

1.10 Piecewise Functions and Step Functions

Objectives:

Students will construct piecewise functions.

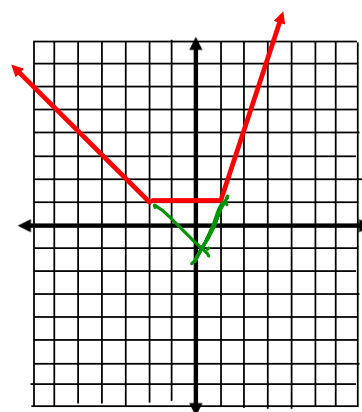
Students will graph piecewise functions.

Students will analyze and relate characteristics of piecewise functions to applicable situations.

Piecewise Function: a function made by combining other functions, much like connecting pieces of railroad track end to end.

Each section of a piecewise function has a corresponding interval of x values associated with it.

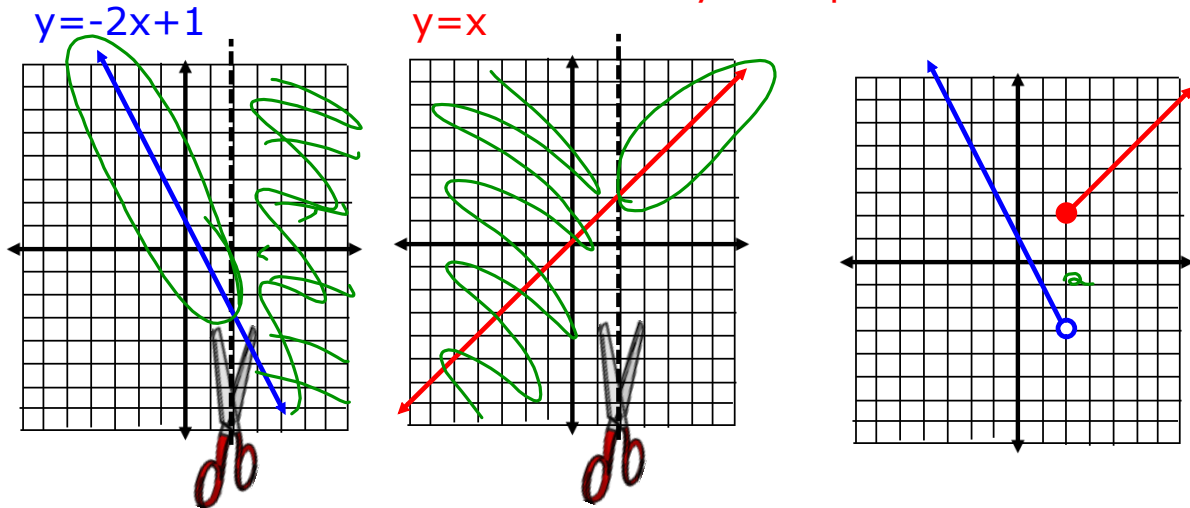
$$f(x) = \begin{cases} -x-1 & \text{if } x < -2 \\ 1 & \text{if } -2 \leq x < 1 \\ 3x-2 & \text{if } x \geq 1 \end{cases}$$



To graph a piecewise function, we can graph the functions that make it up, cut them apart, according to the x intervals, and then place the portions together.

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

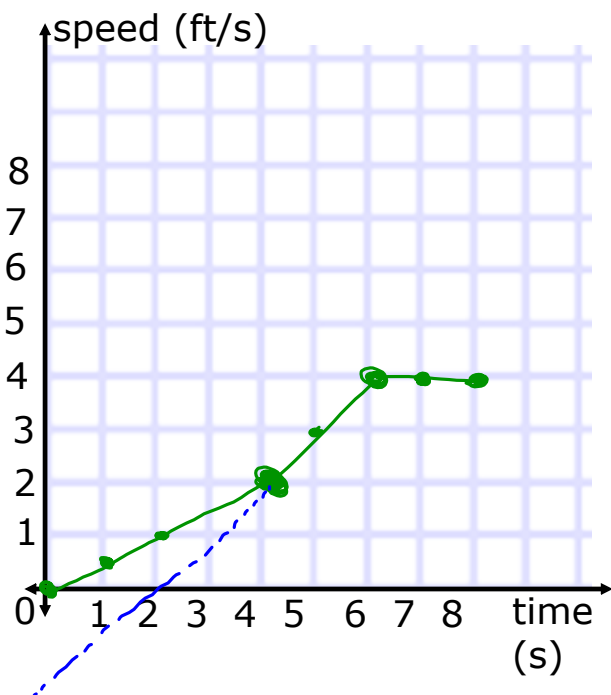
Notice: the left ray's endpoint is not included, but the right ray's endpoint is included.



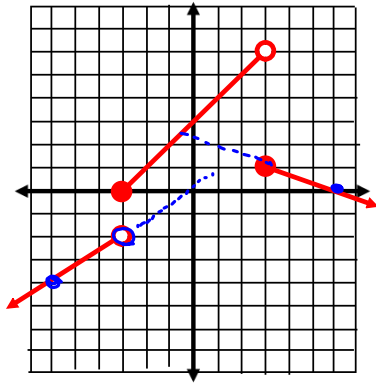
Ex. 1 This piecewise function represents the speed at which a squirrel ran along a fence. Chris only watched it for 8 seconds. Graph the function. On which interval is the speed increasing?

$$f(t) = \begin{cases} t/2 & \text{if } 0 \leq t < 4 \\ t-2 & \text{if } 4 \leq t < 6 \\ 4 & \text{if } 6 \leq t \leq 8 \end{cases}$$

Speed increases on (0, 6)



Ex. 2 Write the equation of this piecewise function and identify the domain, range, & interval where the function is decreasing.



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

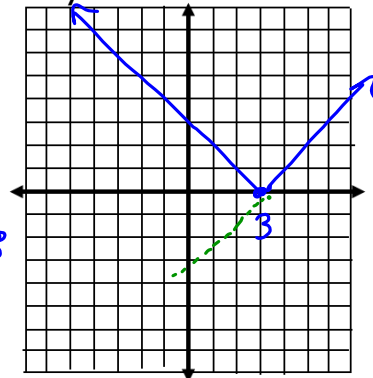
$$D: (-\infty, \infty)$$

$$R: (-\infty, 6)$$

f is decreasing
on $(3, \infty)$

Ex. 3 Graph this absolute value function and then re-write the equation as a piecewise function. $f(x) = |x-3|$
Identify the max or min and line of symmetry.

$$f(x) = \begin{cases} -|x + 3| & \text{if } x \leq 3 \\ x - 3 & \text{if } x > 3 \end{cases}$$



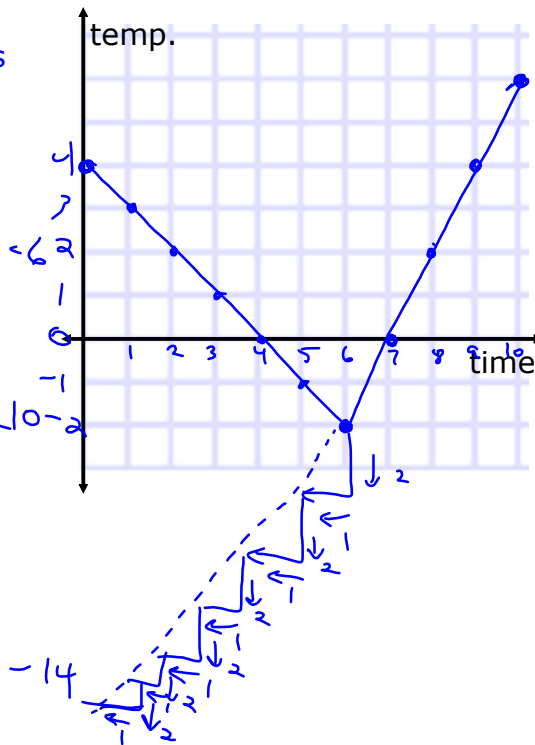
min is 0
line of symm.
 $x = 3$

Ex. 4 At midnight on a cold winter day, the temperature was 4° F and the temperature fell 1° per hour until sunrise at 6am. After that, the temperature rose steadily at 2° per hour until I stopped checking at 10am.

Graph this piecewise function and write its equation. What is the minimum?

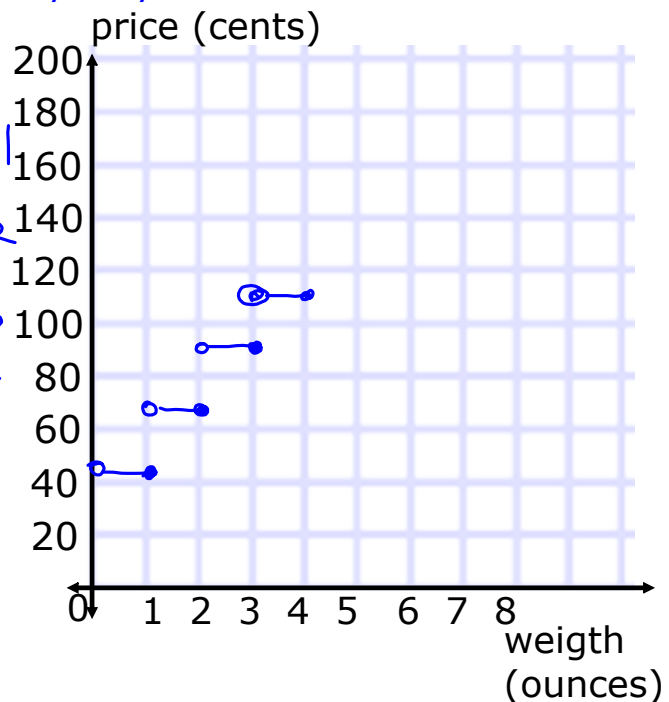
→ -2°

$$\text{Temp}(t) = \begin{cases} -1t + 4 & \text{if } t < 6 \\ 2t - 14 & \text{if } 6 \leq t \leq 10 \end{cases}$$



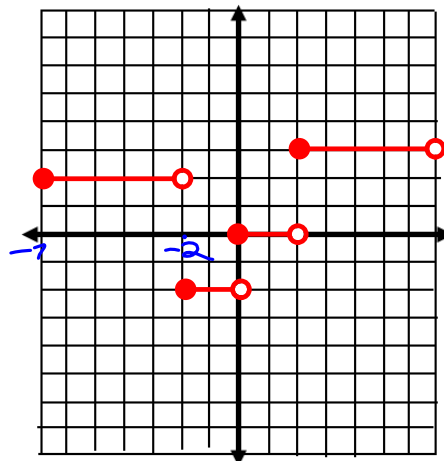
Ex. 5 As of January 2017, the price to mail a first class letter was 47 cents for the first ounce (or less) and 21 cents for (up to) each additional ounce. Roughly sketch the graph of this piecewise function and write its equation. Why do you think we refer to this as a step function?

$$P(w) = \begin{cases} 47 & \text{if } w \leq 1 \\ 68 & 1 < w \leq 2 \\ 89 & 2 < w \leq 3 \\ 110 & 3 < w \leq 4 \end{cases}$$



Ex. 6 Write the equation of this step function. What are the domain and range?

$$f(x) = \begin{cases} 2 & -7 \leq x < -2 \\ -2 & -2 \leq x < 0 \\ 0 & 0 \leq x < 2 \\ 3 & 2 \leq x < 7 \end{cases}$$



$$D: [-7, 7)$$

$$R: \{2, -2, 0, 3\}$$