

Extrema?

- Graphs may contain extrema, or minimum or maximum points.
- A **relative minimum** is the point that is the lowest, or the y -value that is the least for a particular interval of a function.
- A **relative maximum** is the point that is the highest, or the y -value that is the greatest for a particular interval of a function.

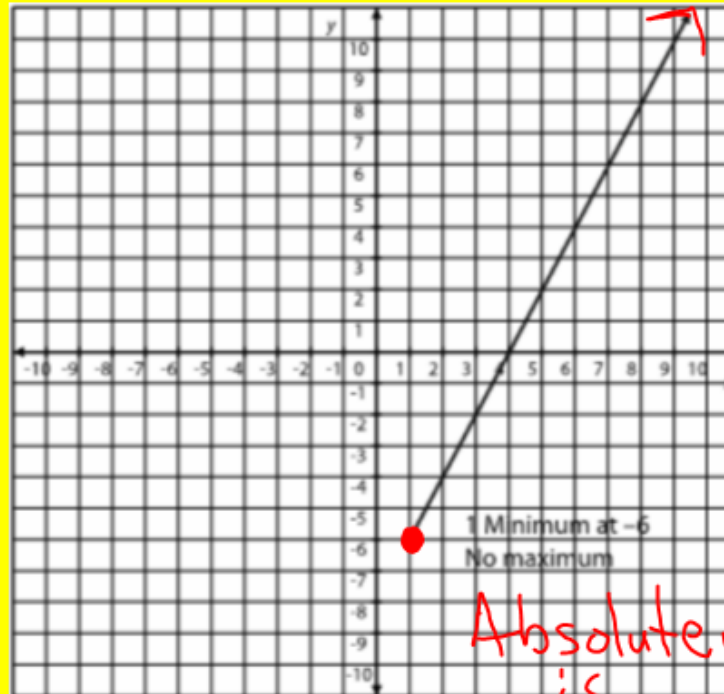
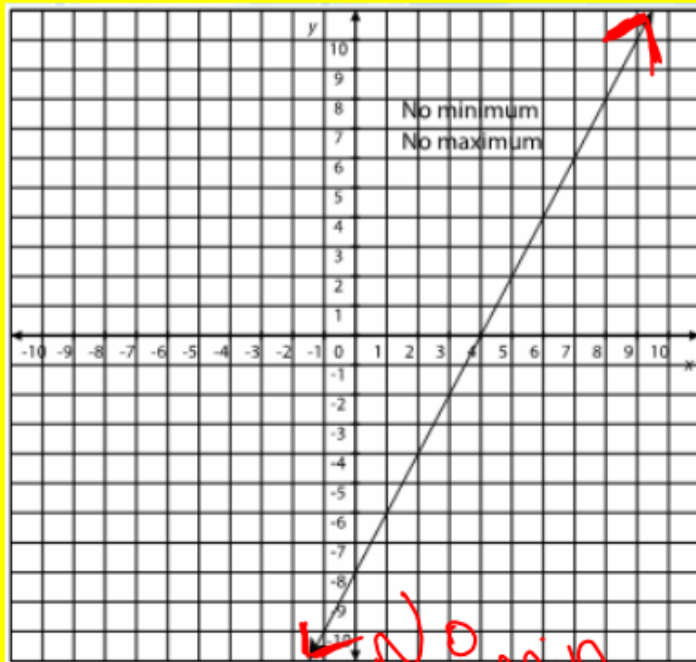
absolute max./min.

Extrema?

"y"

No max.

- The **domain** of a function is the set of all inputs, or x-values of a function.
- Compare the following two graphs. The graph on the left is of the function $f(x) = 2x - 8$. The graph on the right is of the same function, but the domain is for $x \geq 1$. The minimum of the function is -6 .



Extrema?

Max

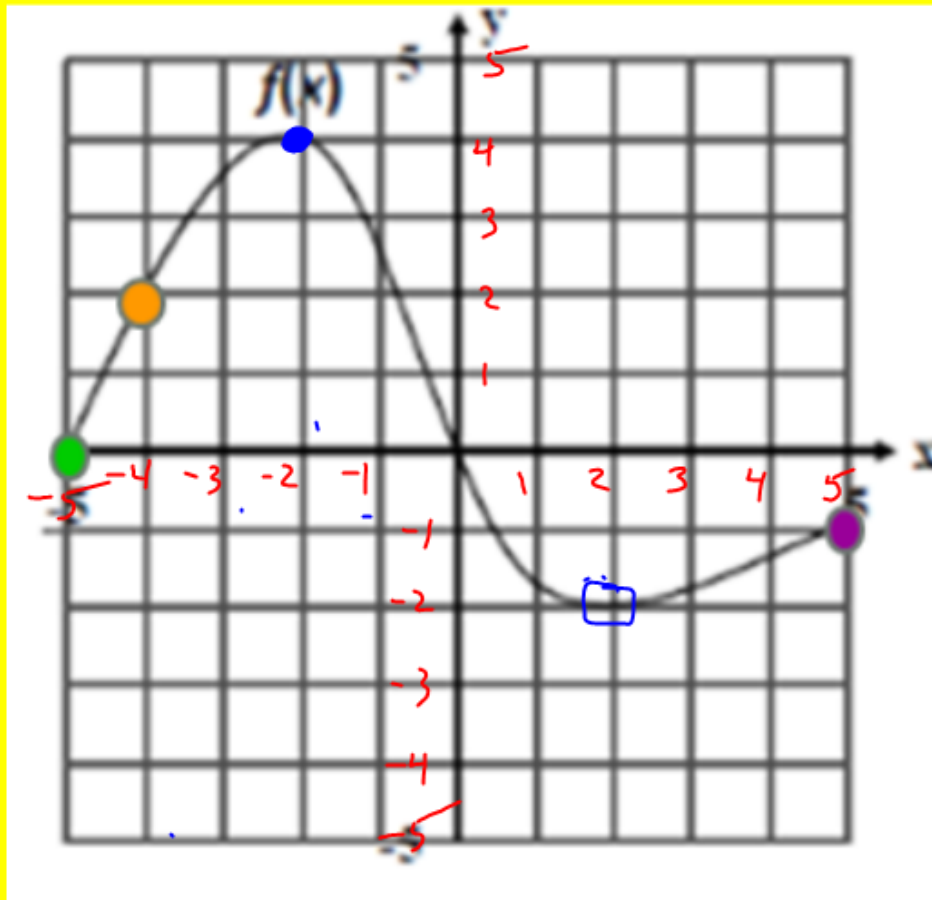
Abs: 4

Rel: — |

Min

Abs: -2

Rel: ○



Average Rate of Change

- Recall that rate of change is another term for slope
- Slope mainly refers to linear functions since the rate of change is constant
- For other functions we find the average rate of change
- We calculate the average rate of change the same way we calculate slope

$$\frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \text{rate of change}$$

Average Rate of Change

avg rate of change from 0 to 3

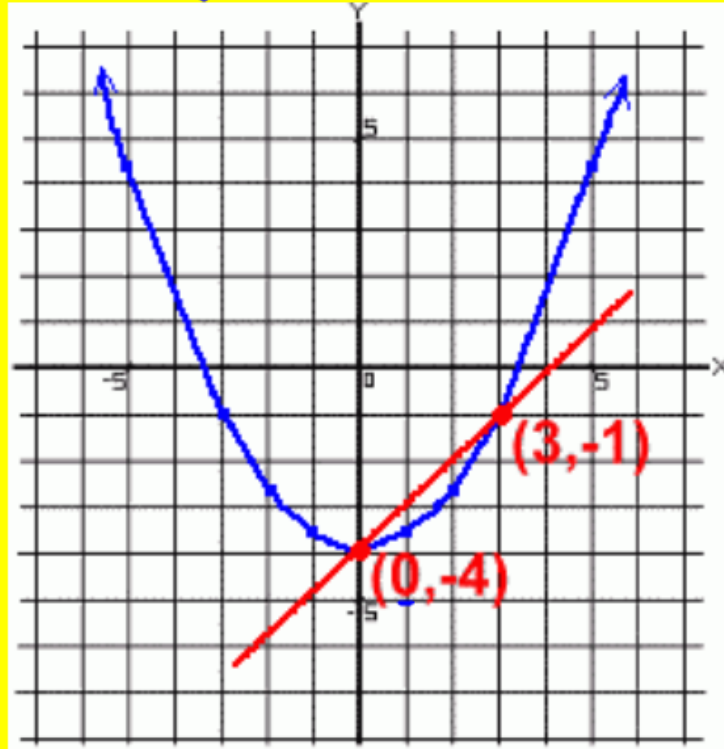
Given $y = f(x)$ at the right,
find the average rate of
change between the points
(0, -4) and (3, -1)

$$\begin{array}{r} x \\ 3 \overline{) 6} \\ \underline{-3} \\ 3 \end{array} \quad \begin{array}{r} y \\ -1 \end{array}$$

+3 < > +3

avg. rate of change = 1

$$\frac{-1 - (-4)}{3 - 0} = \frac{-1 + 4}{3 - 0} = \frac{3}{3} = 1$$



$$\frac{-4 - (-1)}{0 - 3} = \frac{-3}{-3} = 1$$

Average Rate of Change

$G(t)$ represents the temperature measured in Celsius over a period of time measured in minutes.

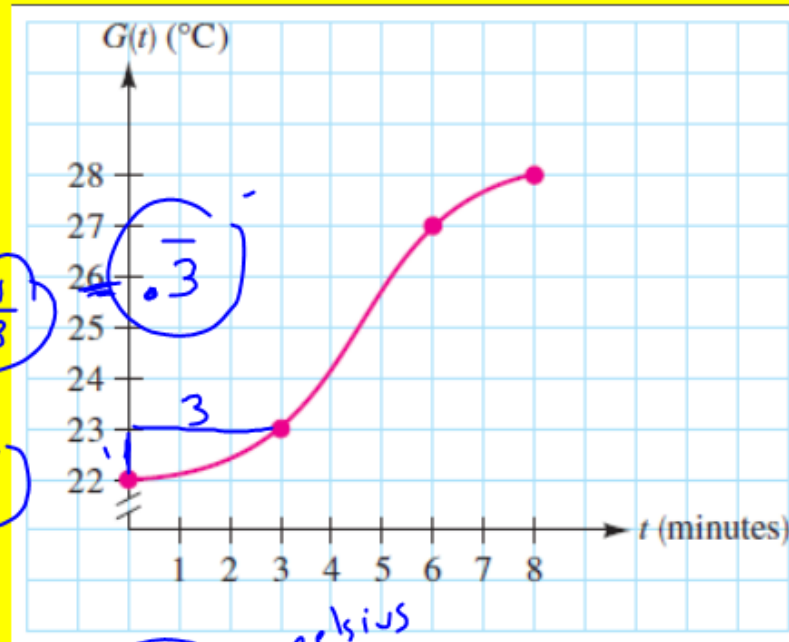
.3° celsius / min

Find the average rate of change between the following sets of points:

#1) $(0,22)$ and $(3,23)$ $\frac{\Delta y}{\Delta x} = \frac{22-23}{0-3} = \frac{-1}{-3} = \frac{1}{3}$

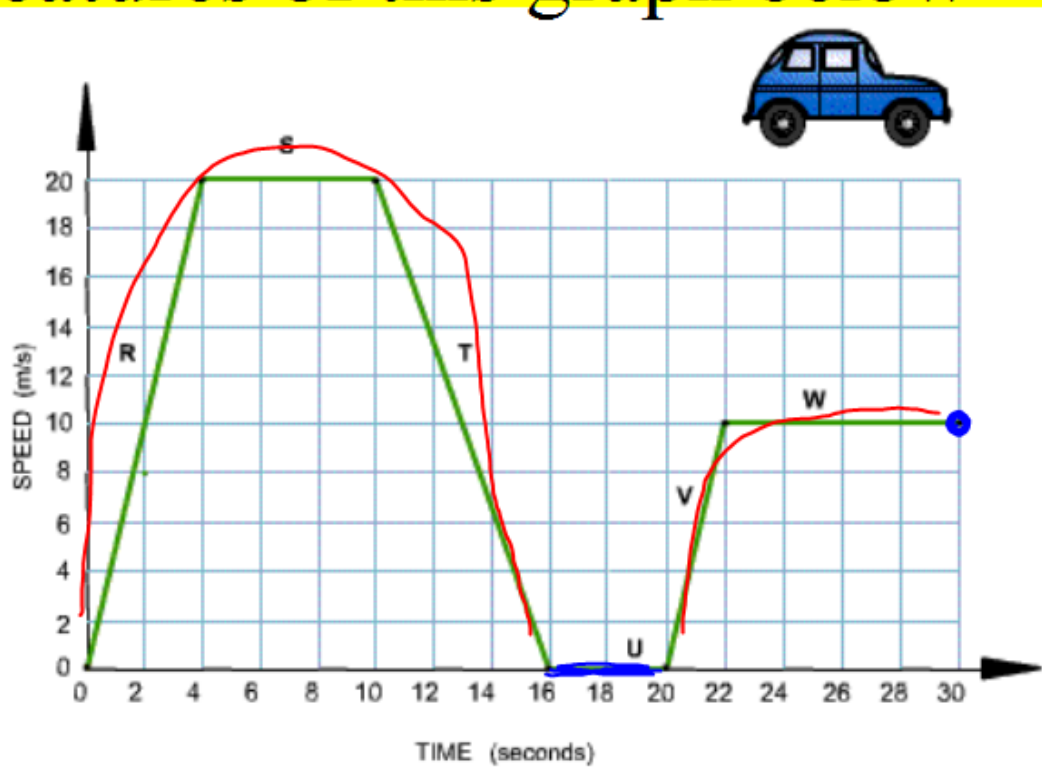
#2) $(3,23)$ and $(8,28)$ $\frac{28-23}{8-3} = \frac{5}{5} = 1$

#3) $(0,22)$ and $(6,27)$ $\frac{27-22}{6-0} = \frac{5}{6} = .8\bar{3}$ °/min



Warmup:

Identify all of the key features of this graph below



x - intercept : $0 \text{ \& } [16, 20]$

y - intercept : 0

increasing $(0, 4) \text{ \& } (20, 22)$

decreasing $(10, 16)$

positive $(0, 16) \text{ \& } (20, 30)$

negative N/A

maximum abs. = 20 rel. = 10

minimum abs. = 0 no rel.

avg. rate of change from

$x = 0$ to $x = 30$ $\frac{1}{3}$

Identify the following characteristics:

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

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

x-int: $-3, 0, 2$

y-int: 0

Maximums:

No abs. Rel. 8

Minimums:

No abs. Rel. -4

Intervals of Increase:

$(1, \infty)$ $(-\infty, -1.5)$

Intervals of Decrease:

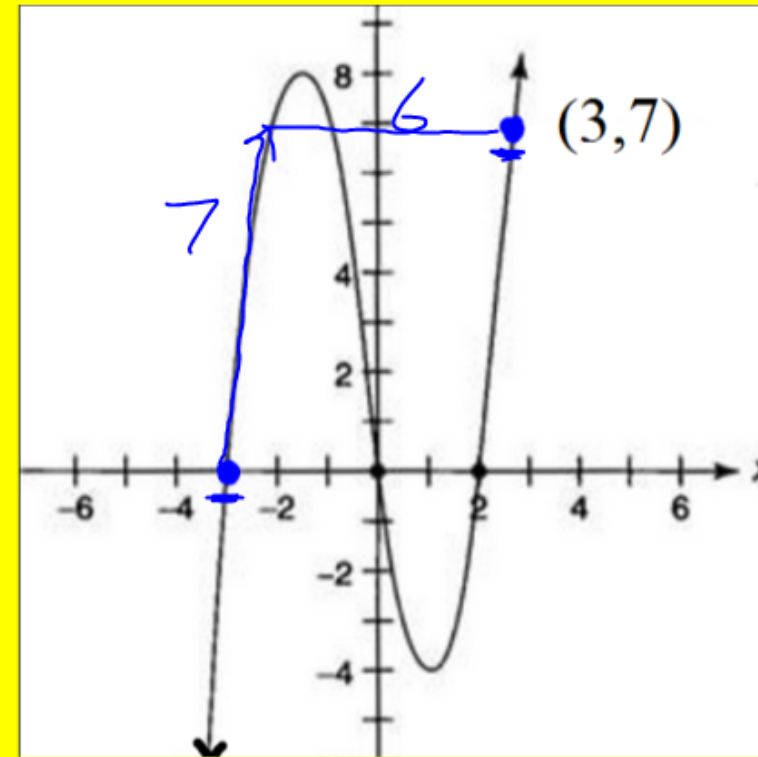
$(-1.5, 1)$

Positive Intervals:

$(-3, 0)$ $(2, \infty)$

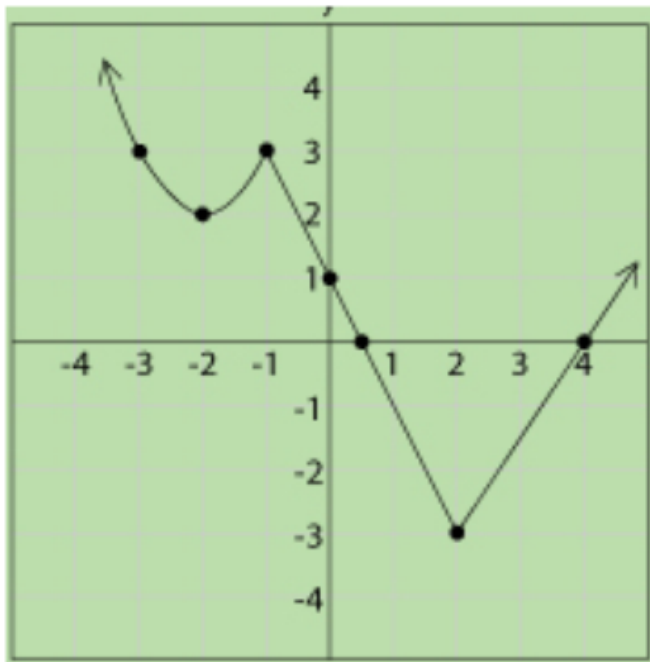
Negative Intervals:

$(-\infty, -3)$ $(0, 2)$



Average rate of change from
-3 to 3:

$\frac{7}{6}$



HW #10

Key Features of Graphs