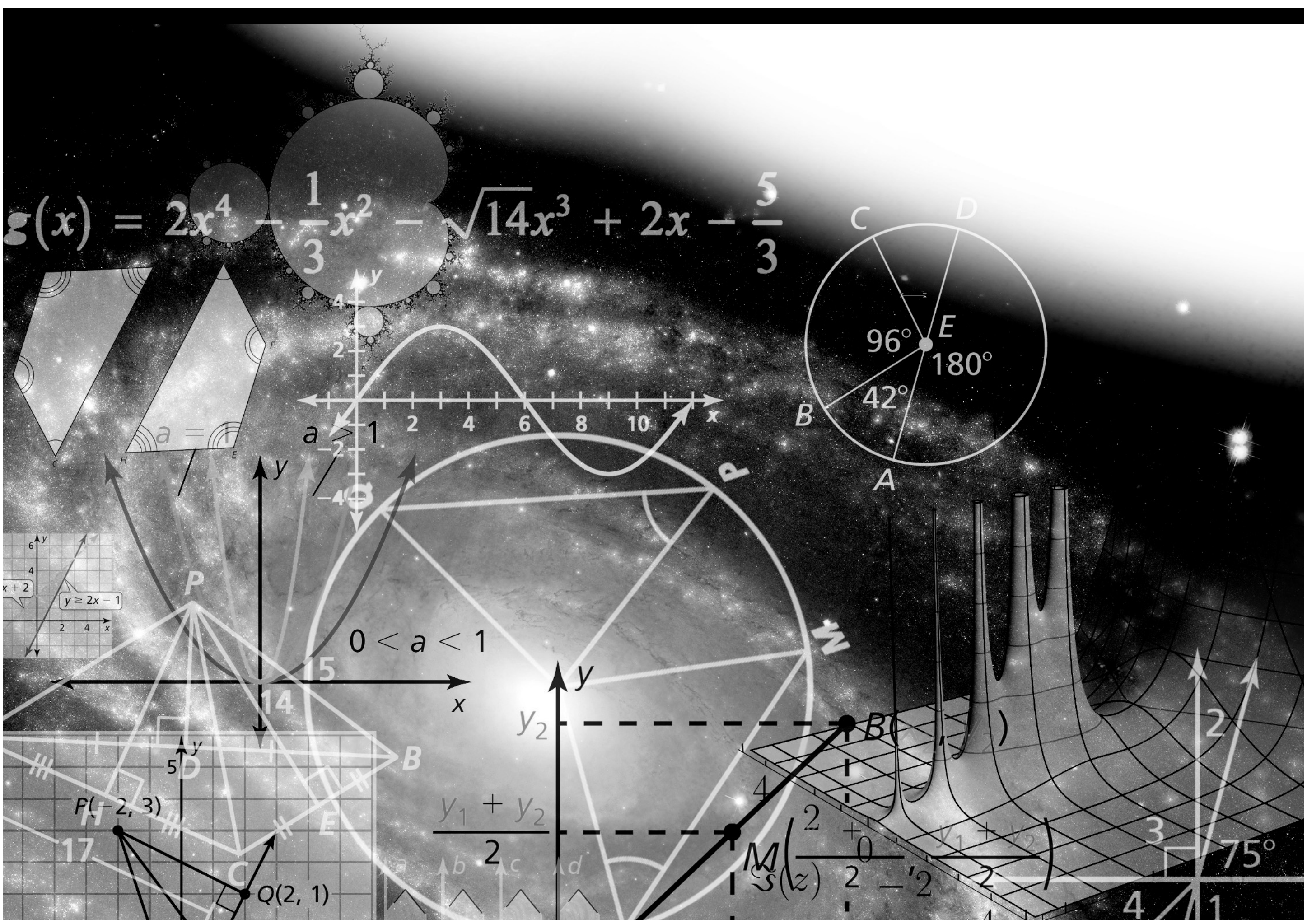
CHAPTER 1

Absolute Value and Piecewise Functions



Name____ Date__________

Chapter 1 Maintaining Mathematical Proficiency

Let $f(x) = 2x$. Graph *f* and *g*. Describe the transformation from the graph of *f* to the graph of *g*.

1. $g(x) = f(x) - 4$

2. $g(x) = f(x + 2)$

3. $g(x) = f\left(\frac{1}{2}x\right)$

4. $g(x) = 3f(x)$

5. Describe the transformation from the graph of $f(x) = x$ to the graph of $h(x) = -\frac{1}{3}x + 2$.

Graph the figure and its image after a reflection in the line $y = x$.

6. $\overline{LM}$ with endpoints $L(2, -4)$ and $M(2, 0)$

7. $\overline{ST}$ with endpoints $S(-2, 5)$ and $T(-4, -1)$

8. $\triangle ABC$ with vertices $A(6, 4)$, $B(6, -1)$, and $C(-2, 0)$

9. $\square EFGH$ with vertices $E(-2, -4)$, $F(4, -4)$, $G(4, 3)$, and $H(-2, 3)$

10. After a reflection in the line $y = -x$, a point originally in Quadrant I will be in which Quadrant?

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1.1 Absolute Value Functions
For use with Exploration 1.1

Essential Question How do the values of a, h, and k affect the graph of the absolute value function $g(x) = a|x - h| + k$?

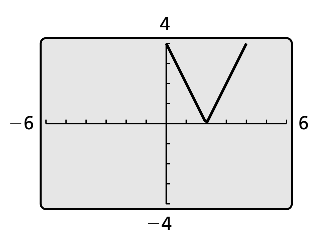
1 EXPLORATION: Identifying Graphs of Absolute Value Functions

Work with a partner. Match each absolute value function with its graph. Then use a graphing calculator to verify your answers.

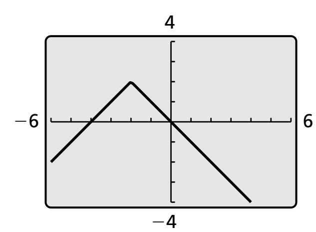
a. $g(x) = -|x - 2|$ **b.** $g(x) = |x - 2| + 2$ **c.** $g(x) = -|x + 2| - 2$

d. $g(x) = |x - 2| - 2$ **e.** $g(x) = 2|x - 2|$ **f.** $g(x) = -|x + 2| + 2$

A.



B.



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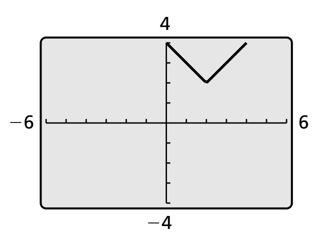
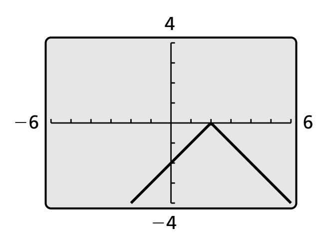
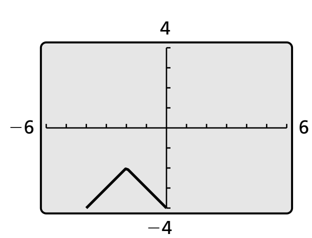


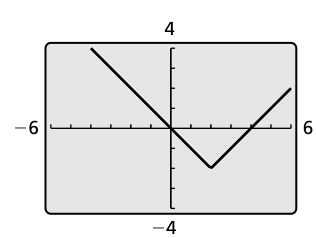
D.



E.



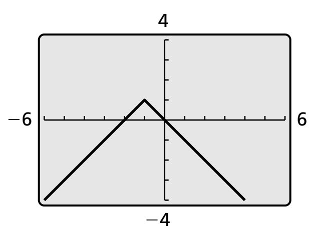
F.



Communicate Your Answer

2. How do the values of a, h, and k affect the graph of the absolute value function $g(x) = a|x - h| + k$?

3. Write the equation of the absolute value function whose graph is shown. Use a graphing calculator to verify your equation.



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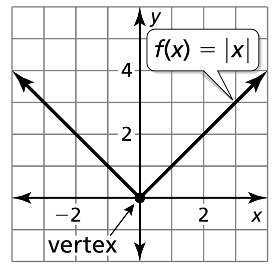
1.1 Practice

For use after Lesson 1.1

Notes:

Core Concepts

Absolute Value Function



An **absolute value function** is a function that contains an absolute value expression. The parent absolute value function is $f(x) = |x|$. The graph of $f(x) = |x|$ is V-shaped and symmetric about the y-axis. The **vertex** is the point where the graph changes direction. The vertex of the graph of $f(x) = |x|$ is $(0, 0)$.

The domain of $f(x) = |x|$ is all real numbers.

The range is $y \geq 0$.

Notes:

Vertex Form of an Absolute Value Function

An absolute value function written in the form $g(x) = a|x - h| + k$, where $a \neq 0$, is in **vertex form**. The vertex of the graph of g is (h, k).

Any absolute value function can be written in vertex form, and its graph is symmetric about the line $x = h$.

Notes:

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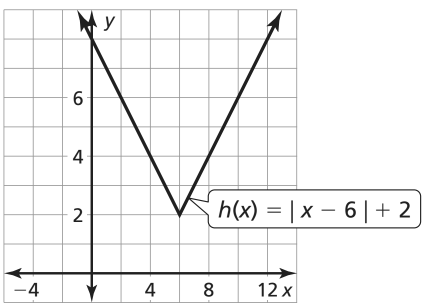
Worked-Out Examples

Example #1

Graph the function. Compare the graph to the graph of f(x) = |x−6|.

$h(x) = |x - 6| + 2$

x	4	5	6	7	8
$h(x)$	4	3	2	3	4



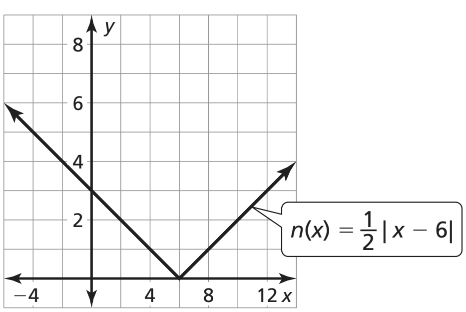
The function h is of the form $y = f(x) + k$, where $k = 2$. So, the graph of h is a vertical translation 2 units up of the graph of $f(x) = |x - 6|$.

Example #2

Graph the function. Compare the graph to the graph of f(x) = |x−6|.

$n(x) = \frac{1}{2}|x - 6|$

x	2	4	6	8	10
$n(x)$	2	1	0	1	2



The function n is of the form $y = af(x)$, where $a = \frac{1}{2}$. So, the graph of n is a vertical shrink of the graph of $f(x) = |x - 6|$ by a factor of $\frac{1}{2}$.

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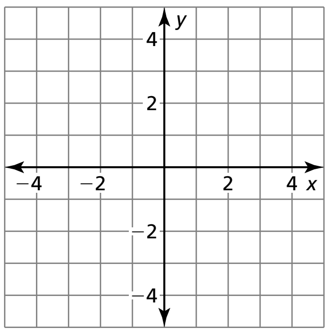
Practice A

In Exercises 1–4, graph the function. Compare the graph to the graph of $f(x) = |x|$. Describe the domain and range.

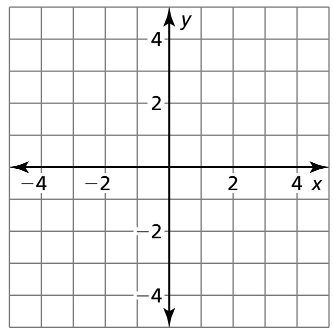
1. $t(x) = \frac{1}{2}|x|$

x	−4	−2	0	2	4
t(x)					



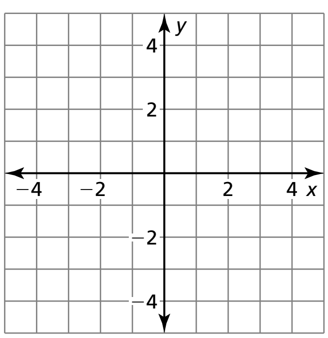
2. $u(x) = -|x|$

x	−2	−1	0	1	2
u(x)					



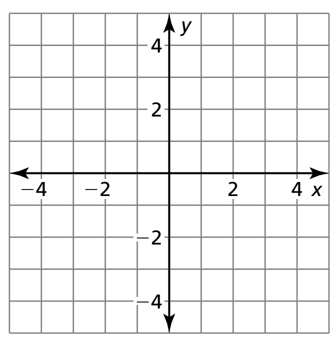
3. $p(x) = |x| - 3$

x	−2	−1	0	1	2
p(x)					



4. $r(x) = |x + 2|$

x	−4	−3	−2	−1	0
r(x)					



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Practice B

In Exercises 1–4, graph the function. Compare the graph to the graph of $f(x) = |x|$. Describe the domain and range.

1. $m(x) = |x - 3|$

2. $t(x) = 4|x|$

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

4. $z(x) = -\frac{4}{3}|x|$

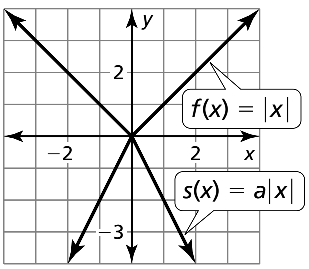
In Exercises 5 and 6, graph the function. Compare the graph to the graph of $f(x) = |x - 2| + 4$.

5. $k(x) = |x - 5| + 4$

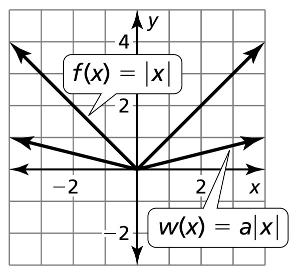
6. $q(x) = |x - 2| - 3$

In Exercises 7 and 8, compare the graphs. Find the value of *h*, *k*, or *a*.

7.



8.



In Exercises 9 and 10, write an equation that represents the given transformation(s) of the graph of $g(x) = |x|$.

9. horizontal translation 7 units right

10. vertical shrink by a factor of $\frac{1}{3}$ and a reflection in the x-axis

In Exercises 11 and 12, graph and compare the two functions.

11. $c(x) = |x - 4| + 3$; $d(x) = |6x - 4| + 3$

12. $p(x) = |x + 1| - 2$; $q(x) = \left|-\frac{2}{5}x + 1\right| - 2$

13. Graph $y = -\frac{3}{2}|x + 3| - 5$ and $y = -8$ in the same coordinate plane. Use the graph to solve the equation $-\frac{3}{2}|x + 3| - 5 = -8$. Check your solutions.