

## Graphing Absolute Value Functions

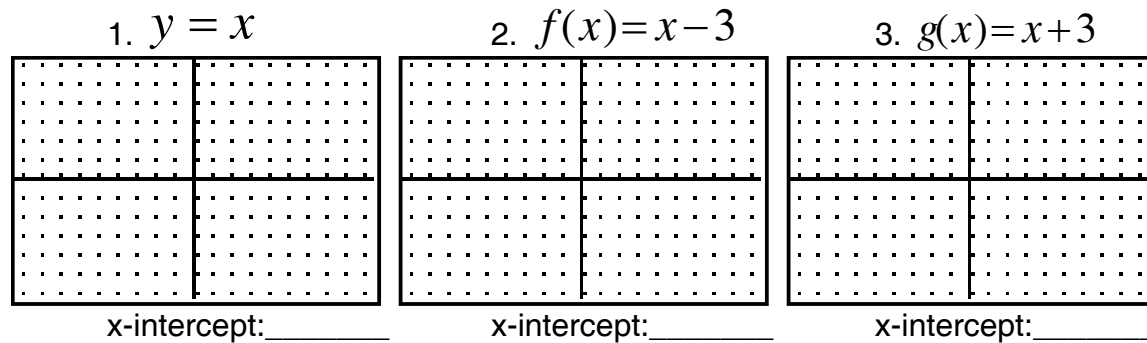
<b>Summary</b>	
<p>In this lesson, students explore the graphs of absolute value functions. They learn to use transformations to graph vertical shifts, horizontal shifts, reflections, and vertical stretches of <math>y =  x </math>.</p>	
<b>Utah State Core Standard</b>	
<p>Standard 3, Objective 3.2 Specify locations and describe spatial relationships using coordinate geometry.</p> <ul style="list-style-type: none"> <li>• Sketch the graph of a quadratic and absolute value function.</li> <li>• Perform the transformations of stretching, shifting, and reflecting the graphs of linear, absolute value, quadratic, and radical functions.</li> </ul> <p>Standard 2, Objective 2.3 Represent quantitative relationships using mathematical models and symbols.</p> <ul style="list-style-type: none"> <li>• Find the vertex, maximum or minimum values, intercepts, and axis of symmetry of a quadratic or absolute value function, algebraically, graphically, and numerically.</li> </ul>	
<b>Desired Results</b>	
<b>Benchmark/Enduring Understanding</b>	
<p>Students will know the graph of the absolute value function. Student will understand that graphing functions can be simplified by using transformations that are consistent among functions.</p>	
<b>Essential Questions</b>	<b>Skills</b>
<p>What is the graph of <math>y =  x </math>? How is the graph of <math>y =  x </math> related to the graph of <math>y = a x - h  + k</math>?</p>	<p>Using functions to generate graphs. Developing numeric tables from functions. Graphing functions using transformation.</p>
<b>Assessment Evidence</b>	
<p>The homework page included in this lesson assesses students' ability to graph absolute value functions and generate data tables from the functions.</p>	

<b>Instructional Activities</b>
<p><b>Launch:</b> Give students time to complete the review section of the worksheet (Parts A and B). Discuss results.</p> <p><b>Explore:</b> Students work individually or in groups (recommended) to complete worksheet. It is helpful to be sure that everyone has the correct graph of <math>y =  x </math> before completing the rest of the worksheet.</p> <p><b>Summarize:</b> Assign homework page. Discuss student conjectures and bring the class to consensus regarding the transformations of <math>y =  x </math>.</p>
<b>Materials Needed</b>
<p>Copies of worksheet Graphing Calculators (optional, but recommended)</p>

Name: \_\_\_\_\_

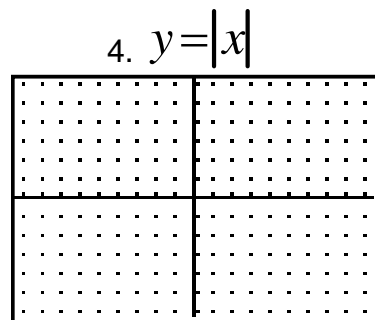
## I. TRANSFORMATIONS

A. (Review): Graph and label intercepts (using ordered pairs) on the graph.



B. Explain your knowledge about **absolute value** using words.

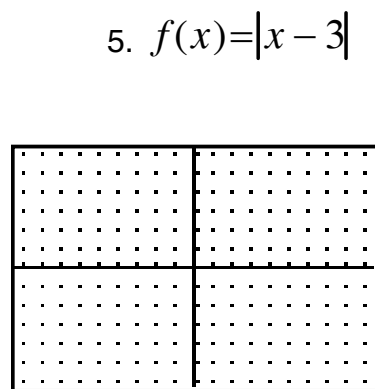
C. Using past knowledge to create new knowledge, try graphing the following function:



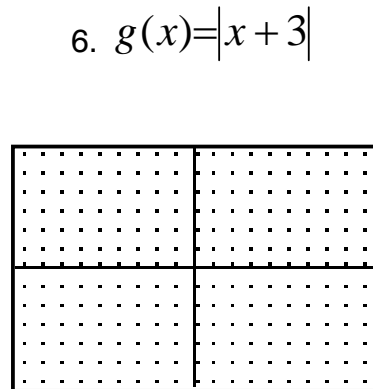
Explain your reasoning for the graph you created.

Please justify this method (using another method).

Now try graphing the following absolute value equations. Create your own table to justify values.



x	f(x)

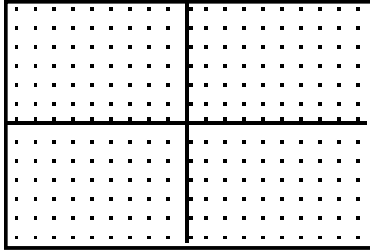


x	g(x)

D. Compare the graphs for problem 4, 5, and 6. Make a conjecture about functions that come in the form:  $y = |x - h|$ .

E. Use a table to create the following graph.

10.  $y = |x| + 3$

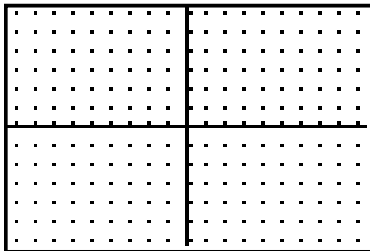


x	y

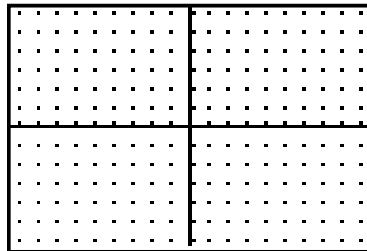
Explain the difference between this graph and the graph of  $y = |x|$ .

Now try graphing the following absolute value equations. Create a table to justify values.

11.  $y = |x| + 1$



12.  $f(x) = |x| - 2$

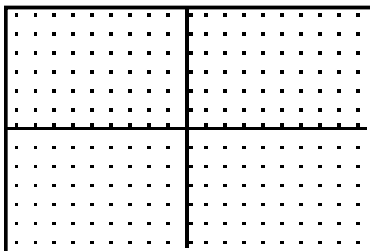


F. Make a conjecture about functions that come in the form:  $y = |x| + k$ .

G. Vertical reflection

Use a table to create the following graph:

13.  $y = -|x|$

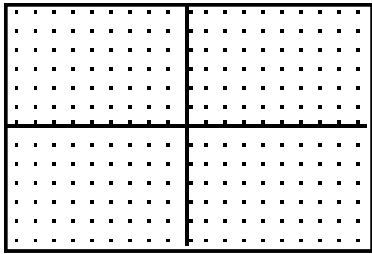


x	y

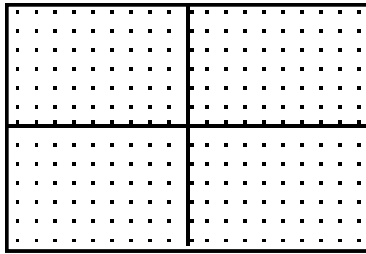
Explain the difference between this graph and the graph of  $y = |x|$ .

Now try graphing the following absolute value equations. Create a table to justify values.

14.  $y = -|x| + 1$



15.  $f(x) = -|x| - 2$

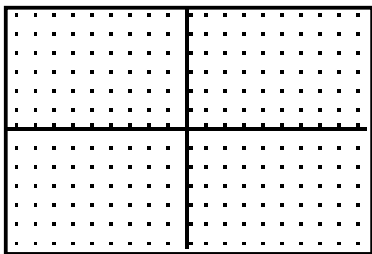


Explain what happens to the graph if the absolute value is multiplied by a negative.

H. Vertical stretch – now we're going to get tricky!

Graph the following:

16.  $y = 2|x|$

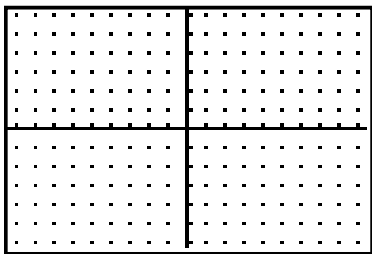


x	y

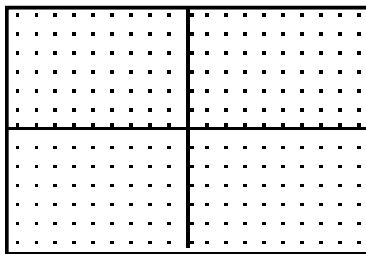
Explain the difference between this graph and the graph of  $y = |x|$ .

Now try graphing the following absolute value equations. Create a table to justify values.

17.  $y = \frac{1}{2}|x|$



18.  $f(x) = \frac{3}{2}|x|$

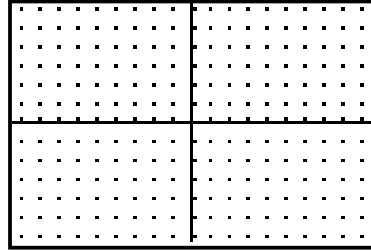


What is the effect on the graph of multiplying the absolute value function by a number?

## II. Piece-wise

E. Absolute value functions can be written without absolute value if they are separated into two equal parts.

Example:  $y = |x|$  can be written as two different linear functions.



19. Sketch the graph (same as number 4):

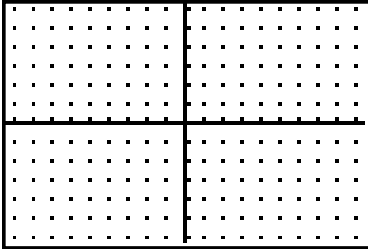
20. Where in the domain do you think the graph will change from one function to the next?

21. If you answered when  $x=0$  for number 8, good job. Now, let's break it apart and write the equation:  $f(x) = \begin{cases} x > 0 \\ x \leq 0 \end{cases}$

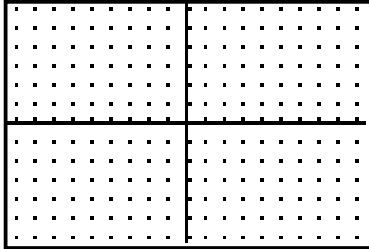
## Homework

In the following functions, I have combined the transformations on the absolute value function that you just discovered. Graph the following functions and confirm your graphs using tables.

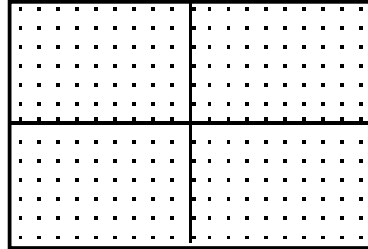
1.  $y = |x - 1| + 2$



2.  $f(x) = -|x + 3|$

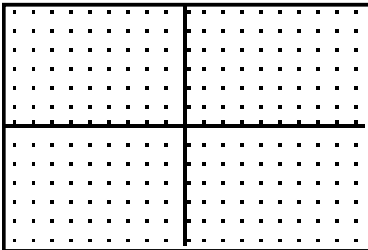


3.  $g(x) = 3|x| - 6$

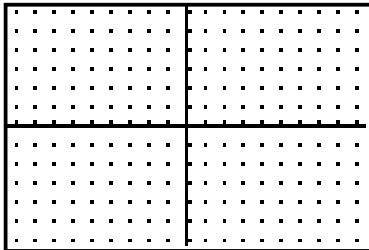


Show your tables here:

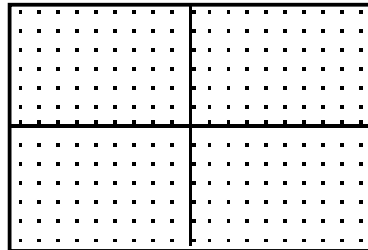
4.  $y = -2|x| + 4$



5.  $f(x) = \frac{1}{2}|x - 2| - 1$



6.  $g(x) = -|x + 2| + 5$



Show your tables here:

Make a conjecture about functions that come in the form:  $y = a|x - h| + k$ . Explain the effect of  $a$ ,  $h$  and  $k$  on the absolute value graph.