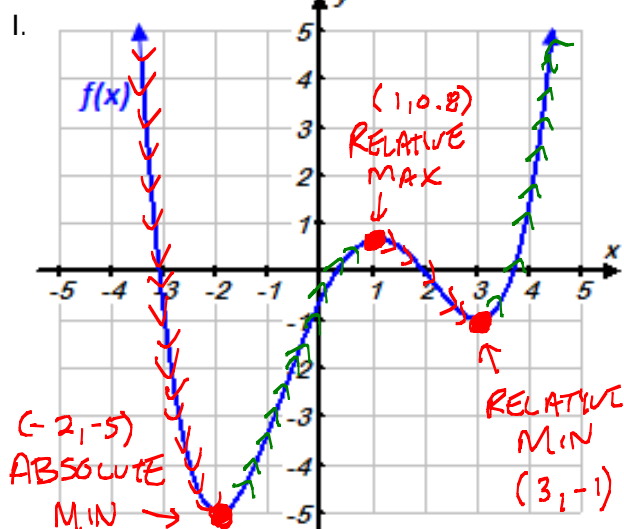


1. Consider the following functions.

- a. Label each of the relative maximums and minimums of each function below and denote which are absolute extrema.
b. Describe the intervals of increase and decrease c. Describe the end behavior.

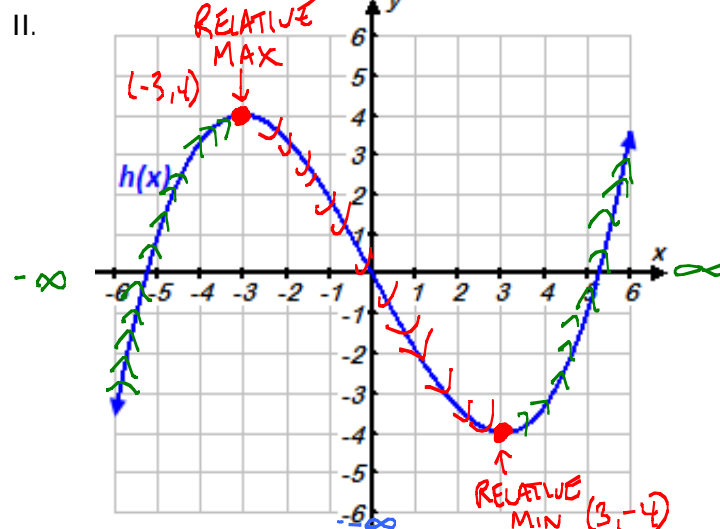


b. Increasing: $(-2, 1) \cup (3, \infty)$

Decreasing: $(-\infty, -2) \cup (1, 3)$

c. As $x \rightarrow -\infty$, $f(x) \rightarrow \infty$
LEFT UP

As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
RIGHT UP

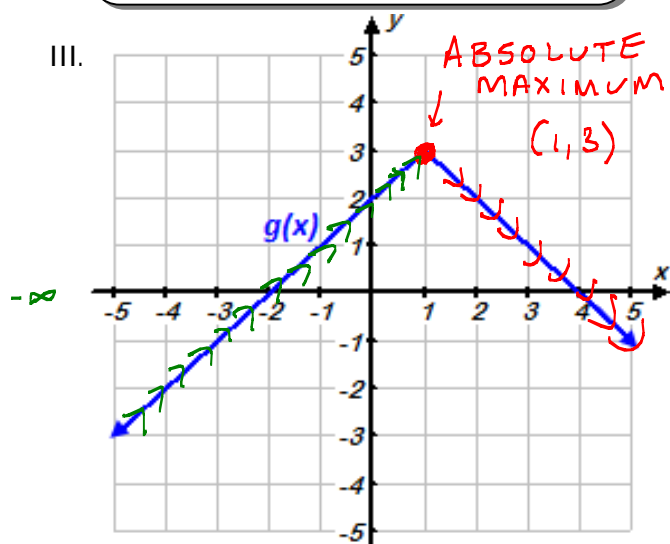


b. Increasing: $(-\infty, -3) \cup (3, \infty)$

Decreasing: $(-3, 3)$

c. As $x \rightarrow -\infty$, $f(x) \rightarrow -\infty$
LEFT DOWN

As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
RIGHT UP

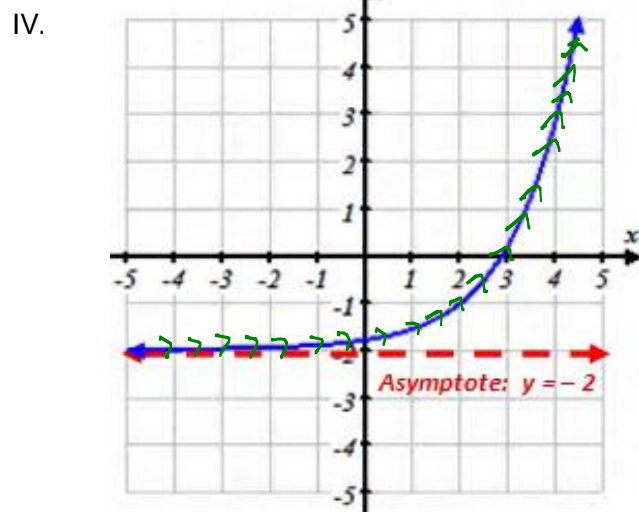


b. Increasing: $(-\infty, 1)$

Decreasing: $(1, \infty)$

c. As $x \rightarrow -\infty$, $f(x) \rightarrow -\infty$
LEFT DOWN

As $x \rightarrow \infty$, $f(x) \rightarrow -\infty$
RIGHT DOWN



b. Increasing: $(-\infty, \infty)$

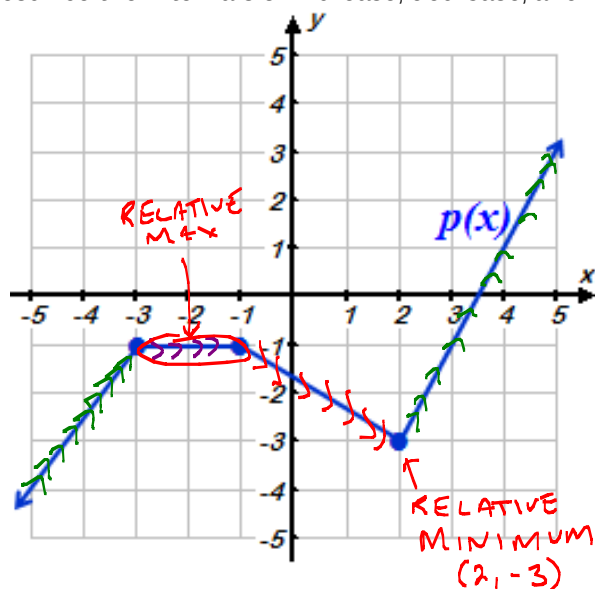
Decreasing: DOES NOT EXIST

c. As $x \rightarrow -\infty$, $f(x) \rightarrow -2$
LEFT

As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
RIGHT UP

2. Consider the following functions.

- Label each of the relative maximums and minimums of each function below and denote which are absolute extrema.
- Describe the intervals of increase, decrease, and when it is constant.
- Describe the end behavior.



b. Increasing: $(-\infty, -3) \cup (2, \infty)$

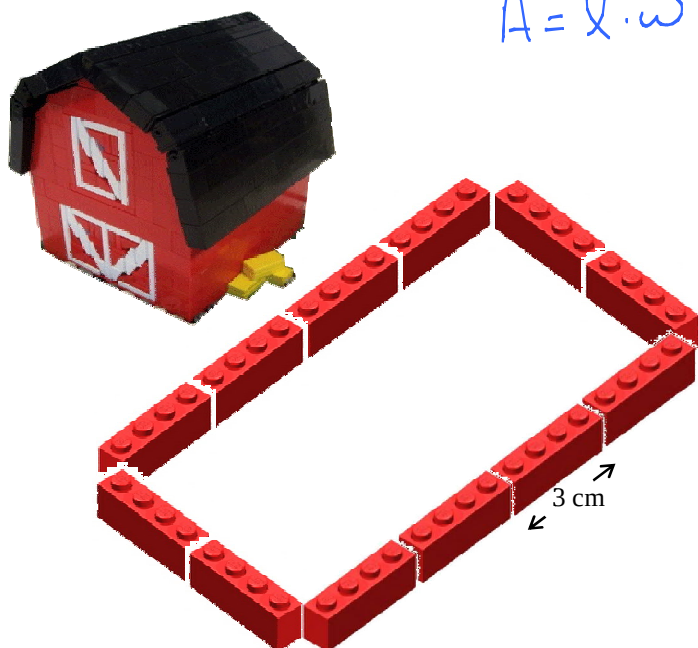
Decreasing: $(-3, -1)$

Constant: $(-3, -1)$

c. As $x \rightarrow -\infty$, $f(x) \rightarrow -\infty$
LEFT DOWN

As $x \rightarrow \infty$, $f(x) \rightarrow \infty$
RIGHT UP

3. A person is building a LEGO fence for his model farm. They have a total of 14 LEGO blocks that are each 3 cm in length. The builder was only using those 14 blocks to create a rectangle as shown below (and didn't need to have them meet at the corners). What are all of the possible configurations to build a rectangular border such that there is at least some area that is enclosed?



Length	Width	Area
3cm	15cm	45cm ²
6cm	12cm	72cm ²
9cm	9cm	81cm ²
12cm	6cm	72cm ²
15cm	3cm	45cm ²

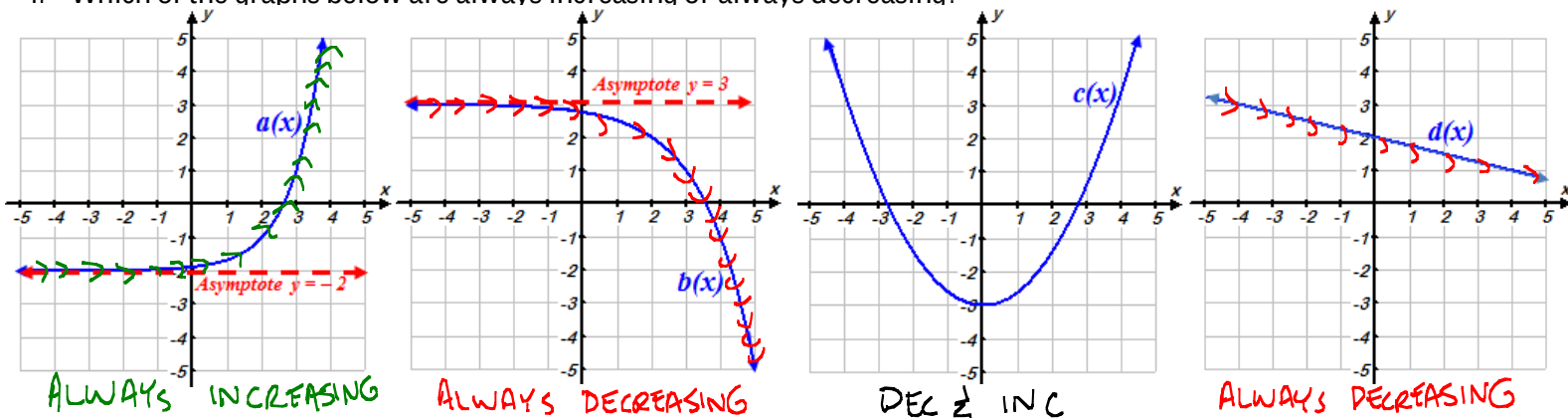
- What is the maximum possible width in centimeters of one of the possible rectangles with at least some enclosed area?
- What is the minimum possible width in centimeters of one of the possible rectangles with at least some enclosed area?
- What is the maximum area that could be enclosed with the 14 LEGO blocks?

15cm which
used 5 blocks

3cm which
used 1 block

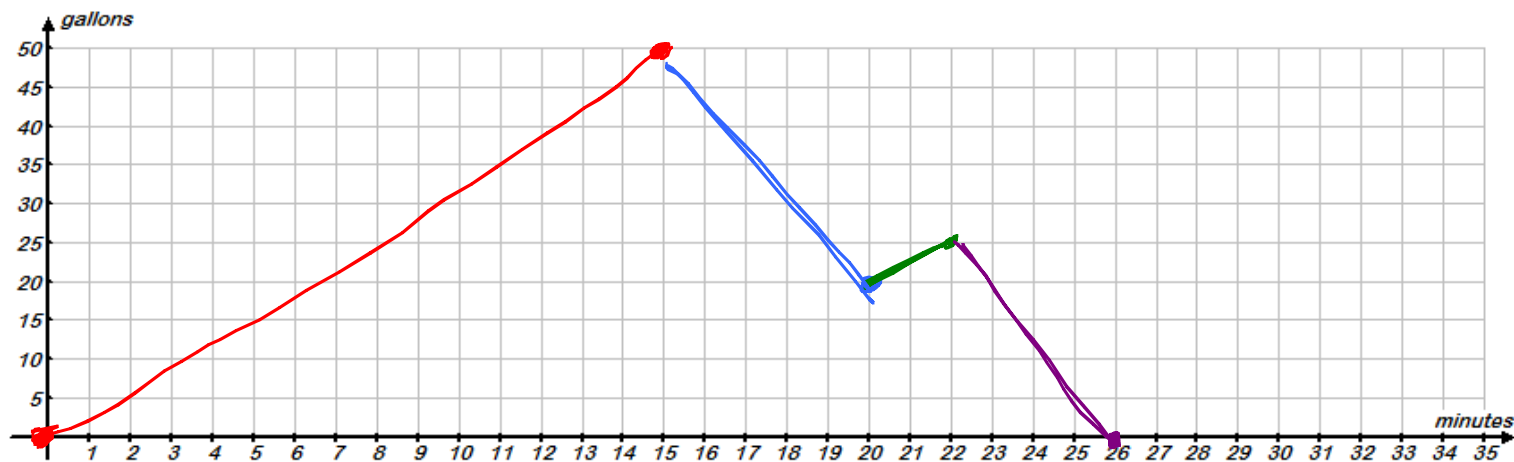
81cm²

4. Which of the graphs below are always increasing or always decreasing?

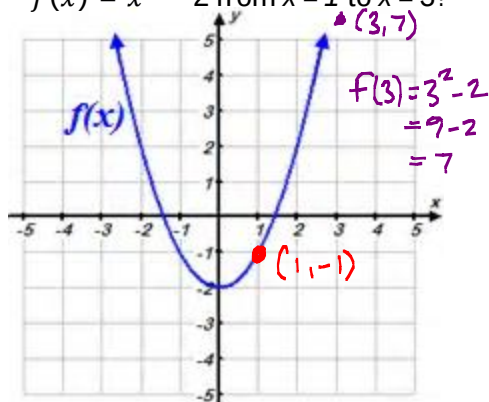


5. At noon, a person begins to fill up a bath tub at a steady rate. The bath tub is completely filled with 50 gallons after 15 minutes. The person filling the tub had to let some water go down the drain because it was too full. After an additional 5 minutes the tub only has 20 gallons in it. The person decided the water got too cold and added 5 more gallons of hot water (for a total of 25 gallons) over the next 2 minutes to warm it up. Then, they decided they didn't have time for a bath and let all the water drain out over the next 4 minutes.

Create an appropriate graph that shows the volume of water in the bath tub in minutes after 12 noon. (you may assume all rates were constant as draining or filling began)



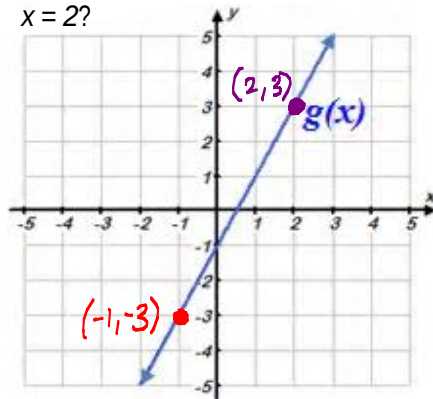
6. What is the average rate of change of the function $f(x) = x^2 - 2$ from $x = 1$ to $x = 3$?



$$M = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - (-1)}{3 - 1} = \frac{8}{2} = 4$$

4

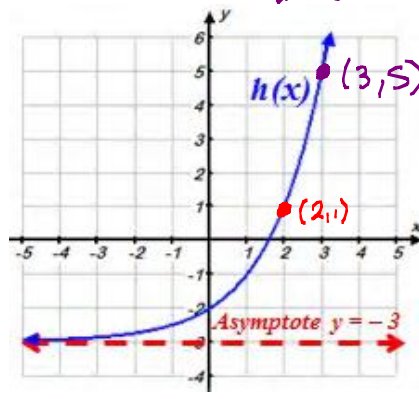
7. What is the average rate of change of the function $g(x) = 2x - 1$ from $x = -1$ to $x = 2$?



$$M = \frac{3 - (-3)}{2 - (-1)} = \frac{6}{3} = 2$$

2

8. What is the average rate of change of the function $h(x) = 2^x - 3$ from $x = 2$ to $x = 3$?



$$M = \frac{5 - 1}{3 - 2} = \frac{4}{1} = 4$$

4

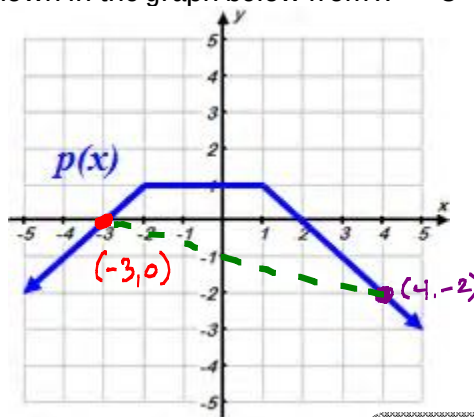
9. What is the average rate of change of the function $t(x) = 2^x - 3$ from $x=1$ to $x=5$?

$$\begin{aligned} (1, -1) & \quad (5, 29) \\ t(1) &= 2^1 - 3 = 2 - 3 = -1 \\ t(5) &= 2^5 - 3 = 32 - 3 = 29 \\ M &= \frac{y_2 - y_1}{x_2 - x_1} = \frac{29 - (-1)}{5 - 1} = \frac{30}{4} = \frac{15}{2} \end{aligned}$$

10. What is the average rate of change of the function

$$p(x) = \begin{cases} x + 3, & x \leq -2 \\ 1, & -2 < x < 1 \\ -x + 2, & x \geq 1 \end{cases}$$

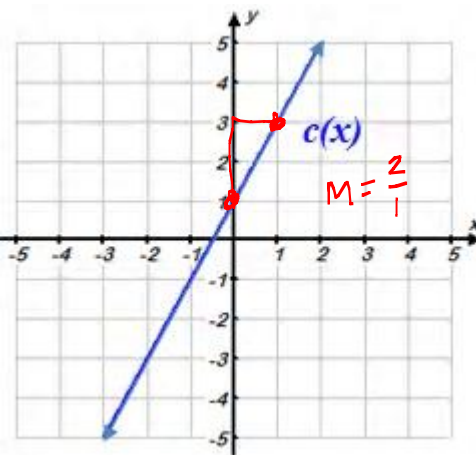
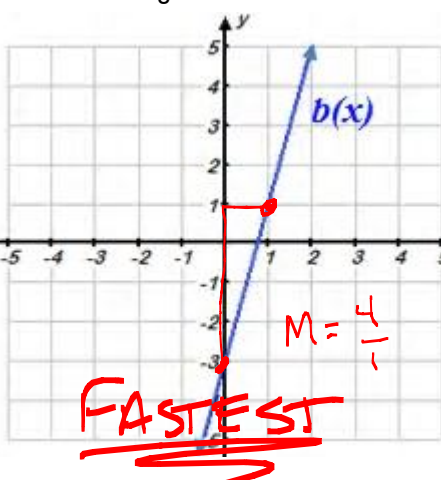
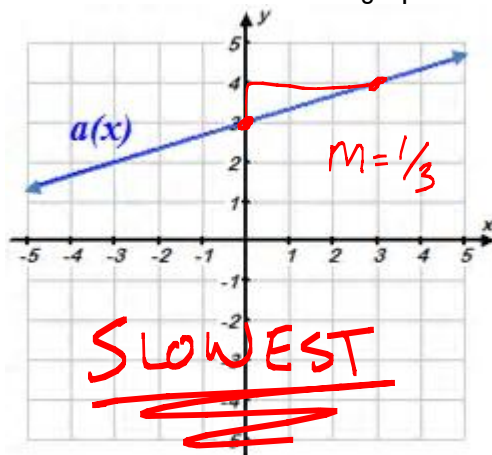
shown in the graph below from $x = -3$ to $x = 4$?



$$M = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 0}{4 - (-3)} = \frac{-2}{7}$$

$$-\frac{2}{7}$$

11. Which linear function in the graph below is increasing at the fastest and which has the slowest rate?



12. Given the partial set of values of the **linear** functions $f(x)$ and $g(x)$, which function, has the greater rate of change?

$$M = \frac{\text{CHANGE IN } Y}{\text{CHANGE IN } X}$$

x	-1	0	1	2	3
$f(x)$	2	4	6	8	10

$M = \frac{2}{1} = 2$

x	-2	0	2	4	6
$g(x)$	-15	-10	-5	0	5

$M = \frac{5}{2} = 2.5$

$g(x)$ HAS A GREATER RATE

14. Consider the linear functions $f(x) = x^2 - 2$ and $g(x) = 2^x - 3$ which function has a greater average rate of change from $x=1$ to $x=3$?

$$\begin{aligned} (1, -1) & \quad (3, 7) \\ f(1) &= 1^2 - 2 = -1 \\ f(3) &= 3^2 - 2 = 7 \\ M &= \frac{7 - (-1)}{3 - 1} = \frac{8}{2} = 4 \end{aligned}$$

$$\begin{aligned} (1, -1) & \quad (3, 5) \\ g(1) &= 2^1 - 3 = -1 \\ g(3) &= 2^3 - 3 = 5 \\ M &= \frac{5 - (-1)}{3 - 1} = \frac{6}{2} = 3 \end{aligned}$$

$f(x)$ HAS THE GREATER AVERAGE RATE OF CHANGE

13. Given the partial set of values of the **exponential** functions $f(x)$ and $g(x)$, which function, has the greater rate of change for all $x \geq 0$?

x	0	1	2	3	4
$p(x)$	-5	-3	3	21	75

$M = \frac{74}{4} = 18.5$

x	0	1	2	3	4
$m(x)$	4	5	7	11	19

$M = \frac{15}{4} = 3.75$

$p(x)$ HAS A GREATER RATE OF CHANGE