Pre-Calculus Name: Date: Period:

1C: Piecewise Functions

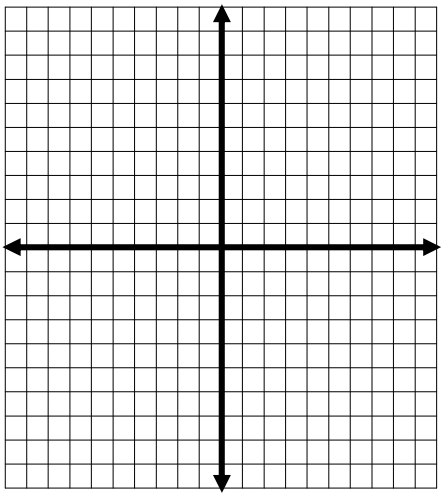
A function is used to describe a relationship between two or more variables. However, sometimes this relationship changes for different input values. In this lesson, we will learn about a type of function called a ***piecewise function*** which is a way to combine parts of different functions into one function.

Explore

1. Graph these functions on separate graphs
   a. $y = -\frac{2}{3}x + 4$
   b. $y = x^2$
2. Now cut out the left side (where $x < 0$) of the graph $y = -\frac{2}{3}x + 4$. Throw the other side away.
3. Cut out the right side (where $x \geq 0$) of the graph $y = x^2$.
4. Now take the two functions and tape them together at the y-axis. This is the graph of

$$y = \begin{cases} -\frac{2}{3}x + 4 & if \quad x < 0 \\ x^2 & if \quad x \geq 0 \end{cases}$$

5. Copy your graph here



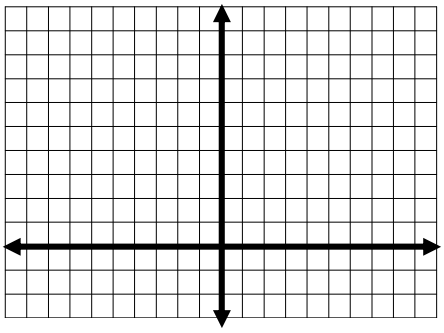
- The example above is called a ***piecewise function*** because the value of the function is made of two "pieces.
- We also note that the function is *discontinuous* since it has one points (x=0) that has a "jump" discontinuities.
- Note: the function is ***decreasing*** on $(-\infty, 0)$ and ***increasing*** on $(0, \infty)$

Piecewise linear functions

A piecewise function definition like the one below gives a set of "rules" that define the output ($f(x)$) for any given input (x) value. Use the following function to answer questions 1 and2.

$$F(x) = \begin{cases} x, & if\ x < 0 \\ x + 1, & if\ 0 \le x < 5 \\ 2, & if\ x \ge 5 \end{cases}$$

1. Find
   $f(-2) =$
   $f(0) =$
   $f(1) =$
   $f(3) =$
   $f(5) =$
   $f(6) =$
2. Use these values to help you graph the function.

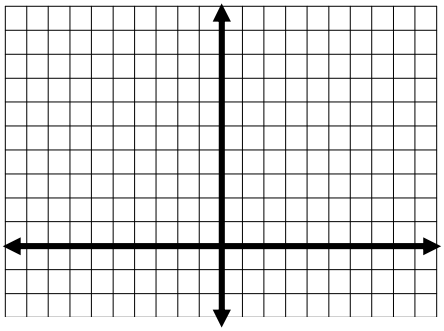


To plot piecewise functions, we can begin by graphing each of the functions (like $y = 0$, $y = x + 1$, and $y = 2$ above). Then "erase" part of the graph so that only part of the graph remains for the given domain piece. Endpoints are "closed" for included values and "open" for non-included values.

Mathematicians often choose to define more complicated functions using piecewise functions. This will greatly help us to model real-life situations

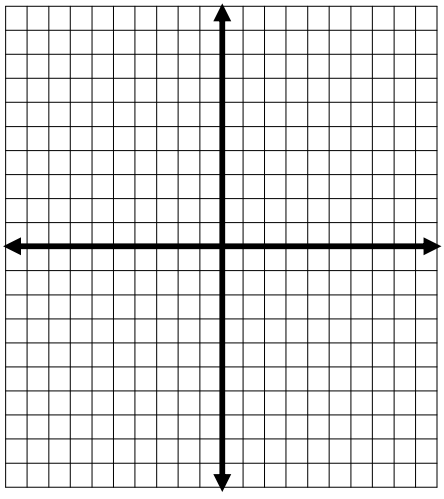
Try this

1. Plot this piecewise function
   $$f(x) = \begin{cases} -x, & if\ x < 0 \\ x, & if x \ge 0 \end{cases}$$
2. What non-piece function has the same graph as this?

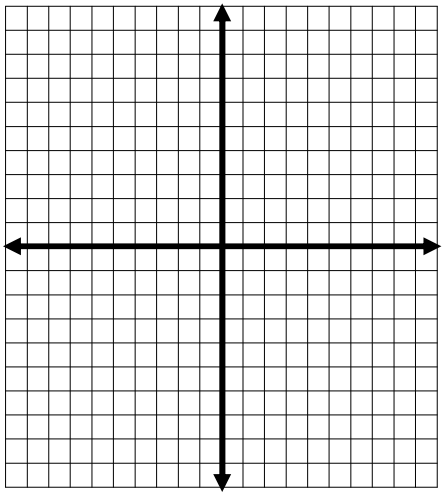


Try These Graph the piecewise functions and determine if they are continuous

1. $y = \begin{cases} x - 1, & if\ x \le 0 \\ x^2, & if\ x > 0 \end{cases}$



2. $y = \begin{cases} -2x + 1, & if\ x \le 1 \\ -2x - 1, & if\ x > 1 \end{cases}$



3. $y = \begin{cases} x + 1, & if\ x < 0 \\ 1, & if\ 0 \le x < 1 \\ \sqrt{x}, & if\ x \ge 1 \end{cases}$