

3.7 Start Thinking

Use a graphing calculator to graph the function $f(x) = |x|$.

Sketch the graph on a coordinate plane. Describe the graph of the function.

Now graph the functions $g(x) = |x + 5|$, and $h(x) = |x| + 5$ on the same coordinate plane. Explain why the graphs of $g(x)$ and $h(x)$ are not the same.

3.7 Warm Up

Solve the equation, if possible.

1. $|n - 8| = 4$

2. $|b - 5| = 1$

3. $|4z + 2| = 10$

4. $|t + 5| = 7$

5. $|5n| = -5$

6. $|6h - 1| = -7$

7. $|2n + 2| = 6$

8. $|5t + 7| = 22$

3.7 Cumulative Review Warm Up

Write the sentence as an inequality. Then solve the inequality.

1. A number minus 7 is less than 12.
2. A number plus 2 is at most -4 .
3. The sum of a number and 8 is greater than 5.
4. The number 5 is greater than or equal to the difference of a number and 16.

3.7

Practice A

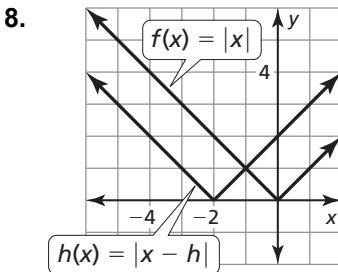
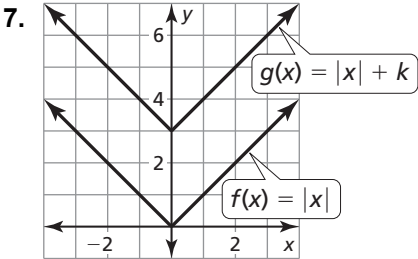
In Exercises 1–4, graph the function. Compare the graph to the graph of $f(x) = |x|$. Describe the domain and range.

- 1. $g(x) = |x| - 2$
- 2. $p(x) = |x| + 1$
- 3. $h(x) = |x + 5|$
- 4. $k(x) = \frac{1}{2}|x|$

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

- 5. $h(x) = |x + 4| - 4$
- 6. $h(x) = 2|x + 4|$

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



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

- 9. vertical translation 4 units up
- 10. vertical stretch by a factor of 3

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

- 11. $f(x) = |x - 3|$; $g(x) = |2x - 3|$
- 12. $m(x) = |x + 2| - 5$; $n(x) = \left|\frac{1}{2}x + 2\right| - 5$
- 13. The number of ice cream cones sold c (in hundreds) increases and then decreases as described by the function $c(t) = -5|t - 6| + 40$, where t is the time (in months).
 - a. Graph the function.
 - b. What is the greatest number of ice cream cones sold in 1 month?

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

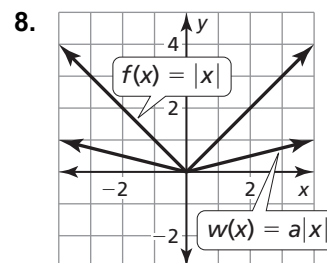
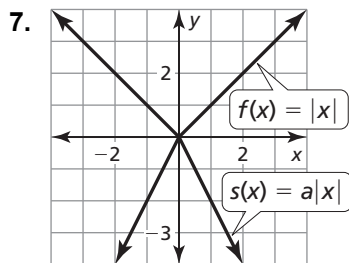
4. $z(x) = -\frac{4}{3}|x|$

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 .



In Exercises 9 and 10, write an equation for $h(x)$ 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.

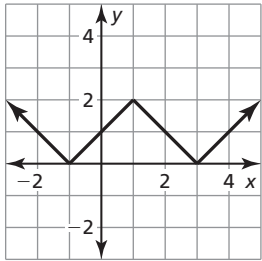
Use the graph to solve the equation $-\frac{3}{2}|x + 3| - 5 = -8$. Check your solutions.

3.7

Enrichment and Extension

Transformations and Compositions

Example: Graph $y = -|x - 1| + 2$, and then state the domain and range in interval notation.

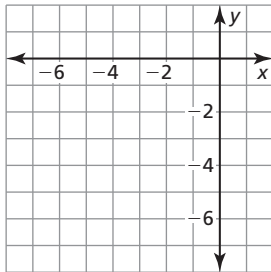


First graph the function on the inside of the outer absolute value. Then invert all the negative y -values to positive y -values, because the final output of this particular absolute value function must be all positive numbers.

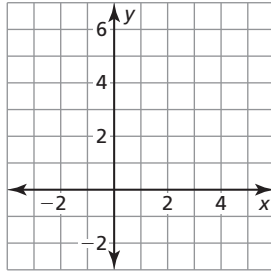
domain: $(-\infty, \infty)$ range: $[0, \infty)$

In Exercises 1–6, graph each function and state the domain and range in interval notation.

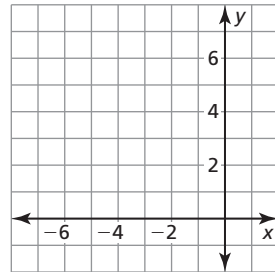
1. $y = |-x - 3| - 4$



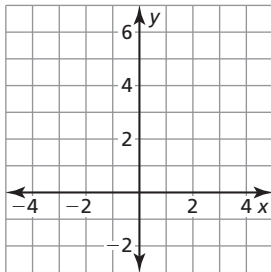
2. $y = |2|x - 1| - 3|$



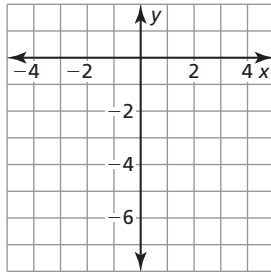
3. $y = |2|x + 3| - 2|$



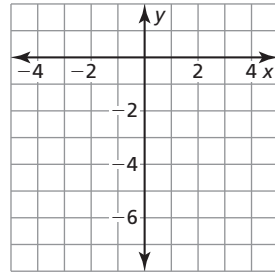
4. $y = -|-x|$



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



6. $y = -|3|x| - 1|$



3.7 Puzzle Time

What Do Sharks Eat For Dinner?

Write the letter of each answer in the box containing the exercise number.

Describe the transformations from the graph of f to the graph of g .

1. $f(x) = |x|$; $g(x) = |x| + 6$
2. $f(x) = |x|$; $g(x) = |x - 3|$
3. $f(x) = |x|$; $g(x) = |-x|$
4. $f(x) = |x|$; $g(x) = \frac{1}{4}|x|$
5. $f(x) = |x - 7|$; $g(x) = -3|x - 7|$
6. $f(x) = |x + 1|$; $g(x) = |x - 2| + 8$
7. $f(x) = |x + 9| - 6$; $g(x) = |x + 7| - 10$
8. $f(x) = |x - 11| + 8$; $g(x) = |4x - 11| + 8$

Write an equation that represents the given transformation(s) of the graph of $f(x) = |x|$.

9. horizontal translation 3 units left and a reflection in the x -axis
10. vertical stretch by a factor of 3 and a reflection in the y -axis
11. a reflection in the x -axis and a vertical translation 3 units up
12. horizontal shrink by a factor of $\frac{1}{3}$ and a vertical translation 3 units down

Answers

- I. $g(x) = -|x| + 3$
- P. reflection in the y -axis
- F. horizontal translation 3 units right and vertical translation 8 units up
- N. reflection in the x -axis and a vertical stretch by a factor of 3
- D. vertical shrink by a factor of $\frac{1}{4}$
- H. horizontal translation 2 units right and vertical translation 4 units down
- A. vertical translation 6 units up
- H. $g(x) = -|x + 3|$
- C. $g(x) = 3|-x|$
- I. $g(x) = |3x| - 3$
- S. horizontal translation 3 units right
- S. horizontal shrink by a factor of $\frac{1}{4}$

6	12	2	9		1	5	4		10	7	11	3	8
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