

## 2) Variation

Variation refers to where the function is increasing, decreasing or constant.

Increasing:

the  $x$ -values (interval of the domain) that cause the function to 'go up and to the right'.

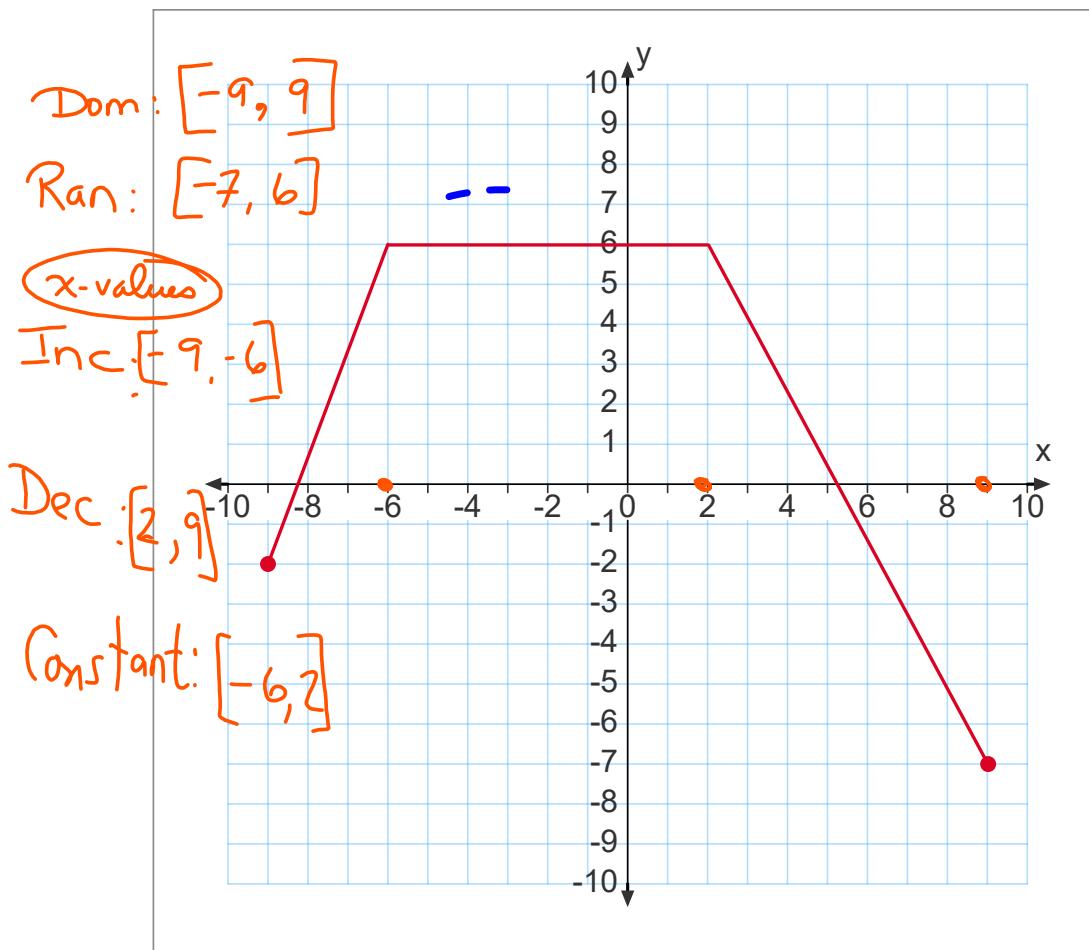
Decreasing:

the interval of the domain that causes the function to 'go down and to the right'.

Constant:

the interval of the domain that causes the function to be horizontal. The function is said to be both increasing and decreasing at the same time.

Determine the variation for the function below.

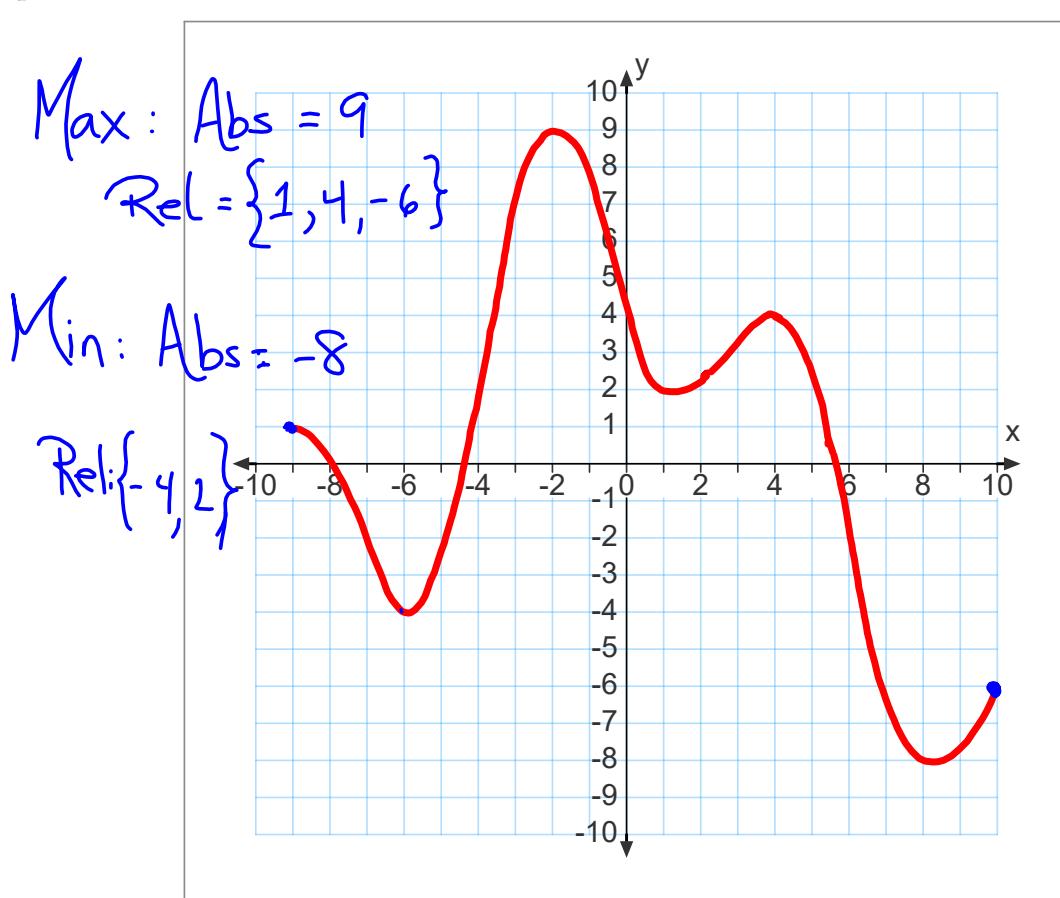


### 3) Extrema

Extrema refer to the highest (maximum) and lowest (minimum) points on a graph ( $y$ -values).

- a) Absolute: the very highest or the very lowest points possible.
- b) Relative: the highest and lowest points when compared to other points nearby.

Determine the extrema of the function below.



#### 4) Sign

The sign of a function refers to where the function is positive and negative.

The reference is the  $x$ -axis.

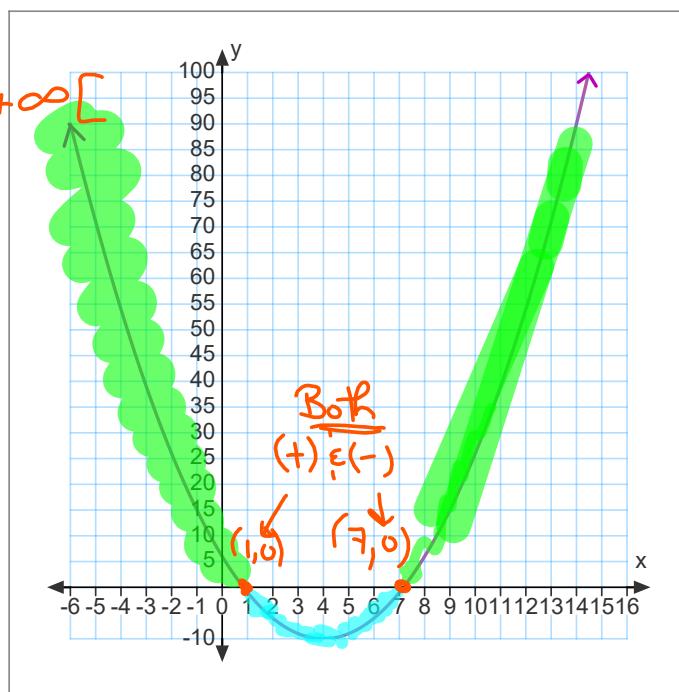
Any part of the function above the  $x$ -axis is positive and any part below the  $x$ -axis is negative.

We use interval notation and  $x$ -values to describe this property.

Determine the sign of the function below.

Pos:  $]-\infty, 1] \cup [7, +\infty[$

Neg:  $[1, 7]$



## 5) Intercepts

The intercepts of a function refer to where the function crosses the axes .

a)  $y$ -intercept AKA: initial value, value at  $0$

This is where the function crosses the  $y$ -axis ( $x = 0$ ).

There can only be one  $y$ -intercept.

b)  $x$ -intercept      AKA: zero, root

This is where the function crosses the  $x$ -axis ( $y = 0$ ).

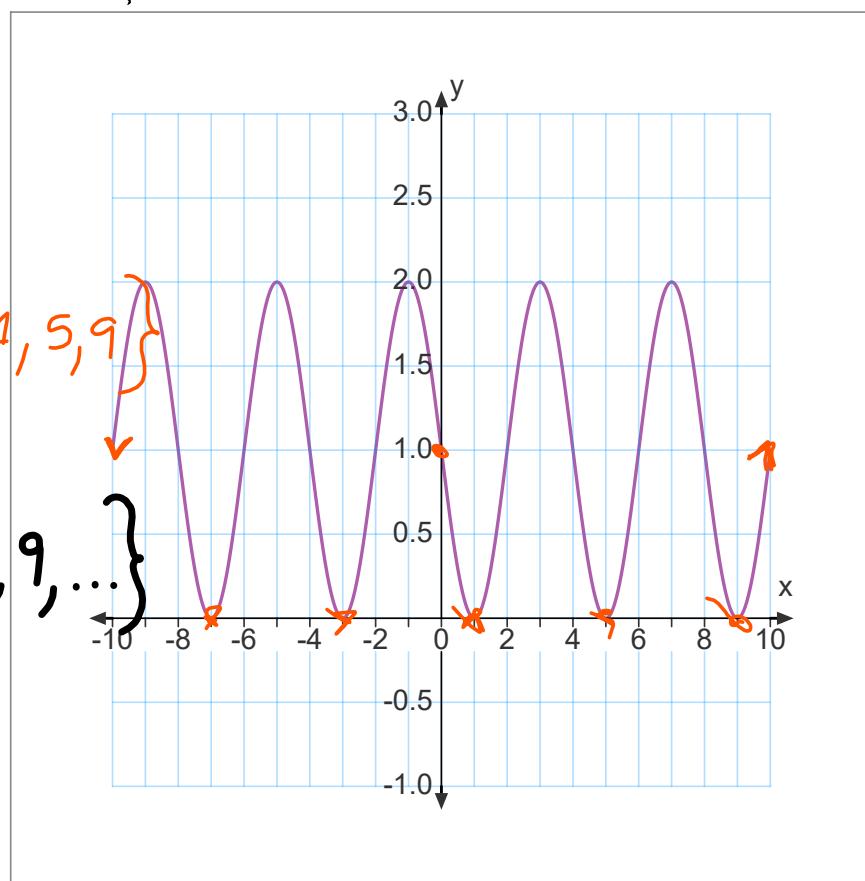
There may be an infinite number of  $x$ -intercepts.

Determine the intercepts of the function below.

$$y\text{-int} = 1$$

$$x\text{-int} = \{-7, -3, 1, 5, 9\}$$

$$\{\dots, -7, -3, 1, 5, 9, \dots\}$$



Provide a study of the function below. This means to list all its properties .

$$\text{Dom: } [-5, 5]$$

$$\text{Ran } [-3, 4]$$

$$\text{Inc: } [-4, 1] \cup [3, 5]$$

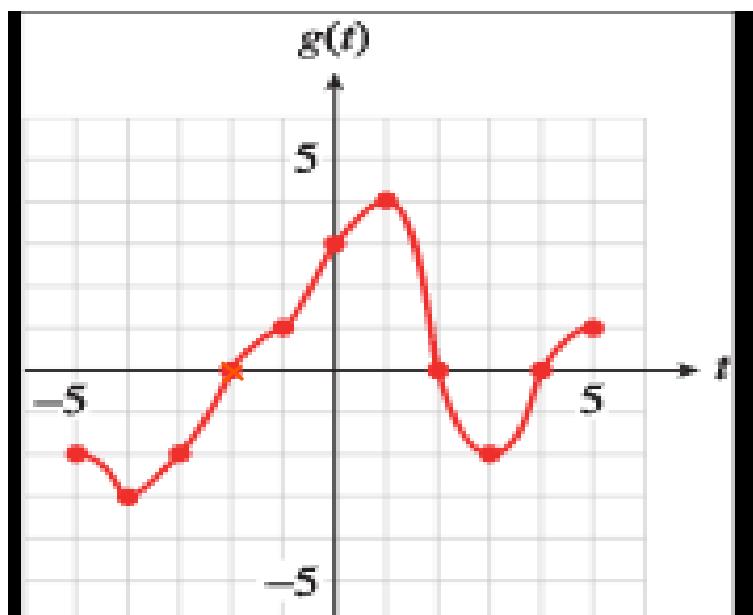
$$\text{Dec: } [-5, -4] \cup [1, 3]$$

$$\text{Pos: } [-2, 2] \cup [4, 5]$$

$$\text{Neg: } [-5, -2] \cup [2, 4]$$

$$y\text{-int} = 3$$

$$x\text{-int} = \{-2, 2, 4\}$$



$$\text{Max: } \text{Abs: } 4 \quad \text{Rel: } \{-2, 1\}$$

$$\text{Min: } \text{Abs: } -3 \quad \text{Rel: } -2$$

Given  $f(x) = 3\sqrt{x+4} - 12$  determine:

a) the  $y$ -intercept = -6

let  $x=0$

$$\begin{aligned} f(0) &= 3\sqrt{0+4} - 12 \\ &= 3\sqrt{4} - 12 \\ &= 3 \cdot 2 - 12 \\ &= -6 \end{aligned}$$

c) the zero(s)  
 $x$ -intercept

let  $y=0$

b)  $f(-3) =$   
let  $x = -3$

$$\begin{aligned} f(-3) &= 3\sqrt{-3+4} - 12 \\ &= 3\sqrt{1} - 12 \\ &= 3 - 12 \\ &= -9 \end{aligned}$$

isolate  $\sqrt{\phantom{x}}$

$$0 = 3\sqrt{x+4} - 12$$

$$\underline{x=12}$$