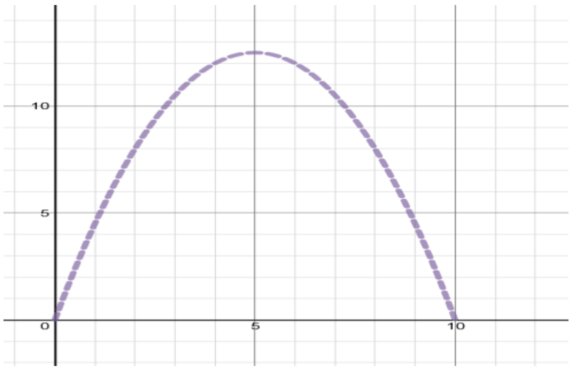
Characteristics of Function

Functions can be used to model real life situation. For example, a ball is being thrown between two people. The height of the ball with respect to time can be represented using the equation of a quadratic and graphically modeled by a parabola.



How long did the ball stay in the air?

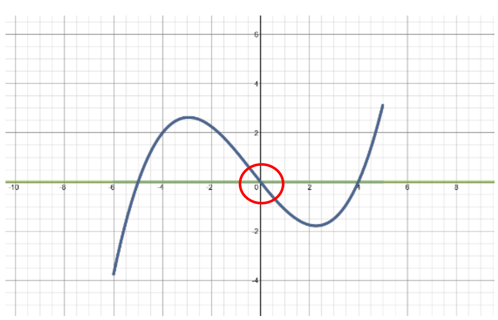
What was the maximum height of the ball?

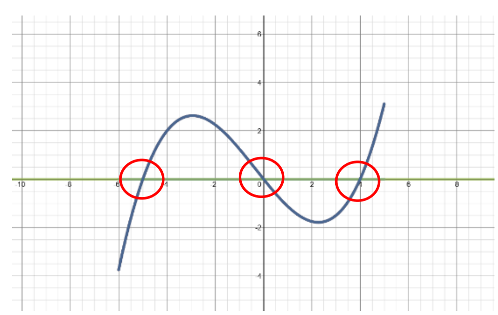
At what time does the ball reach its maximum height?

Questions that maybe asked about the ball:

Answering questions like those above requires you to identify certain characteristics of the graph. The major characteristics of a function include;

- $x - intercepts$: (also known as roots, zeros, and solutions) where the graph crosses the x-axis. This can be found algebraically by setting the function equal to 0 and solving for x. X-intercepts are points that have the general form $(x, 0)$.





- $y - intecepts$: where the graph crosses the y-axis. This can be found algebraically by plugging in 0 for x since the general form of the point is $(0, y)$.

Maximums and Minimums

- *Maximum*- is the greatest y-value that is produced by the function
- *Minimum*- is the least y-value that is produced by the function
  - *Note*: Global (or absolute) refers to the greatest/lowest value on an interval. A global cannot be infinity it has to be a finite number. Local refers to the greatest of lowest value of the overall graph (there can be multiple local max/min.

Example:

Consider the graph below, illustration A, on the interval **[-6, 5]**. Note that the maximum is being considered both a local and the global. Since the graph continues to increase after $x = 5$ that would produce higher values to the global maximum would change if the interval was expanded beyond 5.

Illustration B is considering the whole function without a domain restriction. Note that the global minimum is a finite value so a domain restriction is not necessary.

Illustration A:

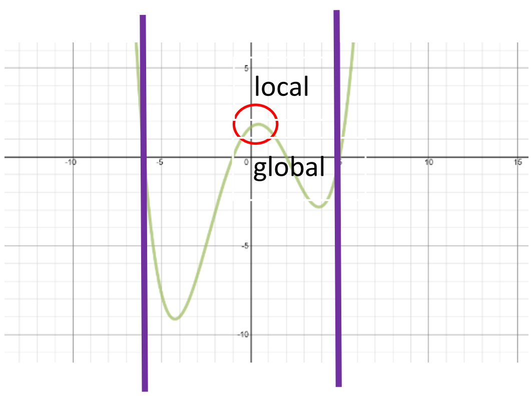
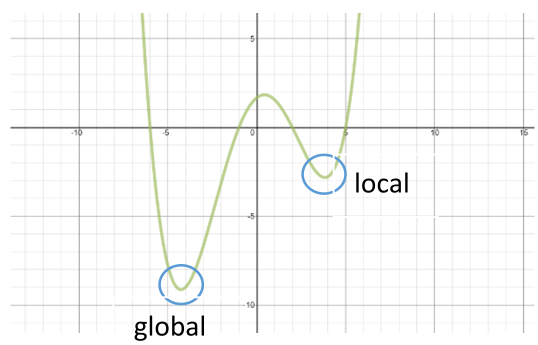
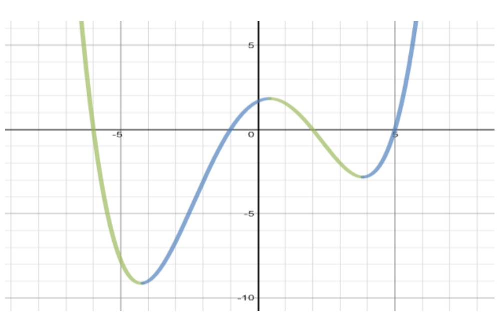


Illustration B:



Increasing and Decreasing

- *Increasing*: $as\ x \to \infty$ (which means as the value of x gets larger) then $f(x) \to \infty$ (which means that the y-values get larger)
- *Decreasing*: $as\ x \to \infty$ (which means as the value of x gets larger) then $f(x) \to -\infty$ (which means that the y-value gets smaller)
  - To state the intervals of increasing and decreasing of a function you must know the maximum and/or minimums.



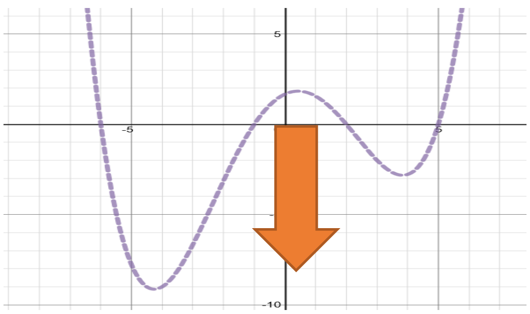
Decreasing: $\{x|x < -4.3\ or\ .3 < x < 3.8\}$

$or\ represented\ (-\infty, -4.3) \cup (.3, 3.8)$

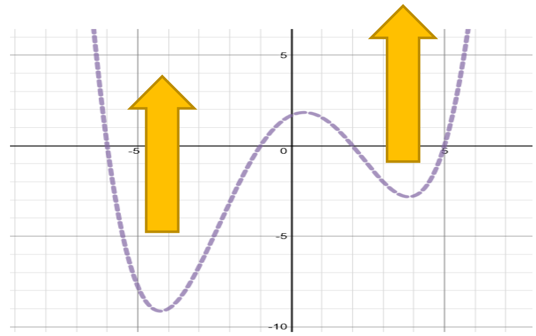
Increasing: $\{x|-4.3 < x < .3\ or\ x > 3.8\}$

$or\ represented\ (-4.3, .3) \cup (3.8, \infty)$

- Concavity- simple terms is the direction in which a curve opens

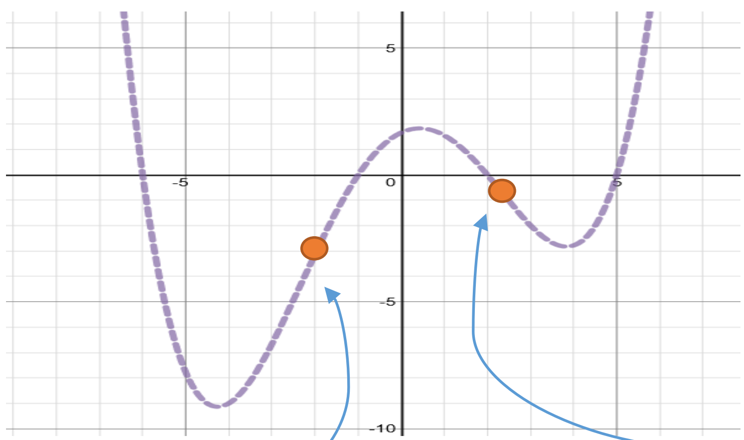


Concave Down



Concave Up

   - To determine when a curve changes from concave up to concave down you must know the inflection point.
   - Inflection points happen between a maximum and a minimum: algebraically to find the x –value you need the x-values of the max and min then $\frac{max+min}{2} = x - value\ of\ the\ inflection$; plug in the x-value into the function to get the corresponding y-value.



$\frac{-4.3+.3}{2} = -2$ *and* $\frac{.3+3.8}{2} = 2.05$

The graph is concave up on the interval $(-\infty, -2) \cup (2.05, \infty)$.

The graph is concave down on the interval $(-2, 2.05)$

***Intervals are x-values only for increasing/decreasing and concavity because it tells us WHEN that characteristic is happening**