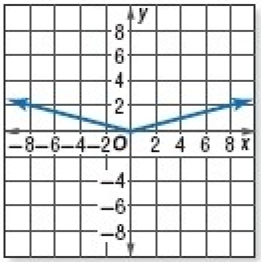
2-7 Parent Functions and Transformations

Identify the type of function represented by each graph.

2. 

SOLUTION:

The graph is in the shape of a V. So, the graph represents an absolute value function.

CCSS SENSE-MAKING Describe the translation in each function. Then graph the function.

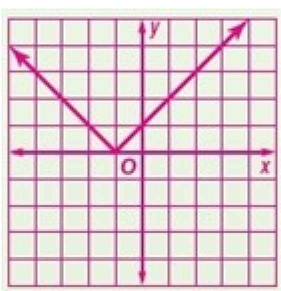
4. $y = |x + 1|$

SOLUTION:

When a constant *h* is added to or subtracted from *x* before evaluating a parent function, the result, $f(x \pm h)$, is a *translation* left or right.

Here 1 is added to *x*, the independent variable of the parent function $y = |x|$.

So it is a translation of the graph $y = |x|$ left 1 unit.



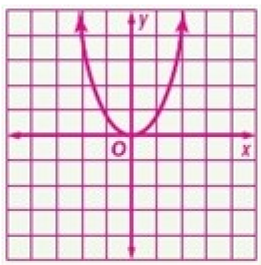
Describe the reflection in each function. Then graph the function.

6. $y = (-x)^2$

SOLUTION:

A *reflection* flips a figure over a line, called a line of reflection. The reflection $-f(x)$ reflects the graph of $f(x)$ across the x-axis and the reflection $f(-x)$ reflects the graph of $f(x)$ across the y-axis.

So, the graph of $y = (-x)^2$ is a reflection of the graph of $y = x^2$ across the y-axis.

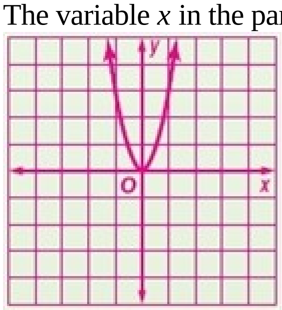


Describe the dilation in each function. Then graph the function.

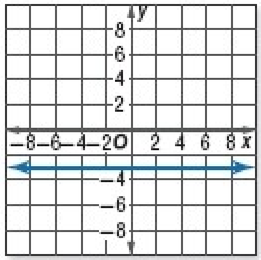
8. $y = 3x^2$

SOLUTION:

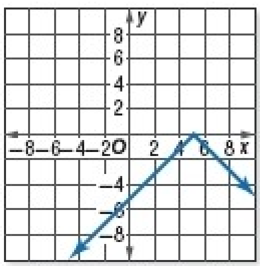
A *dilation* shrinks or enlarges a figure proportionally.
When a parent function is multiplied by a nonzero number, the function is stretched or compressed vertically. Coefficients greater than 1 cause the graph to be stretched vertically and coefficients between 0 and 1 cause the graph to be compressed vertically.
The variable x in the parent function $y = x$ is multiplied by 3. So, the graph will be stretched vertically.



Identify the type of function represented by each graph.

10. 

SOLUTION:
constant

12. 

SOLUTION:
absolute value

2-7 Parent Functions and Transformations

Describe the translation in each function. Then graph the function.

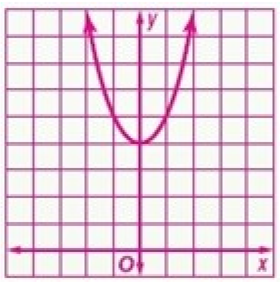
14. $y = x^2 + 4$

SOLUTION:

When a constant k is added to or subtracted from a parent function, the result $f(x) \pm k$ is a *translation* of the graph up or down.

4 is added with x^2.

So, the graph of $y = x^2 + 4$ is a translation of the graph of $y = x^2$ up 4 units.



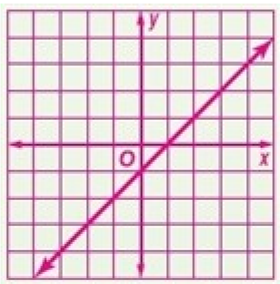
16. $y = x - 1$

SOLUTION:

When a constant h is added to or subtracted from x before evaluating a parent function, the result, $f(x \pm h)$, is a *translation* left or right.

When a constant k is added to or subtracted from a parent function, the result $f(x) \pm k$ is a *translation* of the graph up or down.

So, the graph of $y = x - 1$ can be thought of as a translation of the graph of $y = x$ down 1 unit, or as a translation to the right 1 unit.



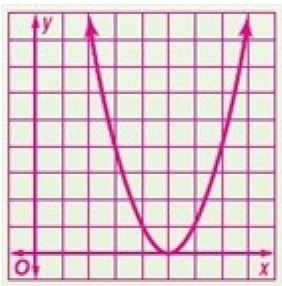
2-7 Parent Functions and Transformations

18. $y = (x - 5)^2$

SOLUTION:

When a constant h is added to or subtracted from x before evaluating a parent function, the result, $f(x \pm h)$, is a *translation* left or right.

So, the graph of $y = (x - 5)^2$ is a translation of the graph of $y = x^2$ right 5 units.



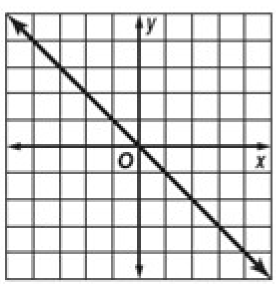
Describe the reflection in each function. Then graph the function.

20. $y = -x$

SOLUTION:

A *reflection* flips a figure over a line called line of reflection. The reflection $-f(x)$ reflects the graph of $f(x)$ across the x-axis and the reflection $f(-x)$ reflects the graph of $f(x)$ across the y-axis.

So, the graph of $y = -x$ is a reflection of the graph of $y = x$ across the x-axis.

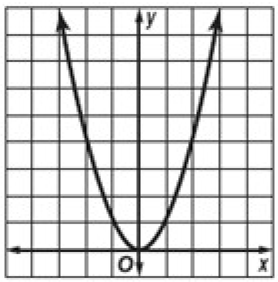


22. $y=(-x)^2$

SOLUTION:

A *reflection* flips a figure over a line called line of reflection. The reflection $-f(x)$ reflects the graph of $f(x)$ across the x-axis and the reflection $f(-x)$ reflects the graph of $f(x)$ across the y-axis.

So, the graph of $y=(-x)^2$ is a reflection of the graph of $y = x^2$ across the y-axis.

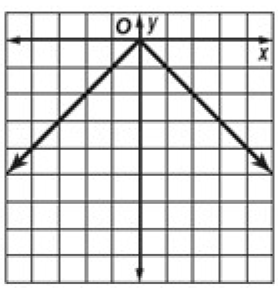


24. $y=-|x|$

SOLUTION:

A *reflection* flips a figure over a line called line of reflection. The reflection $-f(x)$ reflects the graph of $f(x)$ across the x-axis and the reflection $f(-x)$ reflects the graph of $f(x)$ across the y-axis.

So, the graph of $y=-|x|$ is a reflection of the graph of $y=|x|$ across the x-axis.



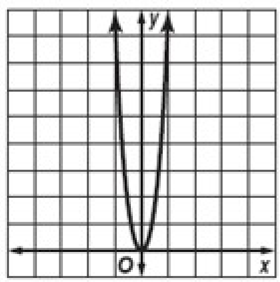
Describe the dilation in each function. Then graph the function.

26. $y = (3x)^2$

SOLUTION:
A *dilation* shrinks or enlarges a figure proportionally.

When the variable in a parent function is multiplied by a nonzero number, the function is stretched or compressed horizontally.
Coefficients greater than 1 cause the graph to be compressed, and coefficients between 0 and 1 cause the graph to be stretched.

Here, the coefficient of x is 3. So, the graph of $y = (3x)^2$ is a horizontal compression of the graph of $y = x^2$. (In this case, the transformation can also be considered a vertical stretch.)

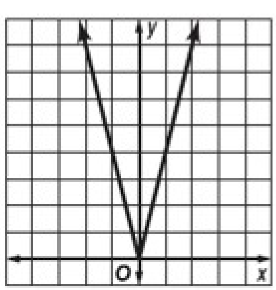


28. $y = 4|x|$

SOLUTION:
A *dilation* shrinks or enlarges a figure proportionally. When a parent function is multiplied by a nonzero number, the graph is stretched or compressed vertically.

Coefficients greater than 1 cause the graph to be stretched vertically and coefficients between 0 and 1 cause the graph to be compressed vertically.

The parent function $y = |x|$ is multiplied by 4. So, the graph of $y = 4|x|$ is a vertical stretch of the graph of $y = |x|$. (In this case, the transformation can also be considered as a horizontal compression.)



30. $y = \frac{2}{3}x$

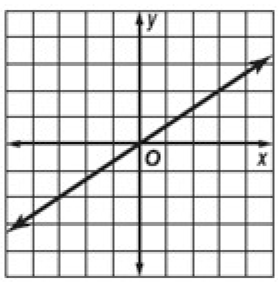
SOLUTION:

A *dilation* shrinks or enlarges a figure proportionally. When a parent function is multiplied by a nonzero number, the graph is stretched or compressed vertically.

Coefficients greater than 1 cause the graph to be stretched vertically and coefficients between 0 and 1 cause the graph to be compressed vertically.

Here, the coefficient is $\frac{2}{3}$, less than 1. So, the dilation is a vertical compression. (In this case, the transformation can also be considered a horizontal stretch.)

The slope is not as steep as that of $y = x$.



32. **CCSS SENSE-MAKING** A non-impact workout can burn up to 7.5 Calories per minute. The equation to represent how many Calories a person burns after m minutes of the workout is $C(m) = 7.5m$.

Identify the transformation in the function. Then graph the function.

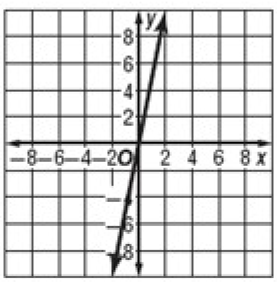
SOLUTION:

A *dilation* shrinks or enlarges a figure proportionally. When a parent function is multiplied by a nonzero number, the graph is stretched or compressed vertically.

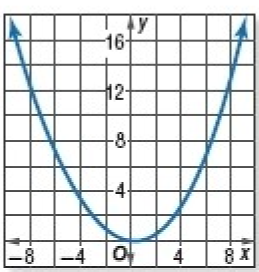
Coefficients greater than 1 cause the graph to be stretched vertically and coefficients between 0 and 1 cause the graph to be compressed vertically.

Here, the coefficient is 7.5, greater than 1.

So, the graph of $C(m) = 7.5m$ is a vertical stretch of the graph of $y = x$.
(In this case, the transformation can also be considered as a horizontal stretch.)

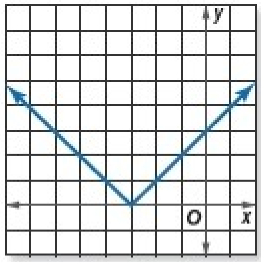


Write an equation for each function.

34. 

SOLUTION:

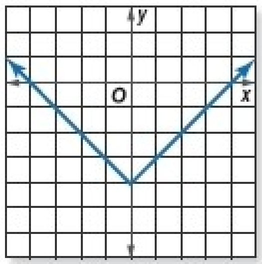
The graph is a vertical compression of the graph of $y = x^2$.

36. 

SOLUTION:

The graph is a translation of the graph of $y=|x|$ left 3 units.

So, the equation is $y=|x+3|$.

38. 

SOLUTION:

The graph is a translation of the graph of $y=|x|$ down 4 units.

So, the equation is $y=|x|-4$.

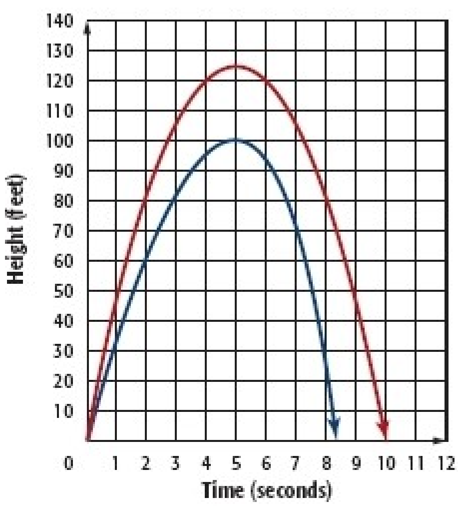
40. **ROCKETRY** Kenji launched a toy rocket from ground level. The height $h(t)$ of Kenji's rocket after t seconds is shown in blue. Emily believed that her rocket could fly higher and longer than Kenji's. The flight of Emily's rocket is shown in red.

a. Identify the type of function shown.

b. How much longer than Kenji's rocket did Emily's rocket stay in the air?

c. How much higher than Kenji's rocket did Emily's rocket go?

d. Describe the type of transformation between the two graphs.



SOLUTION:

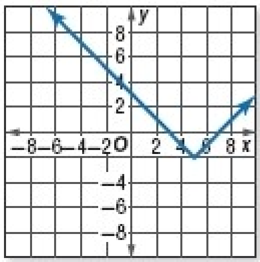
a. quadratic.

b. Emily's rocket stayed in the air for about 10 seconds and Kenji's rocket stayed in the air for about 8.5 seconds. Therefore, Emily's rocket stayed in the air about 1.5 seconds more than Kenji's rocket did.

c. Emily's rocket reached a height of about 125 ft and Kenji's rocket reached a height of about 100 ft. Therefore, Emily's rocket reached height of about 25 ft more than Kenji's rocket did.

d. A dilation in which the red graph is an expansion of the blue graph.

Write an equation for each function.

42. 

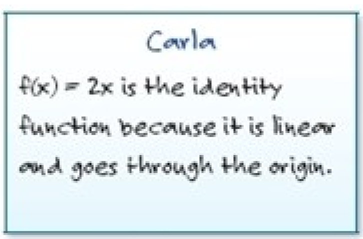
SOLUTION:

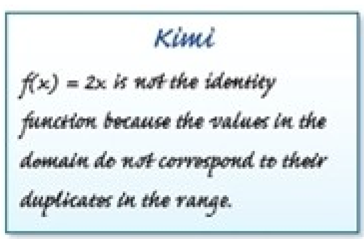
The graph is a combination of transformations of the graph of the parent function $y = |x|$.
When a constant k is added to or subtracted from a parent function, the result $f(x) \pm k$ is a translation of the graph up or down.

When a constant h is added to or subtracted from x before evaluating a parent function, the result, $f(x \pm h)$, is a translation left or right.
The graph is moved 2 units down and 5 units right.

So, the equation of the graph is $y = |x - 5| - 2$.

44. **CCSS CRITIQUE** Carla and Kimi are determining if $f(x) = 2x$ is the *identity function*. Is either of them correct? Explain your reasoning.





SOLUTION:
Kimi; Sample answer: Linear equations that go through the origin are not always the identity. The identity linear function is $f(x) = x$.

46. **REASONING** Study the parent graphs at the beginning of this lesson. Select a parent graph with positive y-values at its leftmost points and positive y-values at its rightmost points.

SOLUTION:

Sample answer: The graph of $y = x^2$ is positive at its rightmost points and leftmost points.

48. What is the solution set of the inequality?

$6 - |x + 7| \le -2$

A $\{x \mid -15 \le x \le 1\}$

B $\{x \mid x \le -1 \text{ or } x \ge 3\}$

C $\{x \mid -1 \le x \le 3\}$

D $\{x \mid x \le -15 \text{ or } x \ge 1\}$

SOLUTION:

$$6 - |x + 7| \le -2$$
$$-|x + 7| \le -8$$
$$|x + 7| \ge 8$$

This implies:

$$x + 7 \le -8 \quad \text{or} \quad x + 7 \ge 8$$
$$x \le -15 \quad \text{or} \quad x \ge 1$$

The solution set is $\{x \mid x \le -15 \text{ or } x \ge 1\}$.
The correct choice is **D.**

50. **GRIDDED RESPONSE** Find the value of *x* that makes $\frac{1}{2} = \frac{x-2}{x+2}$ true.

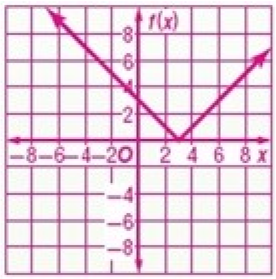
SOLUTION:

$$\frac{1}{2} = \frac{x-2}{x+2}$$
$$x + 2 = 2(x - 2)$$
$$x + 2 = 2x - 4$$
$$x = 6$$

Graph each function. Identify the domain and range.

52. $f(x)=|x-3|$

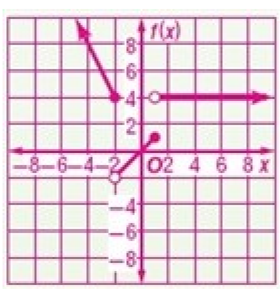
SOLUTION:



D = {all real numbers}
$R=\{f(x)|f(x)\geq 0\}$

54. $f(x)=\begin{cases}-2x \text{ if } x\leq -2\\ x \text{ if } -2<x\leq 1\\ 4 \text{ if } x>1\end{cases}$

SOLUTION:



D = {all real numbers}
$R=\{f(x)|-2<f(x)\leq 1 \text{ or } f(x)\geq 4\}$

Solve each inequality.

56. $-12 \le 2x + 4 \le 8$

SOLUTION:

$$\begin{aligned} -12 &\le 2x + 4 \le 8 \\ -12 - 4 &\le 2x + 4 - 4 \le 8 - 4 \\ -16 &\le 2x \le 4 \\ -\frac{16}{2} &\le \frac{2x}{2} \le \frac{4}{2} \\ -8 &\le x \le 2 \end{aligned}$$

58. $|x - 3| > 7$

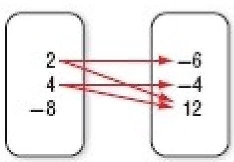
SOLUTION:

$|x - 3| > 7$

$x - 3 < -7$ or $x - 3 > 7$

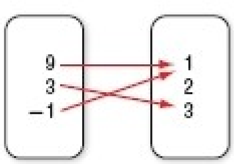
$x < -4$ or $x > 10$

Determine if each relation is a function.

60. 

SOLUTION:

The relation is not a function because 2 and 4 do not correspond to unique element in the range.

62. 

SOLUTION:

Each element of the domain is paired with exactly one element in the range.

So, the relation is a function.

Evaluate each expression if $x = –4$ and $y = 6$.

64. $5y + 3x – 8$

SOLUTION:

$5y + 3x – 8$

Replace x with –4 and y with 6.

$$\begin{aligned} 5(6)+3(-4)-8 &= 30-12-8 \\ &= 10 \end{aligned}$$