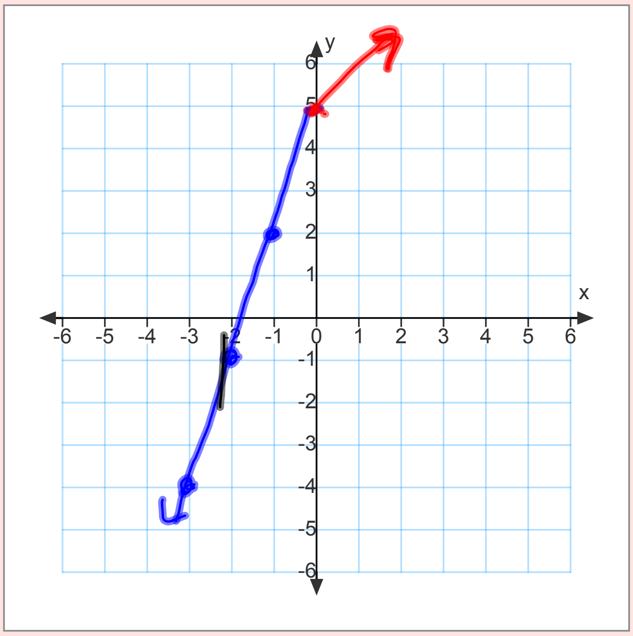
Graph both of these functions on the same graph:

$$y=\frac{2}{3}x+5$$

$$y=3x+5$$



$= \frac{2}{3}x+5,\ x \geq 0$

$= 3x+5,\ x < 0$

Piecewise Functions

What will we do today?

~ Write and graph piecewise functions.

~ Use piecewise functions to describe real-world situations

What is a piecewise function?

A **piecewise function** is a function that is a combination of one or more functions. The rule for a piecewise function is different for different parts, or pieces, of the domain. For instance, movie ticket prices are often different for different age groups. So the function for movie ticket prices would assign a different value (ticket price) for each domain interval (age group).

$$f(x) = \begin{cases} \frac{2}{3}x+5, & x \geq 0 \\ 3x+5, & x < 0 \end{cases}$$

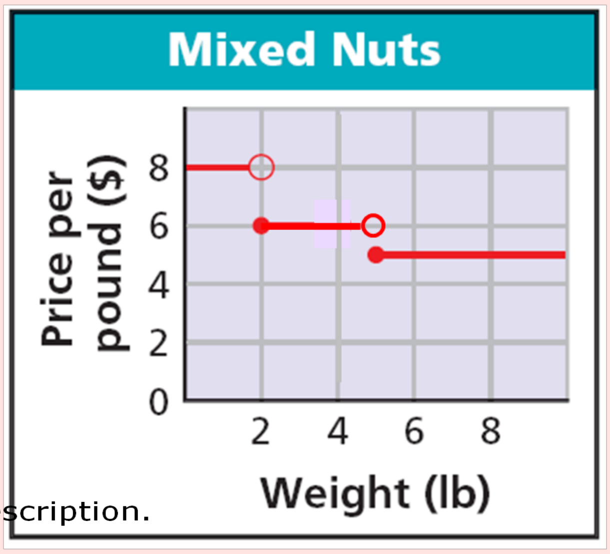
Let's Construct a Piecewise Function

Create a table and a verbal description to represent the graph.

Step 1 Create a table

lbs

x	y $
$0 \le x < 2$	$8x$
$2 \le x < 5$	$6x$
$5 \le x < \infty$	$5x$

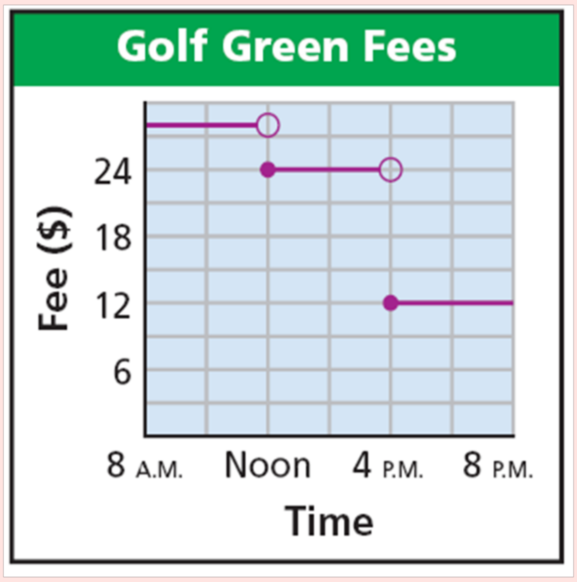


Step 2 Write a verbal description.

Try One!

Create a table and a verbal description to represent the graph.

x (time)	y ($)
$8 \le x < 12$	28
$12 \le x < 16$	24
$16 \le x \le 20$	12



What are we creating?

A piecewise function that is constant for each interval of its domain, such as the mixed nuts price function, is called a **step function.**

$$f(x) = \begin{cases} 5 & \text{if } 0 < x < 13 \\ 9 & \text{if } 13 \leq x < 55 \\ 6.5 & \text{if } x \geq 55 \end{cases}$$

Read this as "*f* of *x* is 5 if *x* is greater than 0 and less than 13, 9 if *x* is greater than or equal to 13 and less than 55, and 6.5 if *x* is greater than or equal to 55."

Evaluating!

Evaluate each piecewise function for $x = -1$ and $x = 4$.

$$h(x) = \begin{cases} 2x + 1 & \text{if } x \le 2 \\ x^2 - 4 & \text{if } x > 2 \end{cases}$$

$x = -1$

$h(-1) = 2(-1) + 1 = -1$

$h(-1) = -1$

$h(4) = (4)^2 - 4 = 12$

$h(4) = 12$

Evaluate each piecewise function for $x = -1$ and $x = 3$.

$$f(x) = \begin{cases} 12 & \text{if } x < -3 \\ 15 & \text{if } -3 \le x < 6 \\ 20 & \text{if } x \ge 6 \end{cases}$$

$x = -1$

$f(-1) = 15$

$x = 3$

$f(3) = 15$

Evaluate each piecewise function for $x = -1$ and $x = 3$.

$$g(x) = \begin{cases} 3x^2 + 1 & \text{if } x < 0 \\ 5x - 2 & \text{if } x \ge 0 \end{cases}$$

$x = -1$

$g(x) = 3(-1)^2 + 1 = 4$

$x = 3$

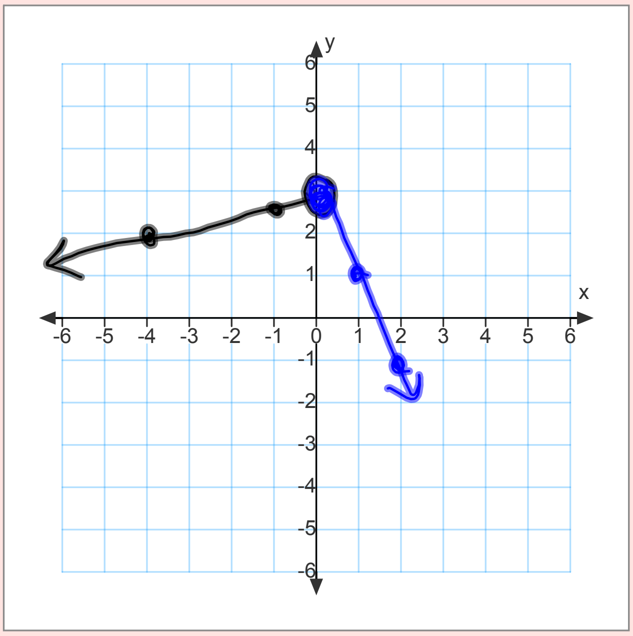
$g(3) = 5(3) - 2 = 13$

Now for the fun...Graphing Piecewise Functions

Graph each function.

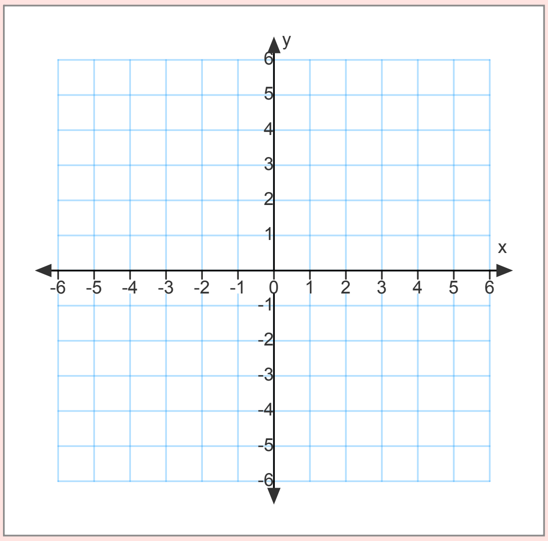
$$g(x) = \begin{cases} \frac{1}{4}x + 3 & \text{if } x < 0 \\ -2x + 3 & \text{if } x \geq 0 \end{cases}$$

x	1/4x+3	-2x+3
-4	2	X
-1	2.75	X
0	3(N.I)	3
1	X	1
2	X	-1



Another Example!

$$g(x) = \begin{cases} x^2 - 3 & \text{if } x < 0 \\ \frac{1}{2}x - 3 & \text{if } 0 \le x < 4 \\ (x-4)^2 - 1 & \text{if } x \ge 4 \end{cases}$$



Try These!

a)

$$f(x) = \begin{cases} 4 & \text{if } x \le -1 \\ -2 & \text{if } x > -1 \end{cases}$$

b)

$$g(x) = \begin{cases} 3x + 8, x \le 3 \\ -2x, -3 < x < 1 \\ x^2 - 3, x \ge 1 \end{cases}$$

Get Ready... Word Problems!

Jennifer is completing a 15.5-mile triathlon. She swims 0.5 mile in 30 minutes, bicycles 12 miles in 1 hour, and runs 3 miles in 30 minutes. Sketch a graph of Jennifer's distance versus time. Then write a piecewise function for the graph.

Remember!

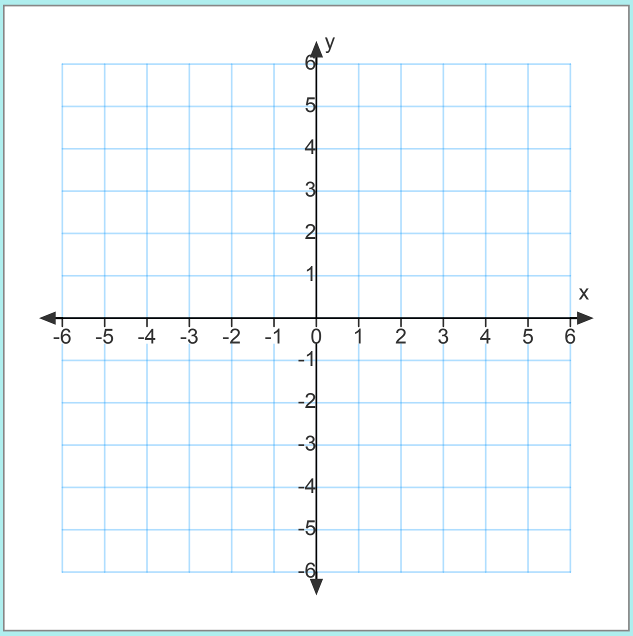
The distance formula $d = rt$ can be arranged to find rates: $r = \frac{d}{t}$.

One More!

Shelly earns $8 an hour. She earns $12 an hour for each hour over 40 that she works. Sketch a graph of Shelly's earnings versus the number of hours that she works up to 60 hours. Then write a piecewise function for the graph.

Graph this piecewise function... It's magical!

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



What type of function are we graphing?

Absolute Value Function!

Parent function: $y = |x|$

Domain:

Range:

End Behavior:

Standard form of an absolute value function:

$$y = a|x - h| + k$$

Let's Transform!

Parent Function: $y=|x|$

Example 1:

$y=2|x|$

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

Example 2:

$y=\left|\frac{1}{2}x\right|$

$y=|2x|$

Example 3:

$y=|x+1|$

$y=|x-4|$

Example 4:

$y=|x|+3$

$y=|x|-6$

Example 5:

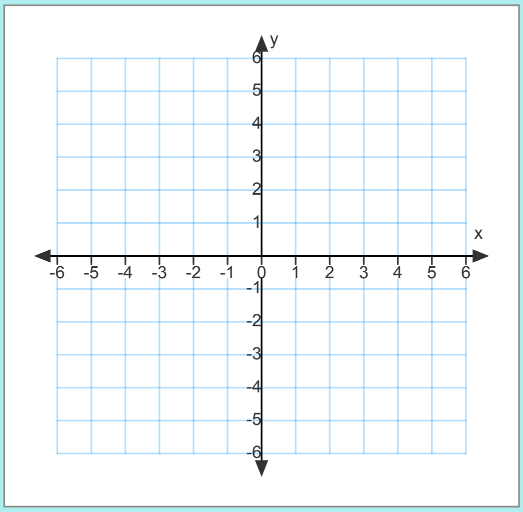
$y=-|x|$ $y=|-x|$

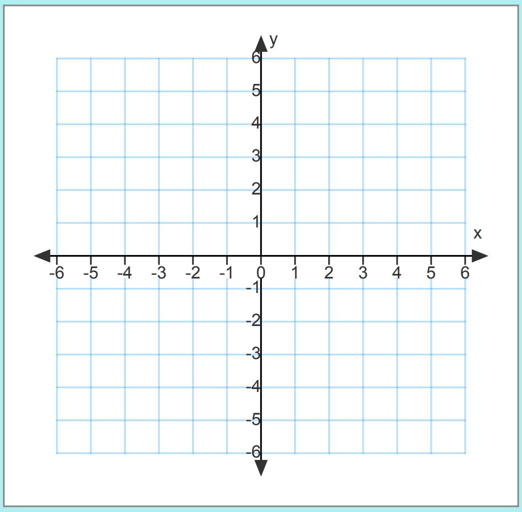
Time to Try Some

Identify the vertex, domain, range and describe the transformations of $y=|x|$. Then, graph the function.

a) $y=2|x+1|$

b) $y=-|x-3|+2$



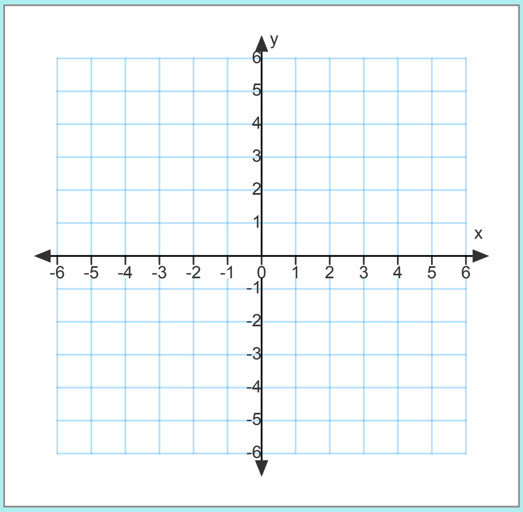


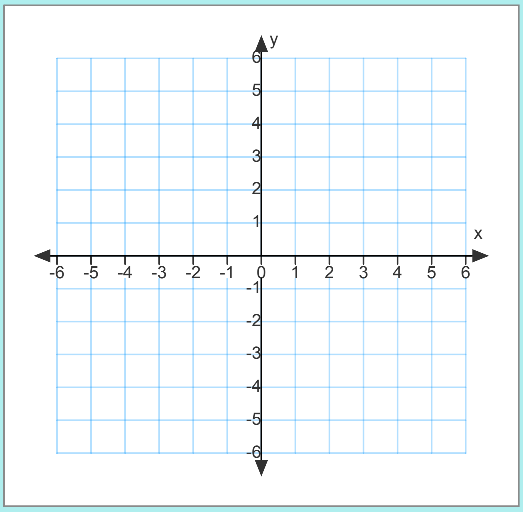
Now, You Try

Identify the vertex, domain, range and describe the transformations of $y = |x|$. Then, graph the function.

a) $y = \frac{1}{2}|x - 3| + 1$

b) $y = -2|x| - 2$



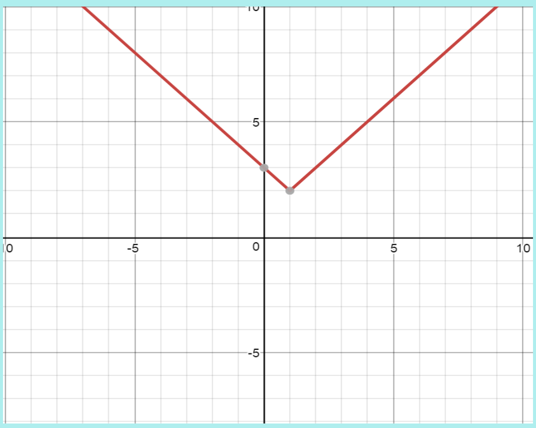


What if we Change It Up?

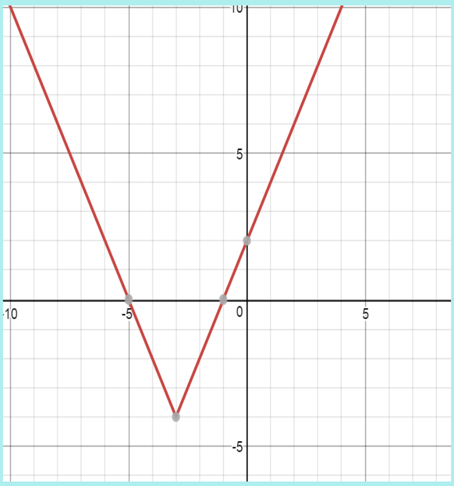
We know how to find the vertex.

Let's write the function using the graph.

a)

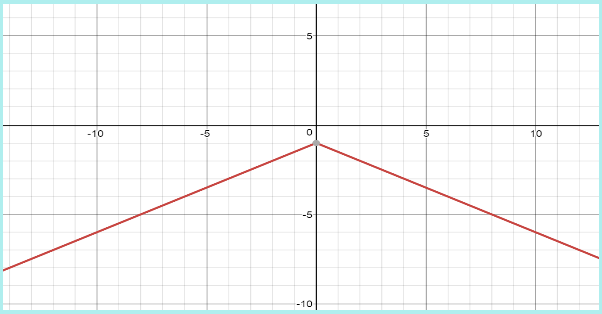


b)

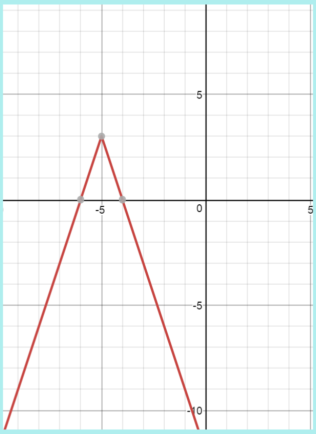


You Try!

a)



b)



A Real-Life Application... Kind of

One side of a sandwich lies on a coordinate grid. The lower left corner of the triangle is on the coordinate (-4,-2) and the lower right corner of the triangle is on the coordinate (4,-2). The top corner of the triangle has the coordinate (0,2). Assuming that the top corner is the vertex,what is the absolute value equation that connects the vertex to the bottom left and right corners?