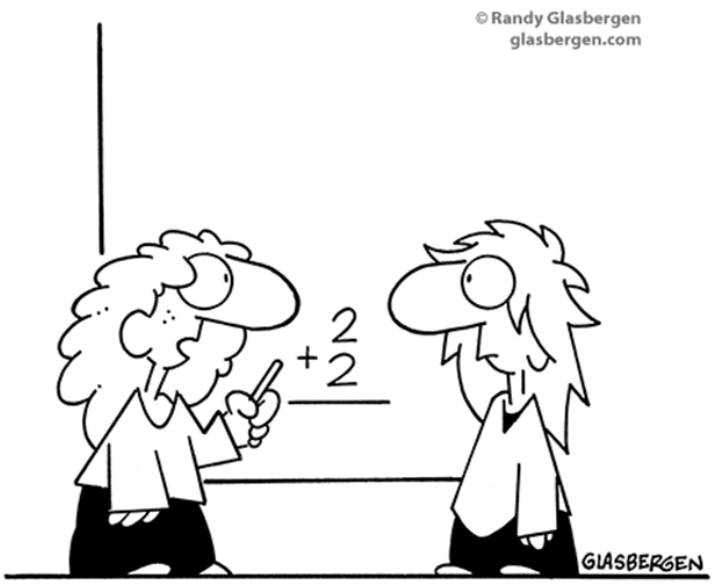
Name: Block:



"First they build up your confidence with simple addition and subtraction, then they slam you with algebra and calculus. It's quite a clever scheme."

Unit 3: Absolute Value

Day 1	Characteristics of Absolute Value
Day 2	Transformations of Absolute Value
Day 5	Absolute Value Equations
Day 6	Absolute Value Inequalities

Schedule of Upcoming Classes

Day 1	A	Mon 9/21	Introducing AV functions
	B	Tues 9/22	
Day 2	A	Wed 9/23	Transformations & Analyzing AV Graphs
	B	Thurs 9/24	
Day 3	A	Fri 9/25	Review of Graphing AV functions
	B	Mon 9/28	
Day 4	A	Tues 9/29	Quiz: Graphing & Analyzing AV Functions
	B	Wed 9/30	
Day 5	A	Thurs 10/1	Solving & Graphing AV Equations
	B	Fri 10/2	
Day 6	A	Mon 10/5	Solving & Graphing AV Inequalities
	B	Tues 10/6	
Day 7	A	Wed 10/7	Unit Review *
	B	Thurs 10/8	
Day 8	A	Fri 10/9	Unit Test
	B	Tues 10/13	

** Skills Review due & Skills Check*

Absent?

See Ms. Huelsman AS SOON AS POSSIBLE to get work and any help you need.

Notes are <u>always</u> posted online on the calendar.

You may also email Ms. Huelsman at Kelsey.huelsman@lcps.org with any questions!

Need Help?

Ms. Huelsman and Mu Alpha Theta are available to help
Monday, Tuesday, Thursday, and Friday **mornings** in L506 starting at 8:10.

Ms. Huelsman is also available after school until 4:30.

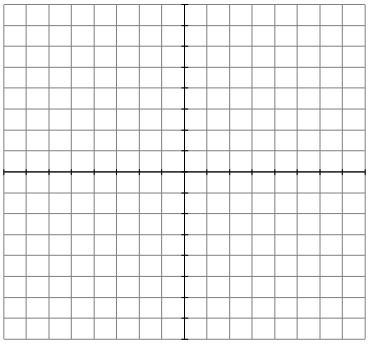
Need to make up a test/quiz?

Math Make Up Room is open Mon/Tues/Thurs/Fri mornings and Mon/Wed/Thurs afternoons.

Schedule is posted around the math hallway & in Ms. Huelsman's classroom ☺

Day 1: Introducing… The Absolute Value Function

Let's take a look at y = x…



What happens if we change every negative y-value to a positive value?

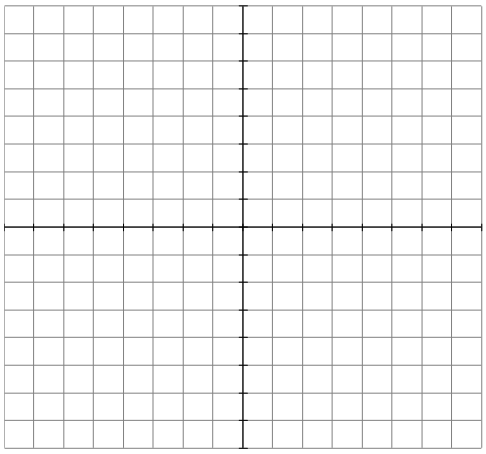
Does this sound familiar? What takes negative values and makes them positive?

Introducing …….. the Absolute Value Function

$$|x| = \begin{cases} x, & x \geq 0 \\ -x, & x < 0 \end{cases}$$

We can analyze the **parent function** for special points and behavior -

$$y = |x|$$



Domain:

Range:

Vertex:

y-intercept:

zeros (roots, x-intercepts, solutions):

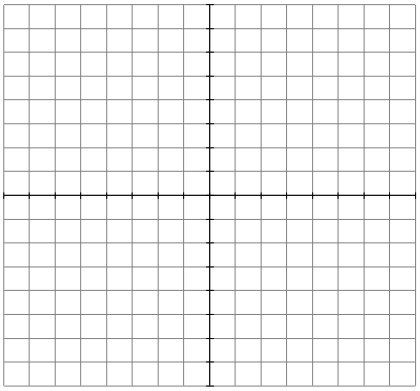
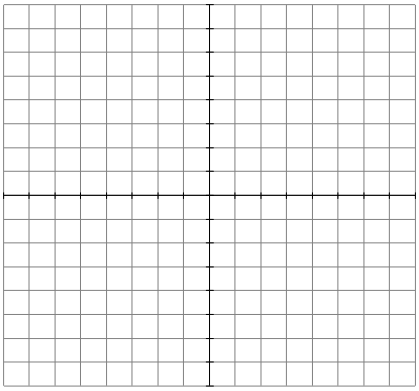
Increasing:

Decreasing:

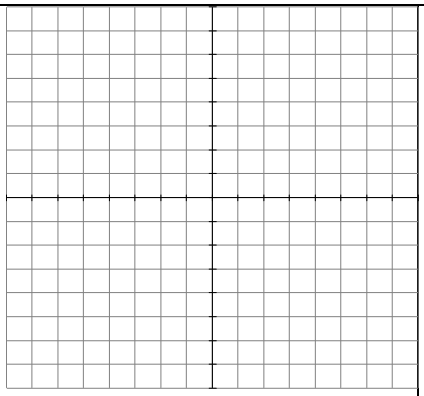
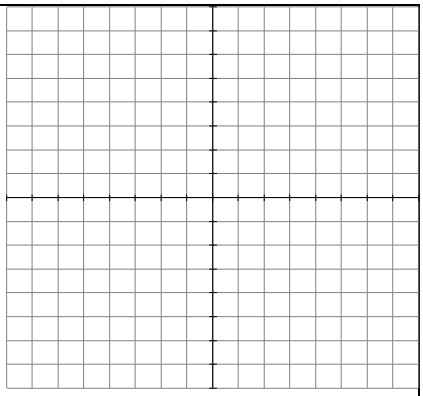
End Behavior:

Slope of right branch:

We can also **move** the parent function to other places on the coordinate plane.

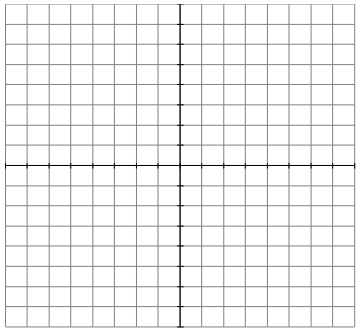
$y=\|x\|-4$ 	$y=\|x+3\|$ 
Domain:	Domain:
Range:	Range:
Vertex:	Vertex:
Y-intercept:	Y-intercept:
Zeros / X-intercepts:	Zeros / X-intercepts:
Increasing:	Increasing:
Decreasing:	Decreasing:
End Behavior:	End Behavior:
Slope of right branch:	Slope of right branch:

Are you noticing any patterns yet? Let's look at domain and range.

$y = 2\|x\| - 5$  Domain: Range: Vertex: Y-intercept: Zeros / X-intercepts: Increasing: Decreasing: End Behavior: Slope of right branch:	$y = -\frac{1}{4}\|x-1\| + 5$  Domain: Range: Vertex: Y-intercept: Zeros / X-intercepts: Increasing: Decreasing: End Behavior: Slope of right branch:

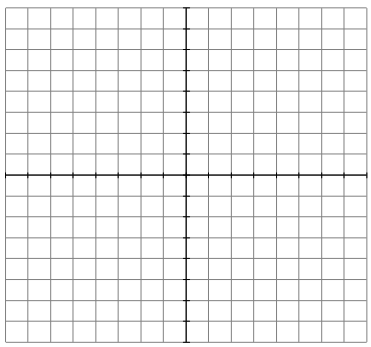
Are you noticing any patterns yet? Let's look at slope of the right branch.

Graph the **inverse** of the Absolute Value Function
(start out with the original $y = |x|$)
then, how do you graph an inverse?



Is the inverse a function?

Graph an Absolute Value Function that has
a **removable discontinuity** at (3,4)



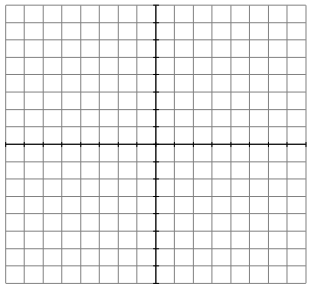
Day 2: Graphing Using TRANSFORMATIONS

In these notes we will

Learn a **new technique** for graphing a function – shifting it up, down, left, right

So we can

Eventually graph **ANY** function given its parent shape

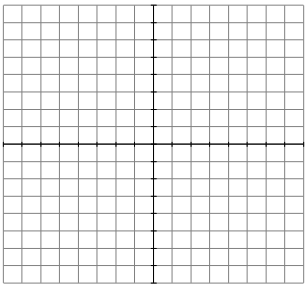


First, let's graph the absolute value "parent function", $y = |x| \rightarrow$

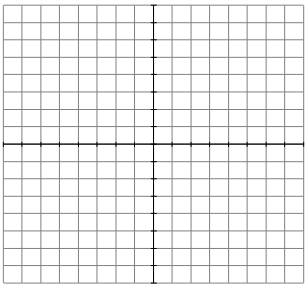
Use your calculator to graph this function in Y_1

What is the vertex of the graph?

Exploration of Transformations – Vertical Shifts



1. Graph $y = |x| + 2$ on your calculator in Y_2.
   a) Sketch this graph and the "parent function".
   b) How does the graph move? (up or down) _____
   c) What is the **vertex** of the graph? _____

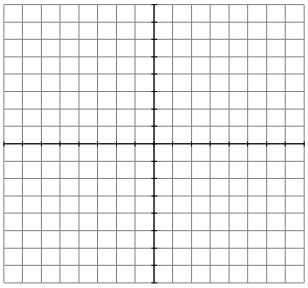


2. Graph $y = |x| - 5$ on your calculator in Y_2.
   a) Sketch this graph and the "parent function".
   b) How does the graph move? (up or down) _____
   c) What is the **vertex** of the graph? _____

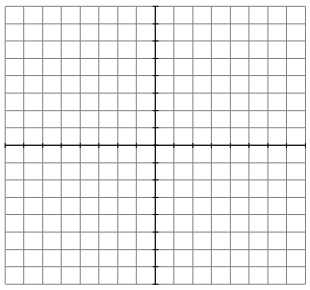
3. Given that **$y = a|x - h| + k$** is the symbolic form of the absolute value function, what does the **parameter *k* control**?

If **k is positive**, what direction do we move? If **k is negative**, what direction do we move?

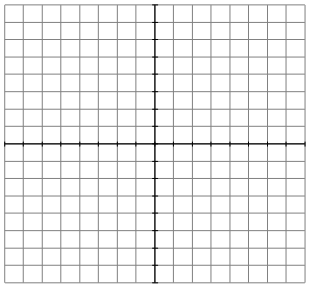
<u>Exploration of Transformations</u> – Horizontal Shifts



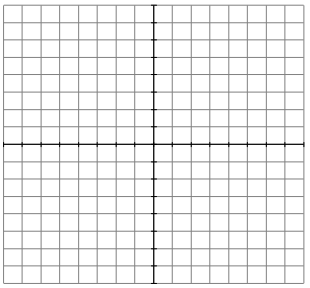
1. Graph y = |x| on your calculator in Y_1.
   a) Sketch a graph of the function.
   b) What is the vertex of the graph? _____



2. Graph y = |x - 1| on your calculator in Y_2.
   a) Sketch a graph of the function and the function in #1.
   b) How does the graph move? Left or Right? _____
   c) What was the **SIGN inside** the absolute value?
   d) What is the vertex of the graph? _____



3. Graph y = |x - 5| on your calculator in Y_2.
   a) Sketch a graph of the function and the function in #1.
   b) How does the graph move? Left or Right? _____
   c) What was the **SIGN inside** the absolute value?
   d) What is the vertex of the graph? _____



4. Graph y = |x + 3| on your calculator in Y_2.
   a) Sketch a graph of the function and the function in #1.
   b) How does the graph move? Left or Right? _____
   c) What was the **SIGN inside** the absolute value?
   d) What is the vertex of the graph? _____

5. Given that **y = a|x – h| + k** is the symbolic from of the absolute value function, what does the **parameter *h* control**?

When we have **|x – h|,** what direction does the graph move?

When we have **|x + h|,** what direction does the graph move?

How is the motion related to the sign of h?

Exploration of Transformations – Vertical Stretch or Shrink

1. Graph $y = |x|$ on your calculator in Y_1.
   a) What direction does the graph open? _____
   b) What is the vertex of the graph? _____
   c) Fill in the table to the right. These coordinates are the basic ordered pairs of the absolute value function.

x	y
-2	
-1	
0	
1	
2	

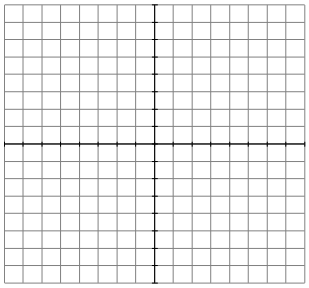
2. Graph $y = 2|x|$ on your calculator in Y_2.
   a) What direction does the graph open? _____
   b) What is the vertex of the graph? _____
   c) Fill in the table. How do these y-coordinates compare with the y-coordinates in question 1? Is the graph fatter or skinnier?

x	y
-2	
-1	
0	
1	
2	

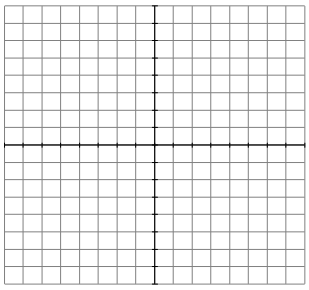
3. Graph $y = ½ |x|$ on your calculator in Y_2.
   a) What direction does the graph open? _____
   b) What is the vertex of the graph? _____
   c) Fill in the table. How do these y-coordinates compare with the y-coordinates in question 1? Is the graph fatter or skinnier?

x	y
-2	
-1	
0	
1	
2	

4. Graph $y = -|x|$ on your calculator in Y_2.
   a) Sketch a graph of the function and the function in #1.
   b) How did the graph change? _____



5. Graph $y = -2|x|$ on your calculator in Y_2.
   a) Sketch a graph of the function and the function in #1.
   b) How did the graph change? _____



6. Given that **$y = a|x - h| + k$** is the symbolic from of the absolute value function, what does the **parameter *a* control**?

1. _____ 2. _____

Examples 1 and 2 *Examples 3 and 4*

Exploration of ALL Transformations –

1. Graph $y = |x|$ on your calculator in Y_1.

2. Graph $y = | x - 3 | - 4$ on you calculator in Y_2.
   a) What direction does the graph open? _____
   b) How does the graph move? (left/right, up/down) _____
   c) What is the vertex of the graph? _____

3. Graph $y = - | x - 2 | - 3$ on you calculator in Y_2.
   a) What direction does the graph open? _____
   b) How does the graph move? (left/right, up/down) _____
   c) What is the vertex of the graph? _____

4. Graph $y = 2|x + 6| - 4$ on you calculator in Y_2.
   a) What direction does the graph open? _____
   b) How does the graph move? (left/right, up/down) _____
   c) What is the vertex of the graph? _____

Given the absolute value function $\mathbf{y = a|x - h| + k}$

If $a > 0$, does the graph open up or down? _____

If $a < 0$, does the graph open up or down? _____

If $|a| > 1$, does the graph have a vertical stretch or vertical shrink? _____

If $0 < |a| < 1$, does the graph have a vertical stretch or vertical shrink? _____

What does the parameter k control? _____

What does the parameter h control? _____

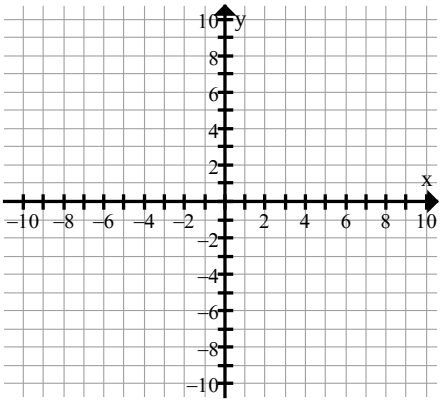
What is the vertex? _____

Now *generalize*...Fill in the table using your knowledge of transformations.

Function	Direction/Opening (up or down)	Vertex	Vertical Stretch or shrink
1. $y = ¼ \|x + 4\| - 9$			
2. $y = - 2\|x + 1\| + 6$			
3. $y = 4\|x - 3\| + 5$			
4. $y = - ½ \|x - 7\| + 3$			
5. $y = 2\|x + 4\| - 1$			

Graph the following using your knowledge of transformations. Verify with your calculator.

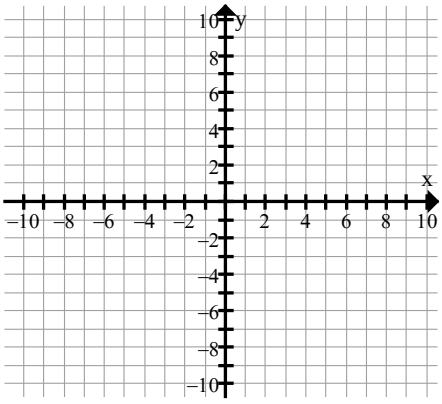
1. $y = \frac{1}{4}|x + 4| - 9$



Domain: _____

Range: _____

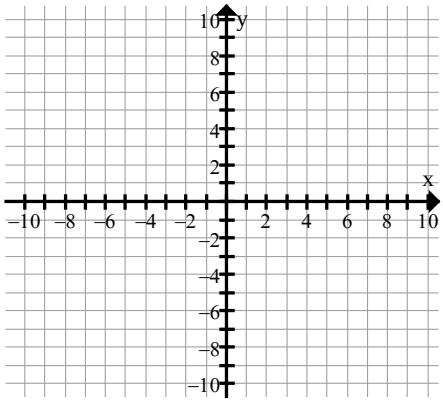
2. $y = -2|x + 1| + 6$



Domain: _____

Range: _____

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

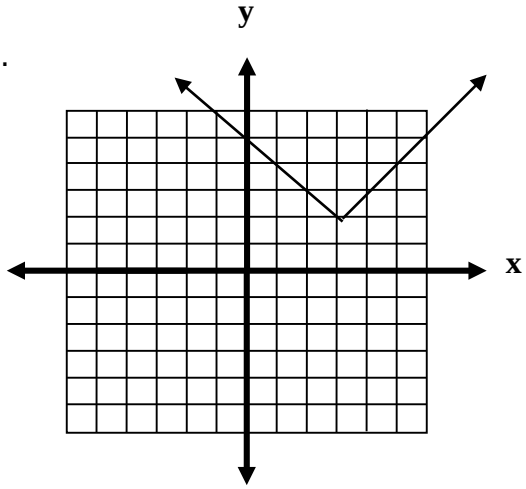


Domain: _____

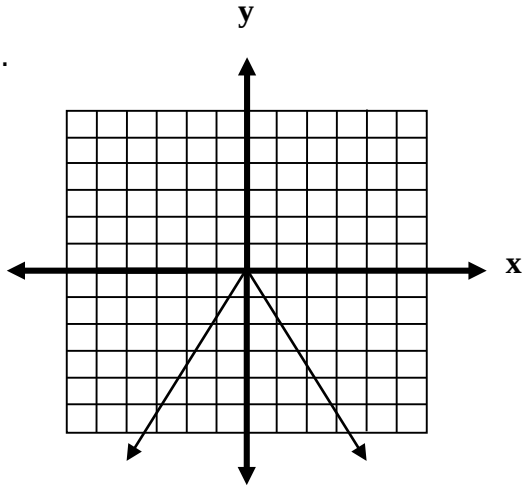
Range: _____

<u>Given the absolute value equation graph, write the absolute value equation:</u>

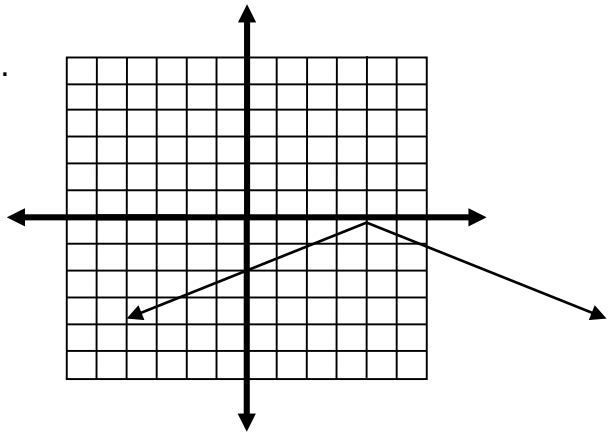
1.

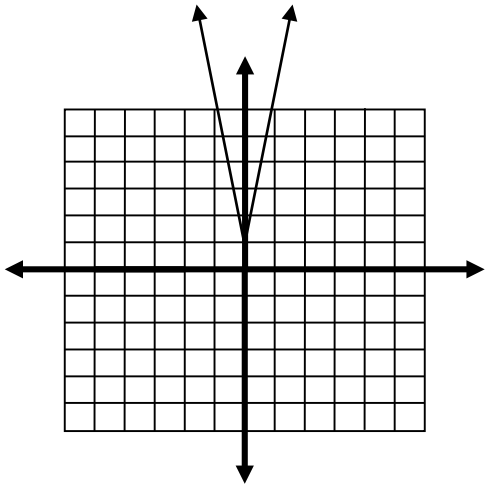


2.



4.





Quick Quiz Review

1. Which absolute value function(s) open **up**?

A. $y = -2|x - 5|$ B. $y = |x + 1| - 7$

C. $y = -|x + 4| + 8$ D. $y = \frac{1}{4}|x - 9|$

2. Which absolute value function(s) are vertically **stretched**?

A. $y = -2|x - 5|$ B. $y = |x + 1| - 7$

C. $y = -|x + 4| + 8$ D. $y = \frac{1}{4}|x - 9|$

3. Which absolute value function(s) have an **absolute minimum** at the vertex?

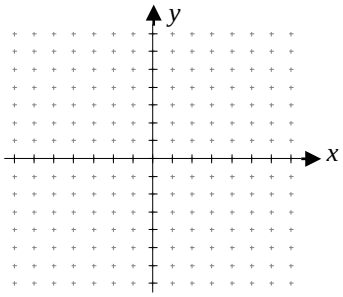
A. $y = -2|x - 5|$ B. $y = |x + 1| - 7$

C. $y = -|x + 4| + 8$ D. $y = \frac{1}{4}|x - 9|$

4. Given $f(x) = |x + 9|$. The vertex of the function moves from (0, 0) nine units _____:

A. left B. right C. up D. down

5. Sketch $f(x) = |x - 5| + 1$



What is the range?

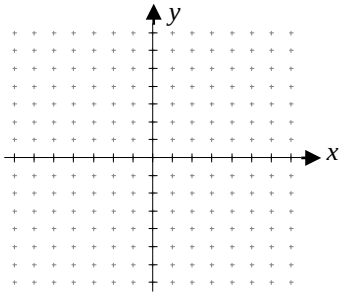
What is the end behavior?

The vertex is... (circle all that apply)

A) a relative minimum B) a relative maximum

C) an absolute minimum D) an absolute maximum

6. Sketch $f(x) = -\frac{4}{3}|x| + 4$



What is the range?

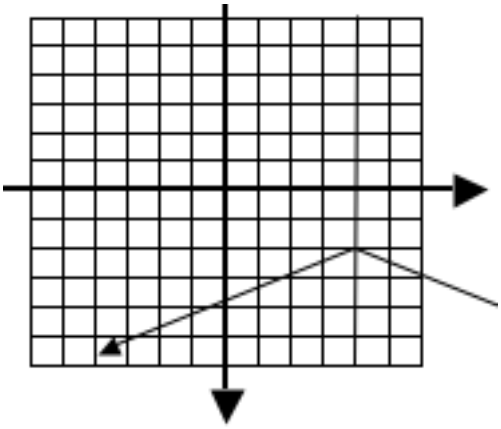
What is the end behavior?

The vertex is... (circle all that apply)

A) a relative minimum B) a relative maximum

C) an absolute minimum D) an absolute maximum

7. Write the equation for the following absolute value functions



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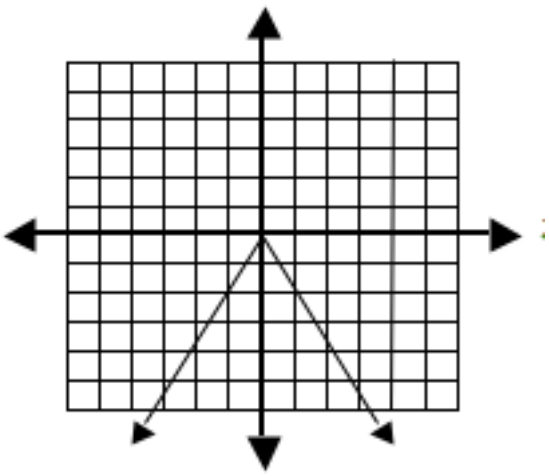

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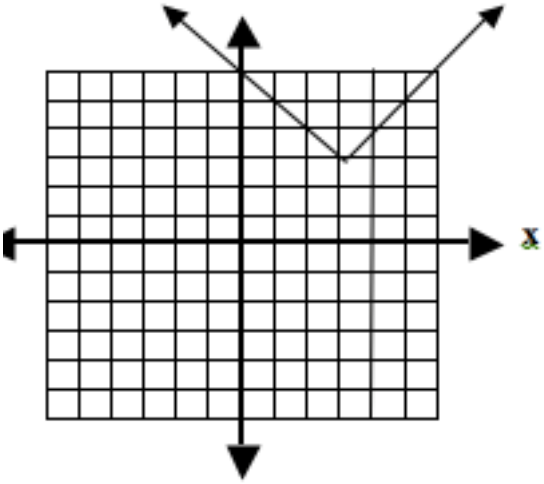

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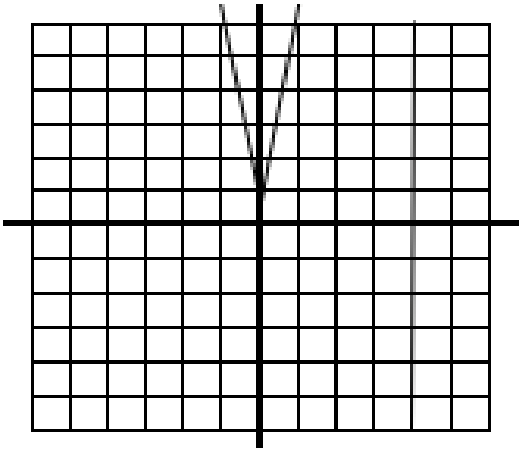


_____

With a vertex at (- 8, 2) that is vertically stretched by a scale of 2:

_____

That opens downward and has a vertex at (5, 0):

_____

That is vertically shrunk and shifted to the right (you pick the details!)

_____

Day 5: Absolute Value Equations

Objective: understand the definition of absolute value and how to manipulate that symbol in solving equations.

Absolute Value means _____

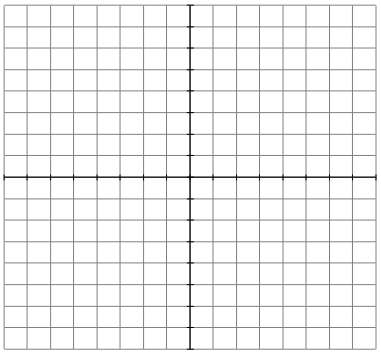
Absolute Value Equations

What it MEANS: Graph an Absolute Value Equation on a Number Line

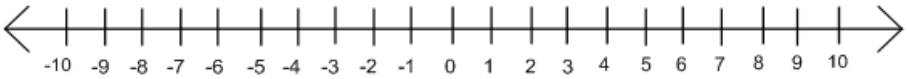
1. $|x| = 4$

As distance: $|x - 0| = 4$ "the set of points whose distance from 0 is 4"

Another way – these are two FUNCTIONS. Where are they EQUAL?
Graph $y=|x|$ and $y=4$...



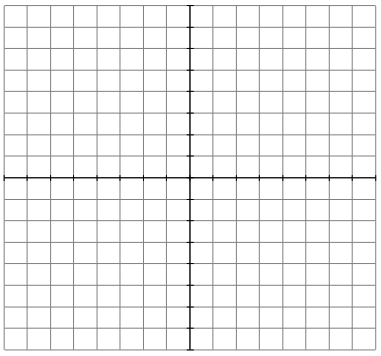
3. $|x - 4| = 3$



As distance: the set of points whose distance from ____ is equal to ___

As functions - What two functions are we looking at here?

Where are they EQUAL?



How we DO it ALGEBRAICALLY: Solve an Absolute Value Equation –

1. **Isolate** the absolute value symbol on one side of the equal sign
2. Break the equation into **2** derived equations – the positive case and the negative case
3. Solve both equations
4. Check your solutions (WARNING: There may be **extraneous** solutions!)

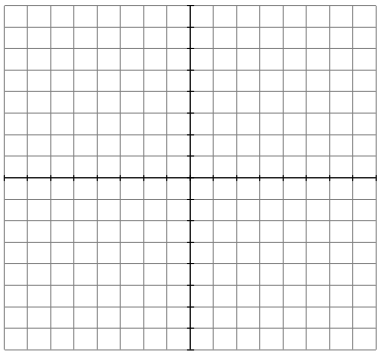
1. $|x+3| = 8$

2. $|3x + 1| - 5 = -3$

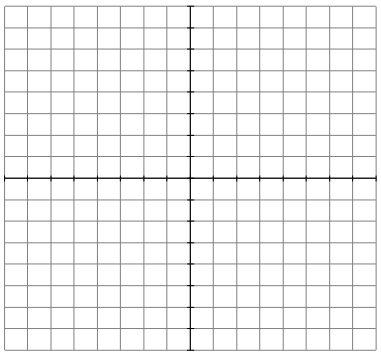
Isolate before writing the two cases!

Let's verify our answers graphically...

$Y_1 =$ $Y_2 =$



$Y_1 =$ $Y_2 =$

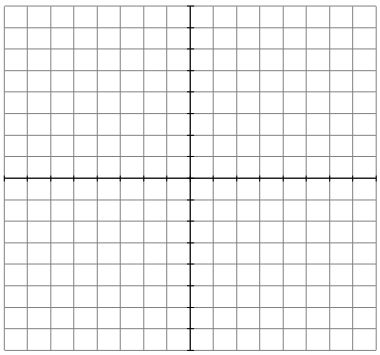


3. $|2x + 12| = 4x$

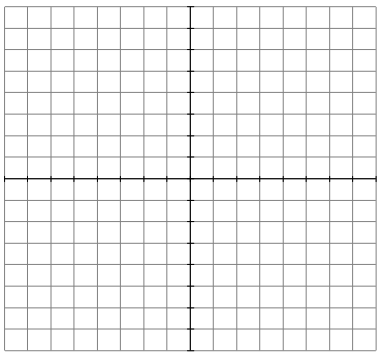
4. $|4x + 5| = 2x + 4$

Let's verify our answers graphically...

$Y_1 =$ $Y_2 =$



$Y_1 =$ $Y_2 =$



5. $2|x + 7| - 5 = 15$

6. $-2|x + 7| - 5 = 15$

Discuss: What was different between #5 and 6? What kind of absolute value equation would have **no solution**?

Let's Review solving linear inequalities (This is a lead-in to absolute value inequalities!)

A) Inequality Symbols: $<$ _____ , $\leq$ _____

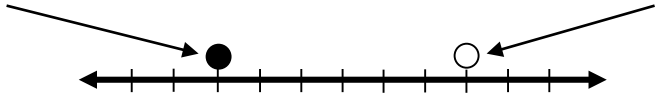
$>$ _____ , $\geq$ _____

Don't forget → switch the sign of the inequality when multiplying or dividing by a negative #

Switch	**Don't switch**	
$-3x < 9$	$3x < -12$	Original Problem(s)
$x > -3$	$x < -4$	Solution

B) Graphing Linear Inequalities:

Closed circle
$\leq$, $\geq$

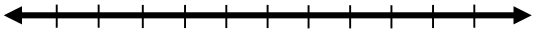


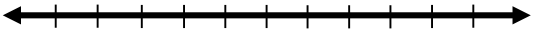
Open Circle
$<$, $>$

C) Solve the following *linear inequalities*, then graph each solution:

EX 1] $3x + 12 < 9$

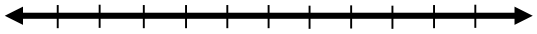
EX 2] $4x - 3 \geq 6x + 15$

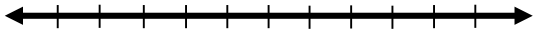




EX 3] $-4x + 16 > 4$

EX 4] $-3x - 6 \leq 3x + 6$





D) Graphing Compound Inequalities

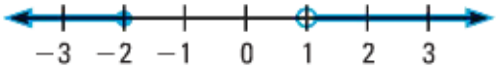
What is different now?

EX] $-1 < x < 2$

The solutions are all real numbers that are greater than -1 **and** less than 2.

EX] $x \leq -2$ **or** $x > 1$

The solutions are all real numbers that are less than or equal to -2 **or** greater than 1.



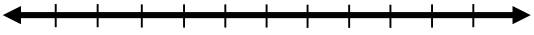
HOW DO I REMEMBER THESE???

_____ _____

Graph the following inequalities.

1. $-3 < x \leq 2$

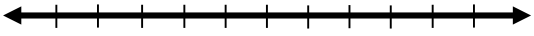
2. $x \leq 3$ or $x > 7$

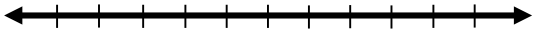


Solve the compound inequality, and then graph your solution.

3. $-10 \leq 2x + 4 < 14$

3. $3x + 2 < -10$ or $2x - 4 > -4$





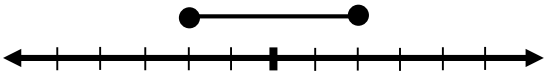
Day 6: Absolute Value Inequalities

Absolute value turns simple inequalities into <u>compound inequalities</u> because we have to <u>consider the negative case</u>.

Less than:	**Greater than:**
| x | < 3 means: set of points whose distance from ____ is  -3 < x < 3	| x | > 3 means: set of points whose distance from ____ is  x < – 3 **or** x > 3

Practice: Write the absolute value inequalities that would correspond with these graphs:

AND or OR



AND or OR

Discuss: What was a key difference between solving **linear** equations and **absolute value** equations?

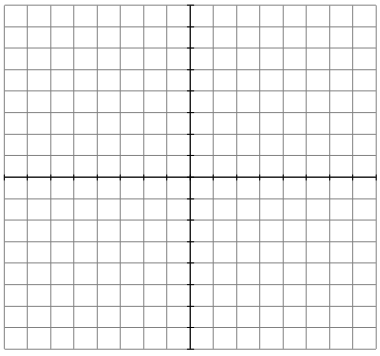
<u>How we DO it: Solve an Absolute Value Inequalities</u> –

6. Isolate the absolute value symbol on one side of the equal sign
7. Break the equation into derived equations – the positive case and the negative case (for the **negative** case – **KEEP, CHANGE, CHANGE**)
8. Solve both equations
9. Check your solutions (WARNING: There may be **extraneous** solutions!)

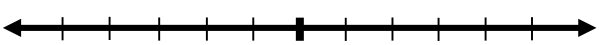
Solve and Graph the Absolute Value Inequality:

| x + 3 | ≥ 5 AND or OR ?

Verify graphically

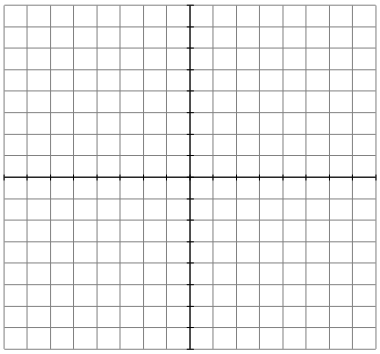


Graph your solution:



| x – 2 | > 4 AND or OR ?

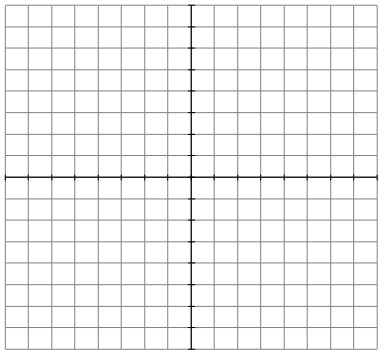
Verify graphically



Does this look like AND or OR?

| 5x + 1 | ≥ 16 AND or OR ?

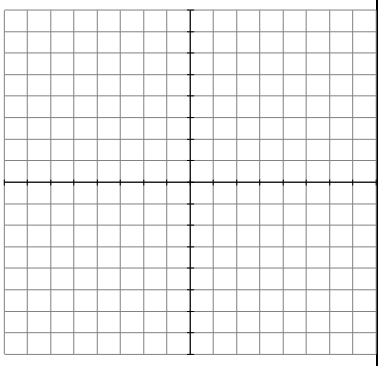
Verify graphically



Does this look like AND or OR?

| 5x + 1 | – 4 ≤ 14 AND or OR ?

Verify graphically



Try these:

1. $|3x + 1| + 2 < 8$

2. $2|x - 3| - 2 \geq 8$

3. $|x - 3| - 2 < -8$
   THINK about this one! ☺

FSGPT: Change something about #3 so that.....