Warm-Up

CST/CAHSEE:Algebra

What is the solution for this equation?

$|2x-3|=5$

A. $x=-4$ *or* $x=4$
B. $x=-4$ *or* $x=3$
C. $x=-1$ *or* $x=4$
D. $x=-1$ *or* $x=3$

Review: Algebra

What is the solution for this equation?

$|x+10|=12$

- Show two ways to solve this equation.

Current: Algebra

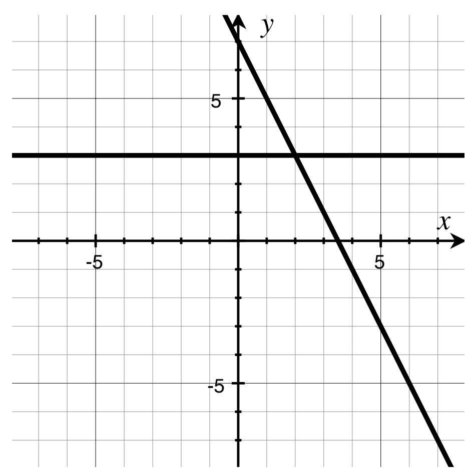
Absolute Value is defined as:

A. A number that is always positive.
B. A number that is always negative.
C. A number's distance from zero.
D. A number's value no matter what.

- True or False: An absolute value equation always has two solutions. Explain or provide an example.

Other: Algebra

What is the solution of the system graphed below?



A. $(-2, 3)$
B. $(2,3)$
C. $(3, 2)$
D. No Solution

- Write the equation of each line.
- Which answer choices could you eliminate immediately and why?

Warm-Up Solutions

CST/CAHSEE: Algebra 1

$$|2x-3|=5$$

$2x-3=5$	$2x-3=-5$
$2x-3+3=5+3$	$2x-3+3=-5+3$
$2x=8$	$2x=-2$
$\frac{2x}{2}=\frac{8}{2}$	$\frac{2x}{2}=\frac{-2}{2}$
$x=4$	$x=-1$

Review: Algebra

$$|x+10|=12$$

$x+10=12$	$x+10=-12$
$x+10-10=12-10$	$x+10-10=-22-10$
$x=2$	$x=-22$

Method #2: Use Guess & Check or a Number Line.

Current: Algebra

Answer Choice C: Absolute Value is defined as a number's distance from zero.

False: An absolute value equation has only one answer when the absolute value expression is equal to zero.

Example: $|3x-12|=0$

The only value of x that satisfies this equation is $x=4$.

Similarly, is an absolute value expression that is equal to a negative number has no solution. A number's distance form zero cannot be negative.

Example: $|3x-12|=-5$

Other:Algebra

Answer Choice C: The solution of the system is the point of intersection of the two lines.
That point is $(3, 2)$.

We may immediately eliminate answer choices A and D. The ordered pair listed in Choice A is in Quadrant II and our point of intersection is clearly in Quadrant I. Answer Choice D states that there is no solution, which would indicate a system of parallel lines. Our lines are clearly intersecting.

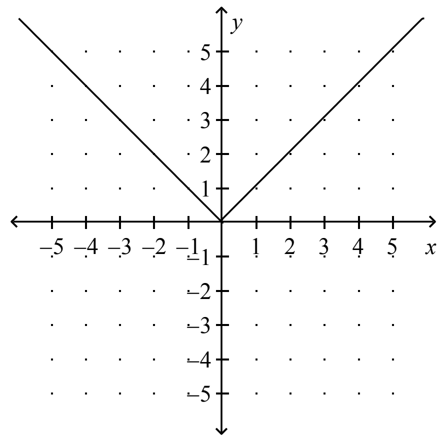
Equations:

$y=3$
$y=2x+8$

<u>All About Absolute Value Functions</u>

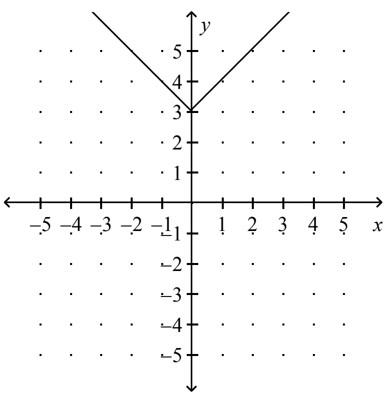
Graphing Absolute Value Functions:

Graph $y = |x|$. We will call this the "mother function" for absolute value functions.



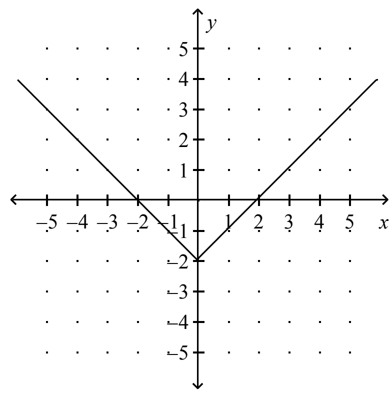
Graph each function.
Explain how it compares to the mother function.

1) $y = |x| + 3$



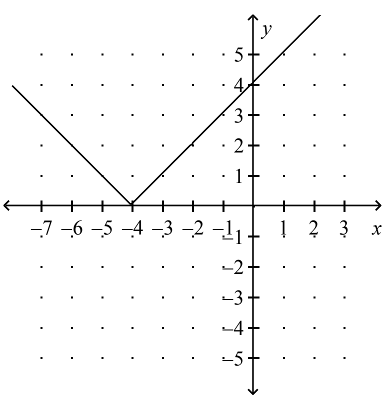
The graph is translated up 3 units.

2) $y = |x| - 2$



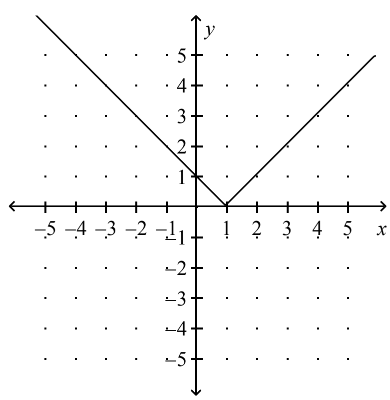
The graph is translated down 2 units.

3) $y = |x + 4|$



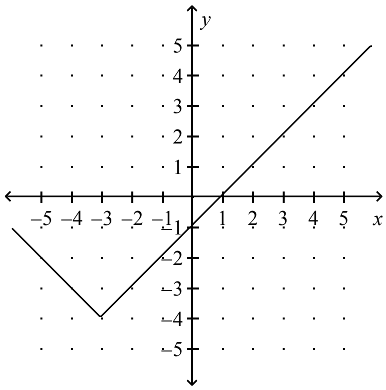
The graph is translated left 4 units.

4) $y = |x - 1|$



The graph is translated right 1 unit.

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



The graph is translated left 3 units and down 4 units.

Summarize the function behavior you observed from the previous examples:

$y = |x+a|$ translates left a units

$y = |x-a|$ translates right a units

$y = |x| + b$ translates up b units

$y = |x| - b$ translates down b units

Explain how the graph for each of the following functions compares to the mother function.
Do this first without graphing, then graph to check your answer.

6) $y = |x+2|$

The graph is translated left 2 units.

7) $y = |x| - 4$

The graph is translated down 4 units.

8) $y = |x-5| - 2$

The graph is translated right 5 units and down 2 units.

NOTE: Stop here and debrief warm-up, CST and review items.

Solving Absolute Value Equations in One Variable:
Any equation in one variable can be rewritten as a system of two equations in two variables. We will explore solving absolute value equations by rewriting them as systems of equations.

Examples:

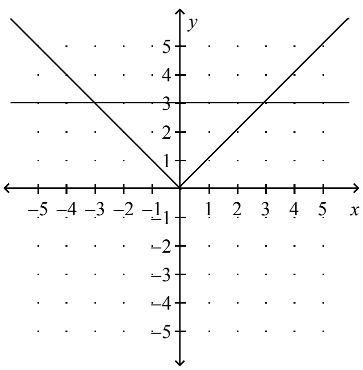
9) Solve $|x| = 3$

Rewrite as a system of equations:

$y = |x|$

$y = 3$

Graph to find the solutions for the system of equations:



The points of intersection are (3, 3) and (–3, 3).
The solutions to $|x| = 3$ are the *x* coordinates of the points of intersection.
Solutions: $x = -3$, $x = 3$

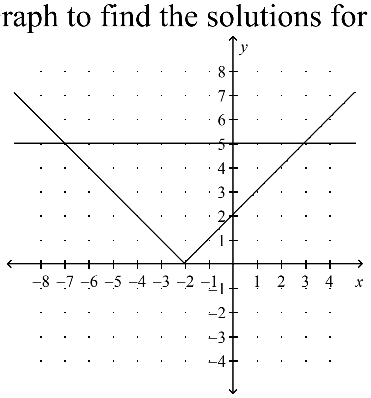
10) Solve $|x + 2| = 5$

Rewrite as a system of equations:

$y = |x + 2|$

$y = 5$

Graph to find the solutions for the system of equations:



The points of intersection are (3, 5) and (–7, 5).
The solutions to $|x + 2| = 5$ are the *x* coordinates of the points of intersection.
Solutions: $x = -7$, $x = 3$

11) **You Try:**

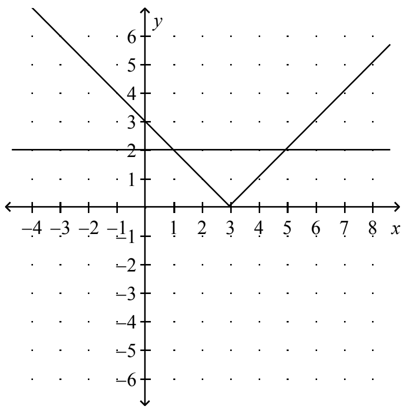
Solve $|x-3|=2$

Rewrite as a system of equations:

$y=|x-3|$

$y=2$

Graph to find the solutions for the system of equations:



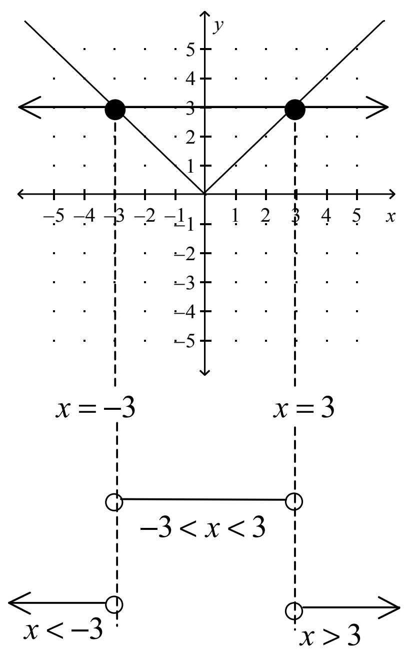
The points of intersection are (5, 2) and (1, 2).

The solutions to $|x-3|=2$ are the x coordinates of the points of intersection.

Solutions: $x=1$, $x=5$

This method can be extended to solve absolute value inequalities as well:

12) Our graph from example 9 showed us the solutions for $|x|=3$. It also shows the solutions to $|x|<3$ and $|x|>3$

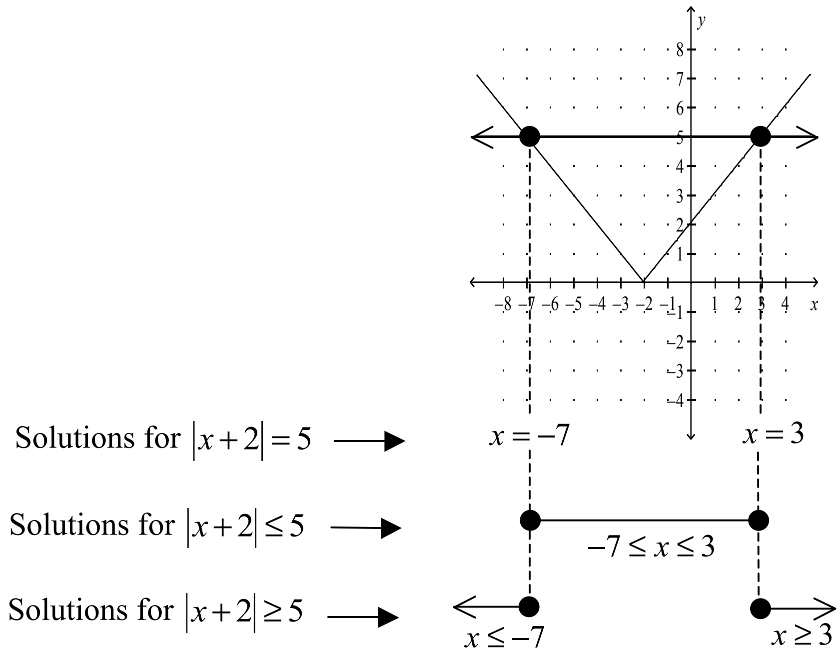


Solutions for $|x|=3$ ⟶

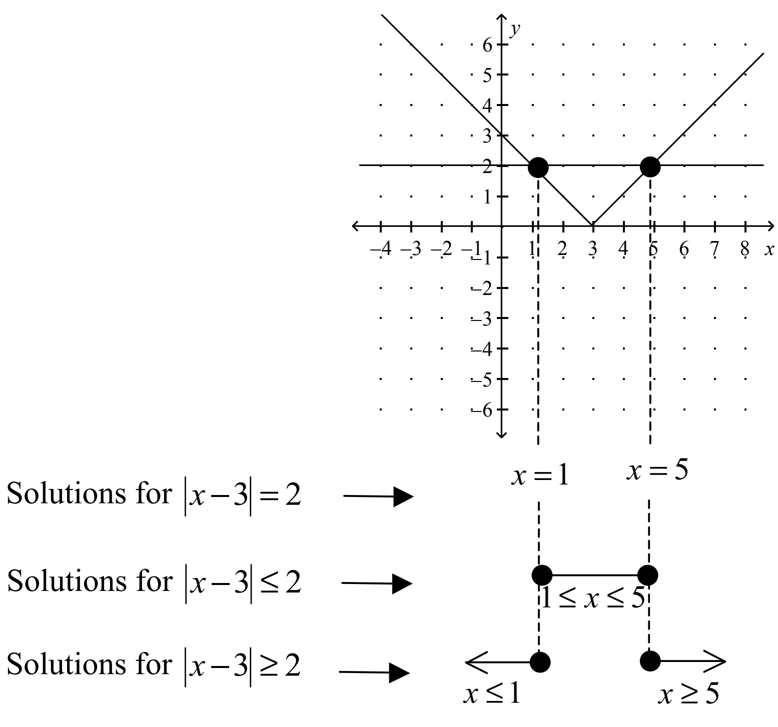
Solutions for $|x|<3$ ⟶

Solutions for $|x|>3$ ⟶

13) Use the graph from example 10 to find the solutions for $|x+2| \le 5$ and $|x+2| \ge 5$



14) **You Try:** Use your graph from example 11 to solve $|x-3| \ge 2$.

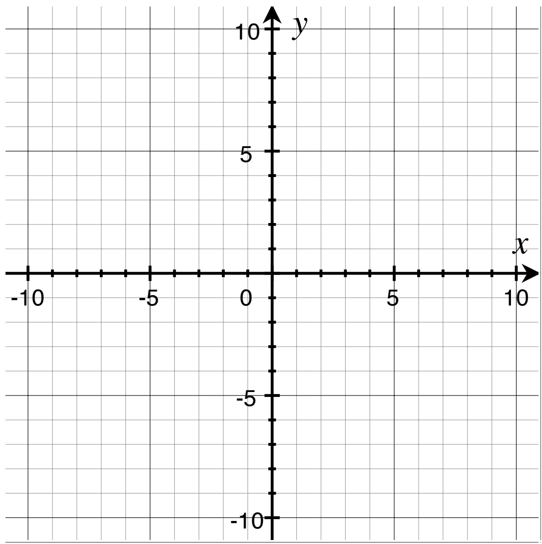


The solutions for $|x-3| \ge 2$ are $x \le 1$ or $x \ge 5$.

All About Absolute Value Functions

Part 1: The Mother Function

Graph the function below. Describe the graph. Write a sentence explaining why it takes the shape it does.

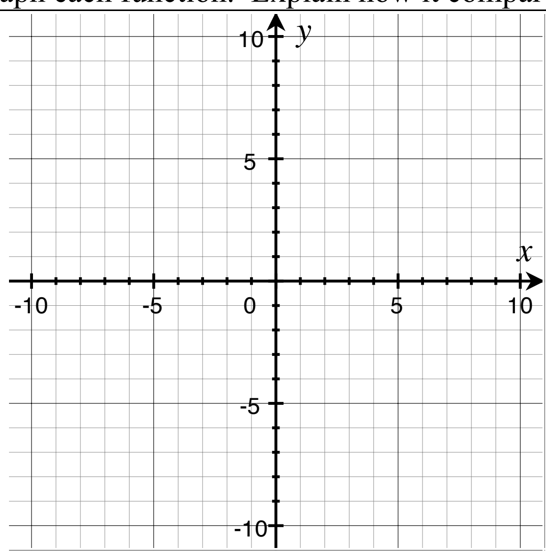


$$y = |x|$$

Part 2: Related Functions

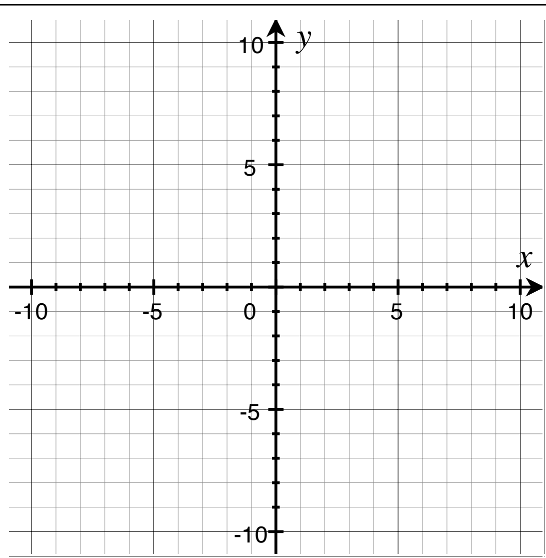
Graph each function. Explain how it compares to the graph of the mother function.

1.

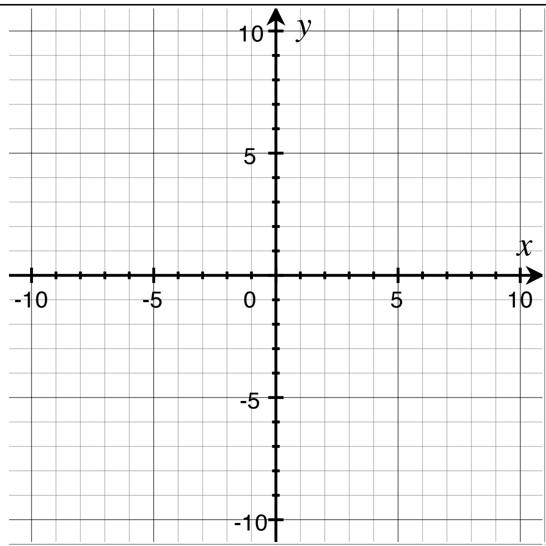
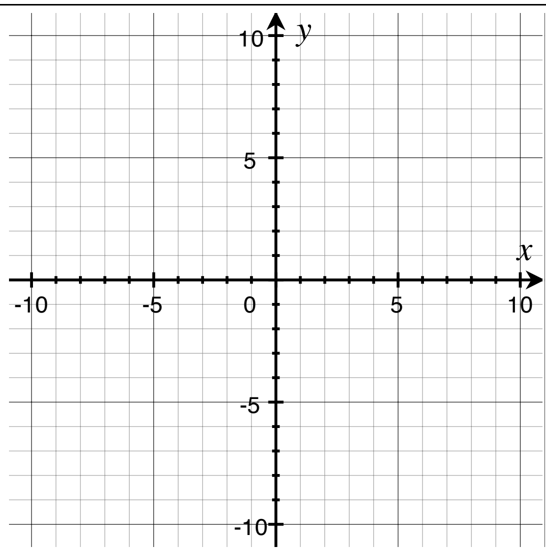
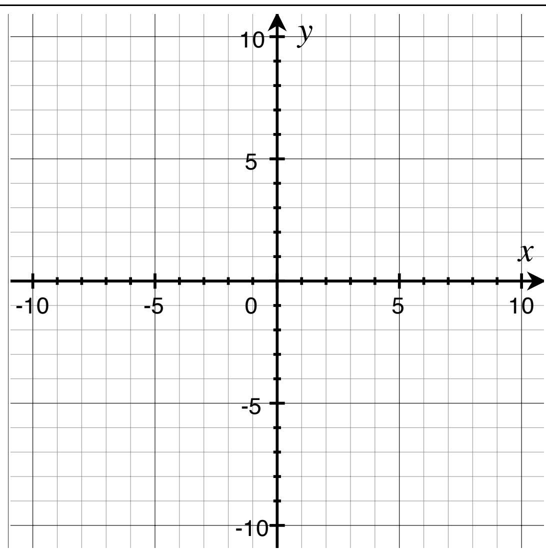


$$y = |x| + 3$$

2.



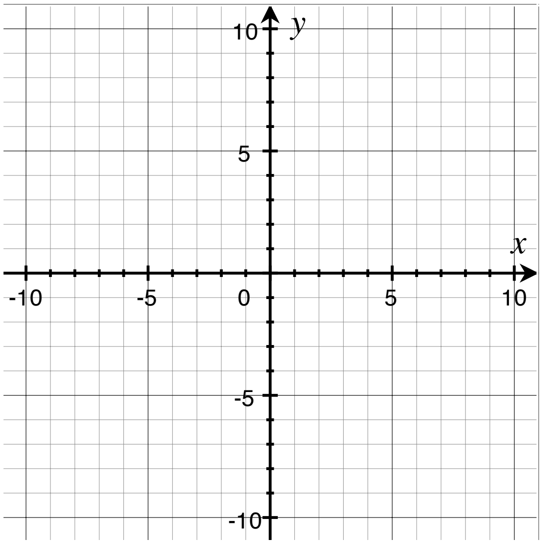
$$y = |x| - 2$$

<table>
<tr><td>3. </td><td>$y = |x+4|$</td></tr>
<tr><td>4. </td><td>$y = |x-1|$</td></tr>
<tr><td>5. </td><td>$y = |x+3|-4$</td></tr>
<tr><td colspan="2">Summarize the function behavior you observed from the previous examples.</td></tr>
<tr><td>$y = |x+a|$: ______________________________</td><td>$y = |x-a|$: __________________________________</td></tr>
<tr><td>$y = |x|+b$: ______________________________</td><td>$y = |x|-b$: __________________________________</td></tr>
</table>

Part 3: Predictions

Predict how the graph for each of the following functions compares to the mother function.
Do this first without graphing; use your transparency to show your prediction to a neighbor.
Then, graph to check your answer.

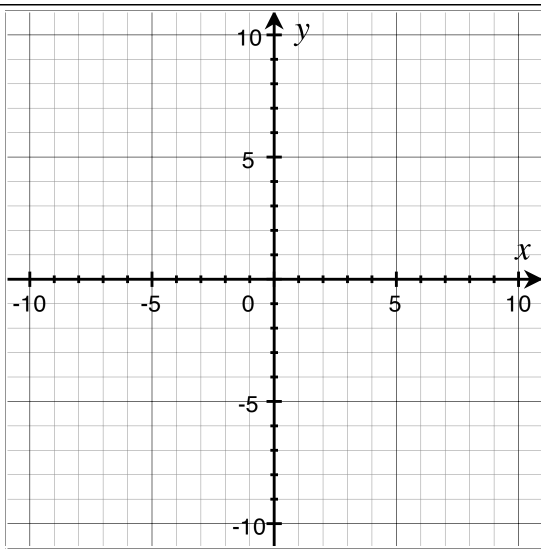
6.



$$y = |x+2|$$

Prediction:

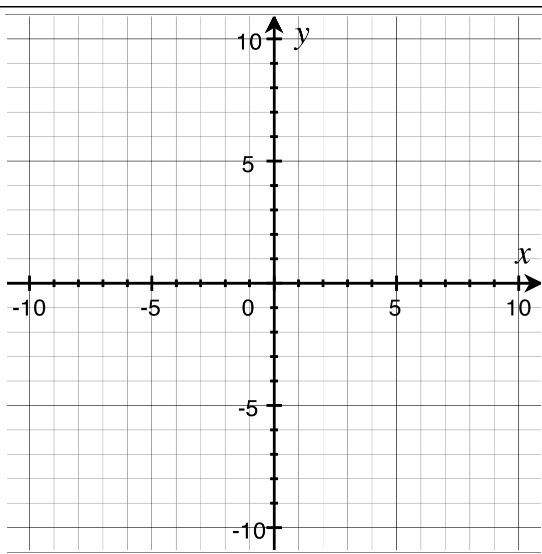
7.



$$y = |x| - 4$$

Prediction:

8.



$$y = |x-5| - 2$$

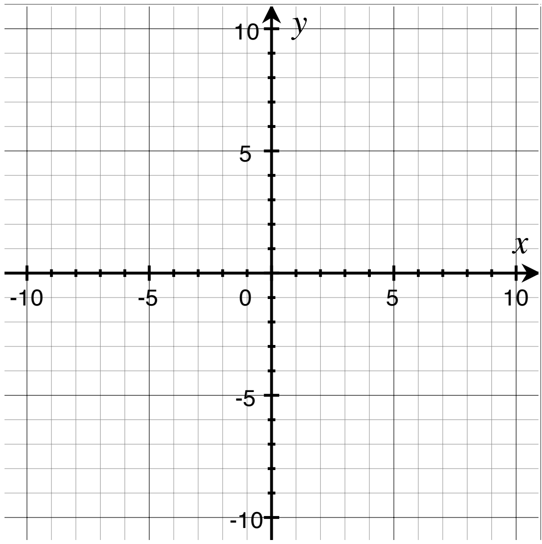
Prediction:

Part 4: Solving Absolute Value Equations as a System of Equations

Any equation in one variable can be written as a system of equations in two variables.

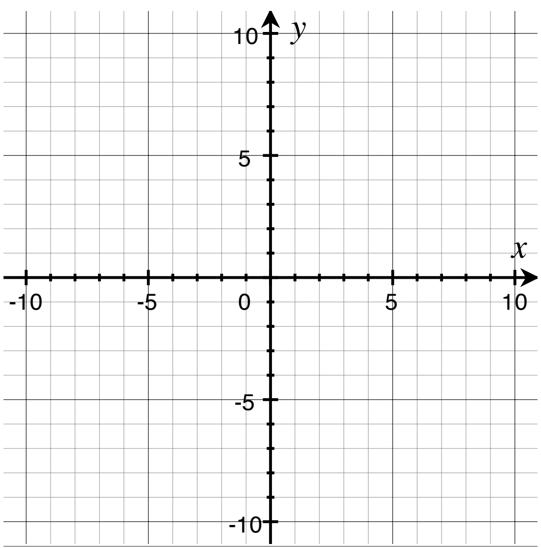
Solve the equations by re-writing each as a system. Graph to solve. (Use transparencies to predict first!)

9.



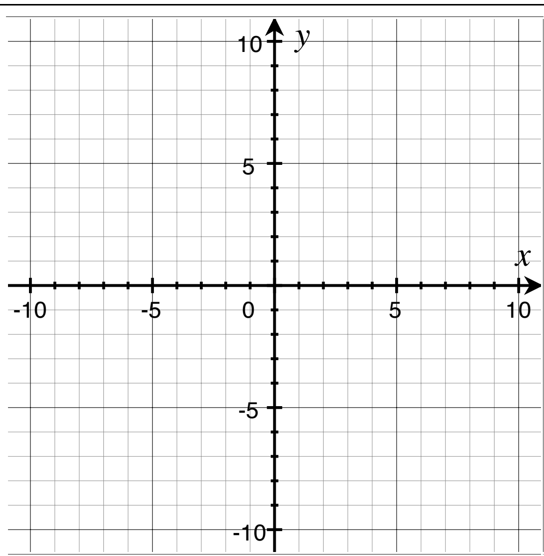
Solve: $|x| = 3$

10.



Solve: $|x+2| = 5$

11.

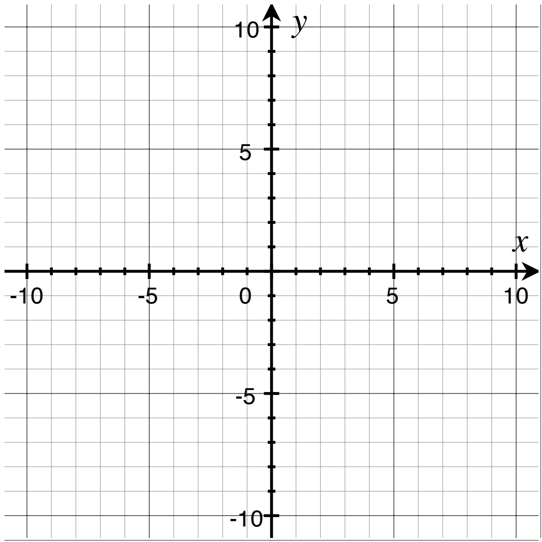


Solve: $|x-3| = 2$

Part 5: Extensions

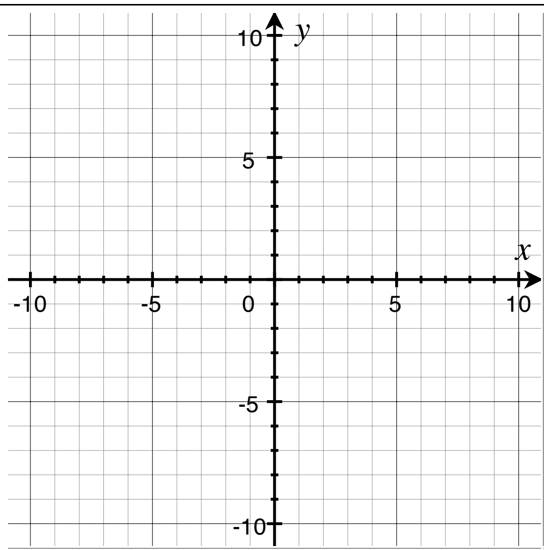
This method may also be used to solve absolute value inequalities.

12.



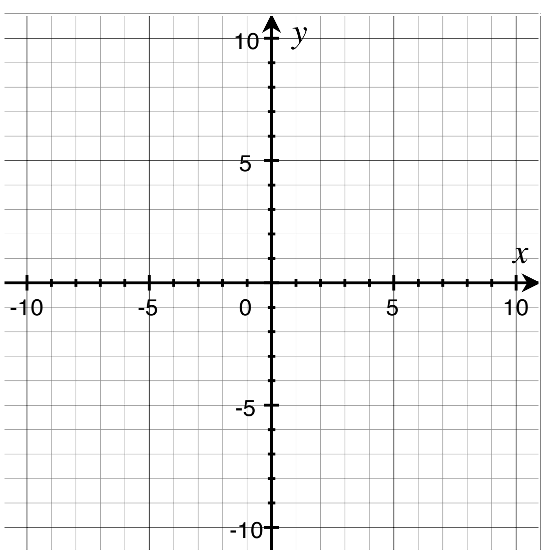
Solve: $|x| < 3$ and $|x| > 3$

13.



Solve: $|x+2| \le 5$ and $|x+2| \ge 5$

14.



Solve: $|x-3| \le 2$ and $|x-3| \ge 2$

Backline Masters: Photocopy onto transparencies and cut out. Each student should be given one of each.

Mother Function $y = \|x\|$	Line $y = x$