Evaluate the function.

1. $f(x) = 6x + 2$, if $x = -3$
2. $g(x) = 3x + 4$, if $x = 3$
3. $y = x + 5$, if $x = 3$
4. $y = -3x$, if $x = -2$
5. $f(x) = -4x + 3$, if $x = -3$
6. $g(x) = 5x + 3$, if $x = 5$

Warm Up

* practice Substitution
* Use proper order of operations.

Graph and compare the two functions.

1. $f(x) = |x| - 3$; $g(x) = |x| - 7$
2. $s(x) = |3x + 4| + 7$; $t(x) = |x + 4| + 7$
3. $v(x) = -|2x - 2| - 3$; $w(x) = 4|2x - 2| + 5$
4. $c(x) = 5|x - 2| + 2$; $d(x) = -\frac{3}{4}|x - 2| - 2$

Cumulative Warm Up

* Discussions:
  - How would you approach this question?
  - Can you think of a method that you could use
  - What does Absolute value mean?

Essential Question

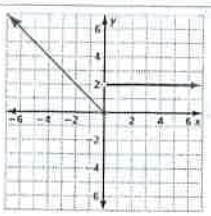
How can you describe a function that is represented by more than one equation?

Essential Question

What you will learn:

- Evaluate piecewise functions
- Graph and write piece wise functions
- Graph and write step functions
- Write absolute value functions.

Work with a partner.



a. Does the graph represent y as a function of x? Justify your conclusion.

b. What is the value of the function when $x = 0$? How can you tell?

c. Write an equation that represents the values of the function when $x \leq 0$.

$f(x) =$ _____, if $x \leq 0$

d. Write an equation that represents the values of the function when $x > 0$.

$f(x) =$ _____, if $x > 0$

e. Combine the results of parts (c) and (d) to write a single description of the function.

$$f(x) = \begin{cases} \text{_____}, & \text{if } x \leq 0 \\ \text{_____}, & \text{if } x > 0 \end{cases}$$

Exploration 1

a.) yes; no vertical line can go through more than 1 point.

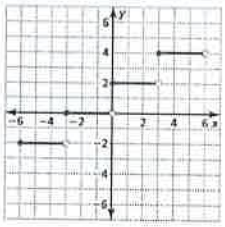
b.) 0; the point (0,0) is plotted

c.) $-x$

d.) 2

e.) $-x$; 2

Work with a partner.



a. Does the graph represent y as a function of x? Justify your conclusion.

b. Describe the values of the function for the following intervals.

$$f(x) = \begin{cases} \text{_____}, & \text{if } -6 \leq x < -3 \\ \text{_____}, & \text{if } -3 \leq x < 0 \\ \text{_____}, & \text{if } 0 \leq x < 3 \\ \text{_____}, & \text{if } 3 \leq x < 6 \end{cases}$$

Exploration 2

a.) yes: no vertical line can be drawn through more than one point on the graph.

b.) -2 ; 0; 2; 4

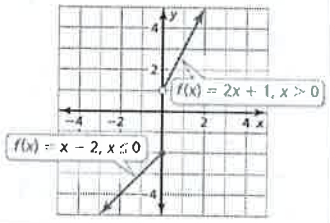
Core Concept

Piecewise Function

A **piecewise function** is a function defined by two or more equations. Each "piece" of the function applies to a different part of its domain. An example is shown below.

$$f(x) = \begin{cases} x - 2, & \text{if } x \leq 0 \\ 2x + 1, & \text{if } x > 0 \end{cases}$$

- The expression $x - 2$ represents the value of f when x is less than or equal to 0.
- The expression $2x + 1$ represents the value of f when x is greater than 0.



Core Concept

piecewise function: a function defined by two or more equations

Evaluate the function f above when (a) $x = 0$ and (b) $x = 4$.

a.) $f(x) = x - 2$

$f(0) = 0 - 2$

$f(0) = -2$

* the value of f is -2 when x = 0

b.) $f(x) = 2x + 1$

$f(4) = 2(4) + 1$

$f(x) = 9$

* the value of f is 9 when x = 4

Example 1

* Refers to graph under core concept

Evaluate the function.

$$f(x) = \begin{cases} 3, \text{ if } x < -2 \\ x + 2, \text{ if } -2 \le x \le 5 \\ 4x, \text{ if } x > 5 \end{cases}$$

1. $f(-8)$

3

2. $f(-2)$

$x + 2$

$-2 + 2$

0

3. $f(0)$

$x + 2$

$0 + 2$

2

4. $f(3)$

$x + 2$

$3 + 2$

5

5. $f(5)$

$x + 2$

$5 + 2$

7

6. $f(10)$

$4x$

$4(10)$

40

Monitoring Progress 1-6

- make sure to understand which 'piece' of the function you are suppose to use
- Read the 'if' statement to determine which function to substitute into

Graph $y = \begin{cases} -x - 4, \text{ if } x < 0 \\ x, \text{ if } x \ge 0 \end{cases}$. Describe the domain and range.

domain: all real numbers

range: $y > -4$

Example 2

* domain includes all of which values?

* range includes all of which values?

Graph the function. Describe the domain and range.

7. $y = \begin{cases} x + 1, \text{ if } x \leq 0 \\ -x, \text{ if } x > 0 \end{cases}$

domain all real #'s

range $y \leq 1$

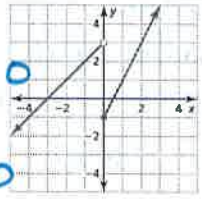
8. $y = \begin{cases} x - 2, \text{ if } x < 0 \\ 4x, \text{ if } x \geq 0 \end{cases}$

domain all real #'s

range: $y < -2$ or $y \geq 0$

Monitoring Progress 7-8

Write a piecewise function for the graph.



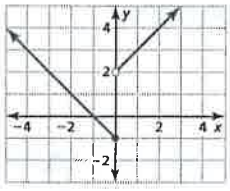
$f(x) = \begin{cases} x + 3, \text{ if } x < 0 \\ 2x - 1, \text{ if } x \geq 0 \end{cases}$

Example 3

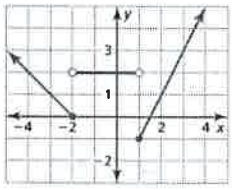
* you will have end points - creating rays - for each piece of the function

Write a piecewise function for the graph.

9.



10.



$f(x) = \begin{cases} -x - 1 & \text{if } x \leq 0 \\ x + 2 & \text{if } x > 0 \end{cases}$

Monitoring Progress 9-10

10.) $f(x) = \begin{cases} -x - 2 & \text{if } x \leq -2 \\ 2 & \text{if } -2 < x < 1 \\ 2x - 3 & \text{if } x \geq 1 \end{cases}$

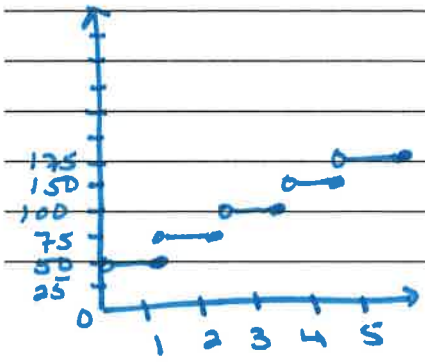
You rent a karaoke machine for 5 days. The rental company charges $50 for the first day and $25 for each additional day. Write and graph a step function that represents the relationship between the number x of days and the total cost y (in dollars) of renting the karaoke machine.

# of days	Total $
$0 < x \leq 1$	50
$1 < x \leq 2$	75
$2 < x \leq 3$	100
$3 < x \leq 4$	125
$4 < x \leq 5$	150

$$f(x) = \begin{cases} 50 & \text{if } 0 < x \leq 1 \\ 75 & \text{if } 1 < x \leq 2 \\ 100 & \text{if } 2 < x \leq 3 \\ 125 & \text{if } 3 < x \leq 4 \\ 150 & \text{if } 4 < x \leq 5 \end{cases}$$

Example 4

Step function: a piece wise function defined by a constant value over each part of its domain.

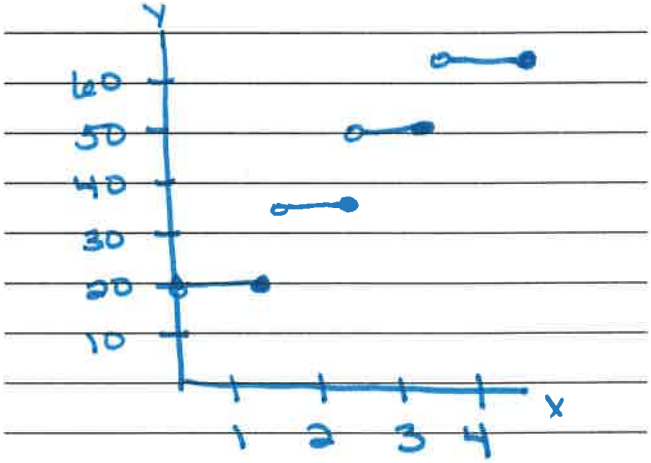


Creates steps

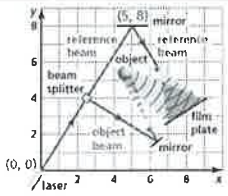
11. A landscaper rents a wood chipper for 4 days. The rental company charges $100 for the first day and $50 for each additional day. Write and graph a step function that represents the relationship between the number x of days and the total cost y (in dollars) of renting the chipper.

$$f(x) = \begin{cases} 20 & \text{if } 0 < x \leq 1 \\ 35 & \text{if } 1 < x \leq 2 \\ 50 & \text{if } 2 < x \leq 3 \\ 65 & \text{if } 3 < x \leq 4 \end{cases}$$

Monitoring Progress 11



In holography, light from a laser beam is split into two beams, a reference beam and an object beam. Light from the object beam reflects off an object and is recombined with the reference beam to form images on film that can be used to create three-dimensional images.



a. Write an absolute value function that represents the path of the reference beam.

b. Write the function in part (a) as a piecewise function.

a.) Vertex is (5, 8)

$g(x) = a|x-5|+8$

$0 = a|0-5|+8$

$-1.6 = a$

$g(x) = -1.6|x-5|+8$ (path of beam)

Example 5

Absolute Value $f(x) = |x|$ as a piece wise:

$$f(x) = \begin{cases} -x & \text{if } x < 0 \\ x & \text{if } x \geq 0 \end{cases}$$

Vertex form of absolute value

$g(x) = a|x-h|+k$

$$g(x) = \begin{cases} a[-(x-h)]+k & \text{if } x-h < 0 \\ a(x-h)+k & \text{if } x-h \geq 0 \end{cases}$$

12. WHAT IF? The reference beam originates at (3, 0) and reflects off a mirror at (5, 4).

a. Write an absolute value function that represents the path of the reference beam.

b. Write the function in part (a) as a piecewise function.

Monitoring Progress 12

Student practice

Point of Most Significance: Ask students to identify, aloud or on a paper to be collected, the most significant point (or part) in the lesson that aided their learning.

Closure