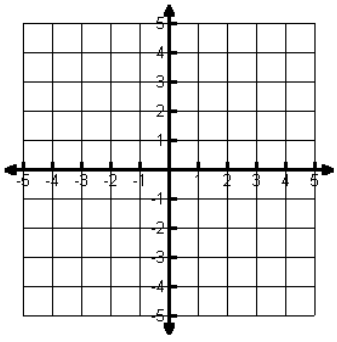
What's the vertex? (-2,0)

Does it open up or down? Up

Domain: $(-\infty, \infty)$ Range: $[0, \infty)$

Now try:

$f(x) = |x| + 2$. How is it different from the parent graph? shifted up 2 units



What's the vertex? (0,2)

Does it open up or down? Up

Domain: $(-\infty, \infty)$ Range: $[2, \infty)$

Vertical Transformations:

A constant added outside the absolute value symbol shifts the graph UP that many units.

$f(x) = |x| + 5$ moves the parent graph ___up___

A constant subtracted outside the absolute value symbol shifts the graph DOWN that many units.

$f(x) = |x| - 3$ moves the parent graph ___down___

Horizontal Transformations:

A constant added inside the absolute value symbols shifts the graph LEFT horizontally.

$f(x) = |x + 2|$ moves the parent graph ___left___

A constant subtracted inside the absolute value symbols shifts the graph RIGHT horizontally.

$f(x) = |x - 2|$ moves the parent graph ___Right___

Reflection over the x-axis:

If you have a ___negative___ in front of the absolute value, the graph will be reflected or ___flips___ over the x-axis.

$f(x) = -|x|$ moves the parent graph ___reflected over the x-axis___

Vertical Stretch/Compression:

$f(x) = a|mx+b| + c$ → up or down; left or right

$a \cdot f(x)$, where a is a real number > 0

If $a > 1$, then f(x) has a vertical ___shrinks___ by a factor of a units.

If $0 < a < 1$ (decimal or fraction), then f(x) has a vertical ___stretches___ by a factor of a units.

$f(x) = 2|x|$ How does this compare to the parent? ___shrinks by a factor of 2___

$f(x) = 0.5|x|$ How does this compare to the parent? ___stretches by a factor of 0.5___

Quick Recap:

In what way would the graph of $y = |x|$ move according to the following equations? Be specific.

1. $y = 4|x + 3| - 5$

vertical shrink by a factor of 4
shifts left 3 units
shifts down 5 units

2. $y = -|x - 2| + 7$

reflected over the x-axis
shifts right 2 units
shifts up 7 units

Application:

A rainstorm begins as a drizzle, builds up to a heavy rain, and then drops back to a drizzle. The rate r (in inches per hour) at which it rains is given by the function $r = -0.5|t - 1| + 0.5$ and t represents time in hours.

Graph the function.

How long does it rain?

When does it rain the hardest?

What is the rate of the rain after 30 minutes?