

Warm UP

- ▶ Find the average rate of change over the interval $[-2, 3]$
- ▶ $f(x) = -3x - 6$

▶

x	-3	-2	-1	0	1	2	3
y	7	14	28	56	47	36	30

- ▶ Which function had a more significant rate of change?

Nonlinear Functions

Graphing & End Behavior
Exponential Functions

Objective

- ▶ Students will be able to create graphs and determine end behavior of nonlinear functions.
 - Square Root
 - Cube Root
 - Absolute Value
 - Piecewise
 - Exponential

Exponential Growth/Decay

▶ $f(x) = 3^x$

▶ End Behavior:

Exponential Growth/Decay

▶ $f(x) = -4^x$

▶ End Behavior:

Exponential Growth/Decay

▶ $f(x) = 4^x$

▶ End Behavior:

Exponential Growth/Decay

▶ $f(x) = -5^x$

▶ End Behavior:

Exponential Growth/Decay

▶ $f(x) = 5^x - 10$

▶ End Behavior:

Exponential Growth/Decay

▶ $f(x) = -2^x - 3$

▶ End Behavior:

Exponential Growth/Decay

▶ $f(x) = 3^x + 1$

▶ End Behavior:

Exponential Growth/Decay

▶ $f(x) = -2^x + 1$

▶ End Behavior:

Today

- ▶ We learned how to graph and find the end behavior of piecewise, absolute value, and exponential function

Warm Up

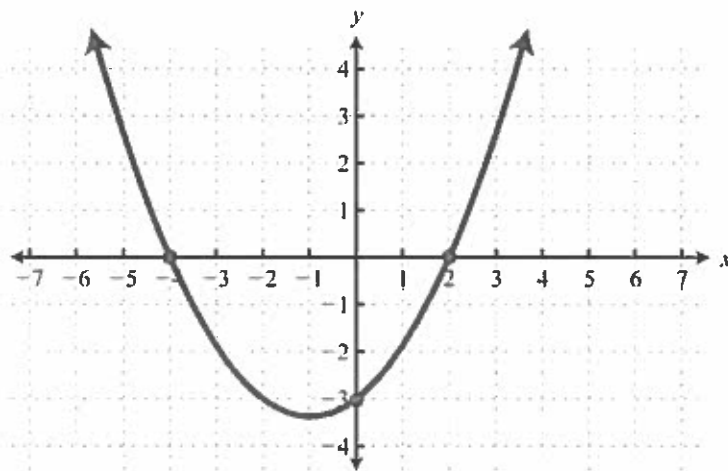
- Find the rate of change between each set of ordered pairs.
- $(1, 7)$ and $(2, 18)$
- $(3, 42)$ and $(-7, 6)$
- $(-8, 7)$ and $(4, 13)$

7.5 Average Rate of Change

Objective

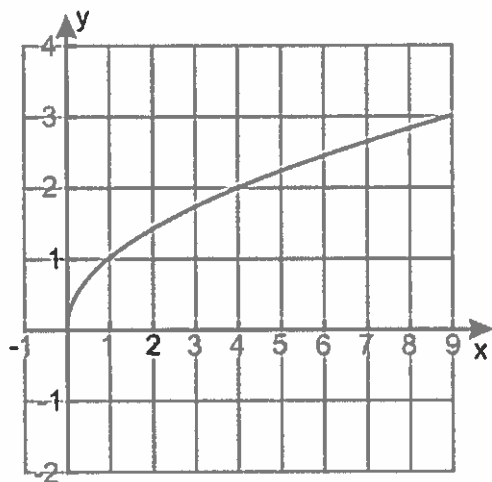
- Students will be able to calculate average rate of change of nonlinear functions over a specified interval.

Find the Average Rate of Change



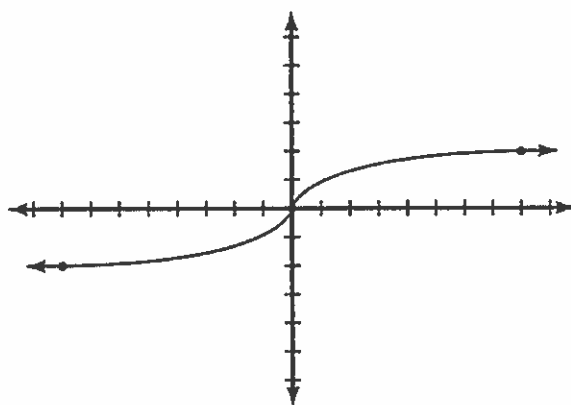
- Over the interval $[-4, 0]$
- From -3 to 2
- Over which of these two intervals did the graph change the most?

Find the Average Rate of Change



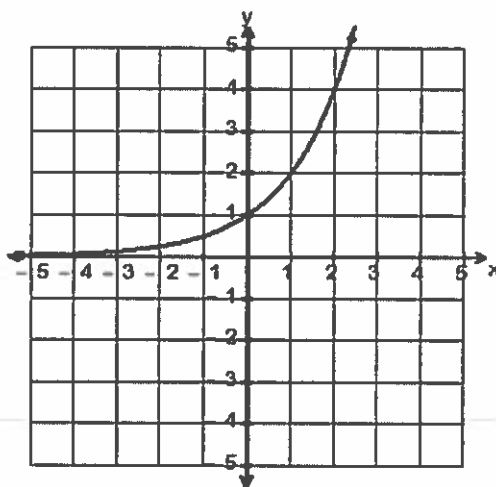
- Over the interval $[0, 9[$
- From 1 to 4
- Over which of these two intervals did the graph change the most?

Find the Average Rate of Change



- Over the interval $[-1, 8[$
- From -8 to 0
- Over which of these two intervals did the graph change the most?

Find the Average Rate of Change



- Over the interval $[0, 1]$
- From 0 to 2
- Over which of these two intervals did the graph change the most?

Find the Average Rate of Change

x	0	1	2	3	4
y	4	8	16	32	64

- From 2 to 4
- Over the interval $[0, 4]$
- Which of these two intervals produced a more significant rate of change?

x	1	3	5	7	9
y	972	324	108	36	12

- Over the interval $[1, 7]$
- From 7 to 9
- Which of these two intervals produced a more significant rate of change?

Find the Average Rate of Change

- $f(x) = 3x + 7$
 - Over the interval $[0, 3]$
 - From -2 to 1
 - Which of these two intervals produced a more significant rate of change?
- $f(x) = 5x^2$
 - Over the interval $[-2, 0]$
 - From 1 to 4
 - Which of these two intervals produced a more significant rate of change?

- Function A $f(x) = 4x - 8$

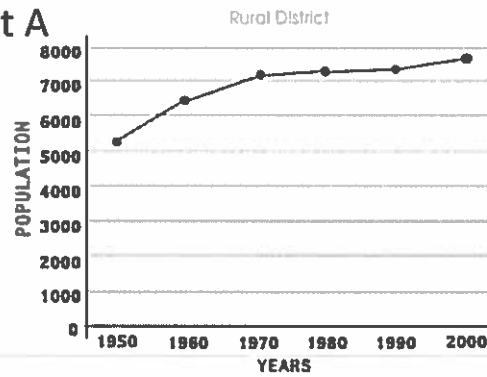
- Function B

x	-6	-4	-2	0	2	4
y	7	14	28	-56	-500	-35

- Which function had a more significant rate of change over the interval $[-6, 4]$?

Two districts start out with the same populations in 1950 but have different growth rates. Compare the districts by finding and interpreting the average rates of change from 1960 to 1980.

- District A



- District B

Year	1955	1960	1965	1970	1975	1980	1985
Population	5,107	5,700	5,784	5,972	6,508	6,805	7,223

Closure

- What did we learn today?

Exit Ticket

Homework



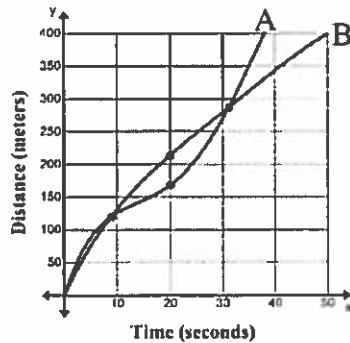
Test Tuesday On:

- How much should a person spend on rent?
- How much can a person borrow?
- Down Payment & Mortgage
- Reading Mortgage Table & Calculating
 - Monthly payment, amount paid over the term, & interest paid

Rate of Change Practice Worksheet

Name: _____ Date: _____

Below is the graph and table for 2 runners running the 400 meter hurdles race.

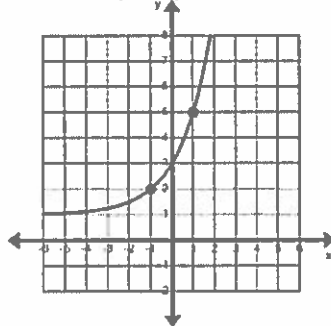


Time	Runner A	Runner B
0	0	0
9	120	120
20	168	213
31	287	287

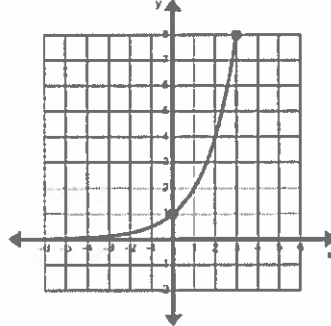
- Which runner has a faster average speed for the first 9 seconds?
- Which runner has a faster average speed from 9 to 20 seconds?
- Which runner has a faster average speed from 20 to 31 seconds?
- Which runner has a faster average speed from 9 to 31 seconds?
- Which runner wins the race? How do you know?

Find the average rate of change for each of the following graphs over the given interval.

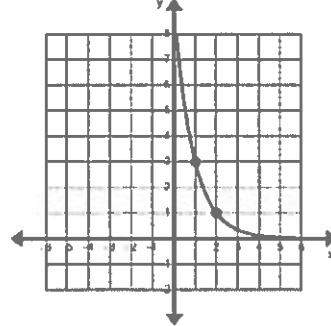
6. $[-1, 1]$



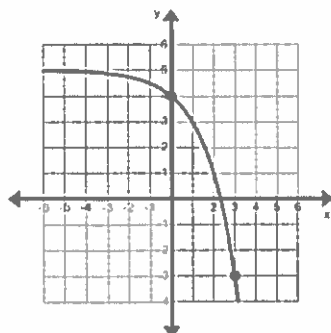
7. $[0, 3]$



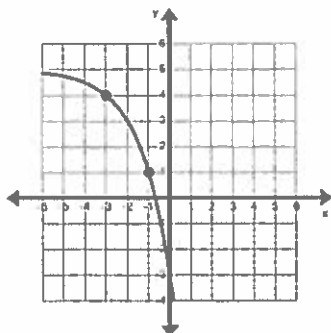
8. $(1, 2)$



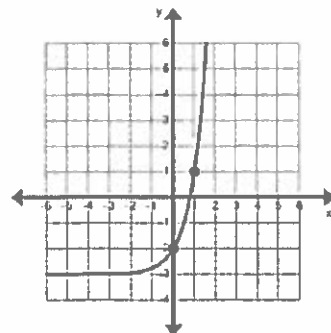
9. $(0, 3)$



10. $(-3, -1)$



11. $(0, 1)$



Suppose 25 flour beetles are left undisturbed in a warehouse bin. The beetle population doubles in size every week. The equation $P(x) = 25 \cdot 2^x$ can be used to determine the number of beetles after x weeks. Complete the table.

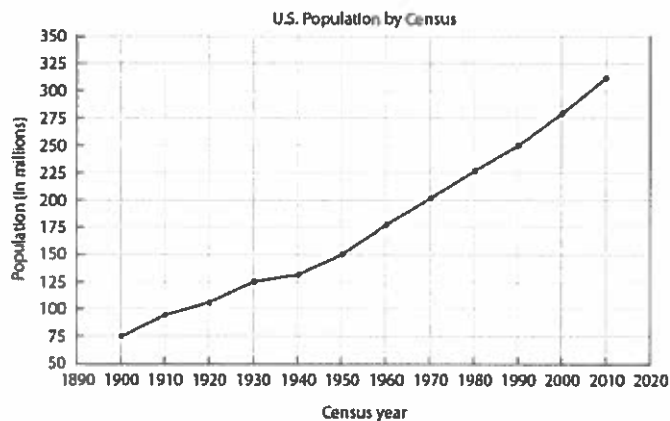
12. Calculate the average growth rate between weeks 1 and 3.

13. Calculate the average growth rate for the first five weeks (0, 5).

14. Which average growth rate is higher? Why do you think it is higher?

Week	Population
0	
1	
2	
3	
4	
5	

The graph below shows the United States population from 1900 to 2010, as recorded by the U.S. Census Bureau.



15. What was the rate of change in the population from 1900 to 2000? Is this greater or less than the rate of change in the population from 2000 to 2010?

16. Which 10-year time periods have the highest and the lowest rates of change? How did you find these?

Find the rate of change of Pete's height from 3 to 5 years.

17.

Time (years)	1	2	3	4	5	6
Height(in.)	27	35	37	42	45	49

For $f(x) = x^2 - 2$, find the rate of change on the interval $(-2, 4)$.

18.

Name _____ Date _____

Algebra I CC Unit 7 Test Review: Non-Linear Functions

1. Write the expression $25^{\frac{5}{3}}$ in radical form.
2. Simplify $\left(x^{\frac{3}{2}}\right)^5 \sqrt[5]{x^2}$. All variables represent nonnegative numbers.
3. Frets are small metal bars positioned across the neck of a guitar so that the guitar can produce notes of a specific scale. To find the distance a fret should be placed from the bridge, multiply the string length by $6^{\frac{-n}{5}}$ where n is the number of notes higher than the string's root note.

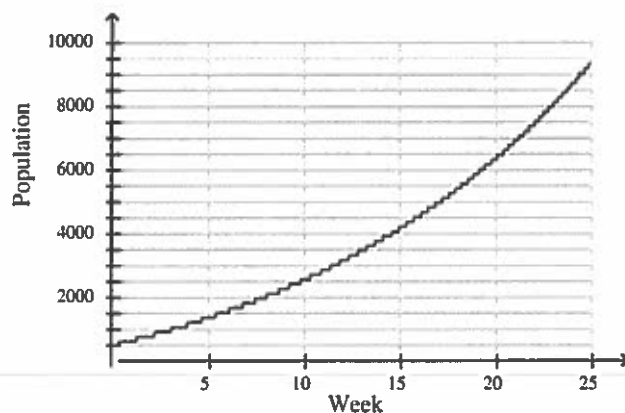
Determine where to place a fret to produce an E note on a C string (3 notes higher) that is 80 cm long. Round your answer to the nearest hundredth.

4. This table shows the number of runners on a track at a given time. Find the rate of change for each time period. During which period did the number of runners increase at the fastest rate?

Time	10:30 am	12:30 pm	1:30 pm	3:30 pm	5:30 pm
Number of runners	12	30	52	59	73

5. Two insect colonies start out with the same populations but have different growth rates. Compare the colonies by finding and interpreting the average rates of change from week 5 to week 10.

Colony A



Colony B

Week	0	5	10	15	20	25
Population	500	1000	1100	1225	1700	2200

6. Which is the average rate of change over the interval $[2, 3]$?

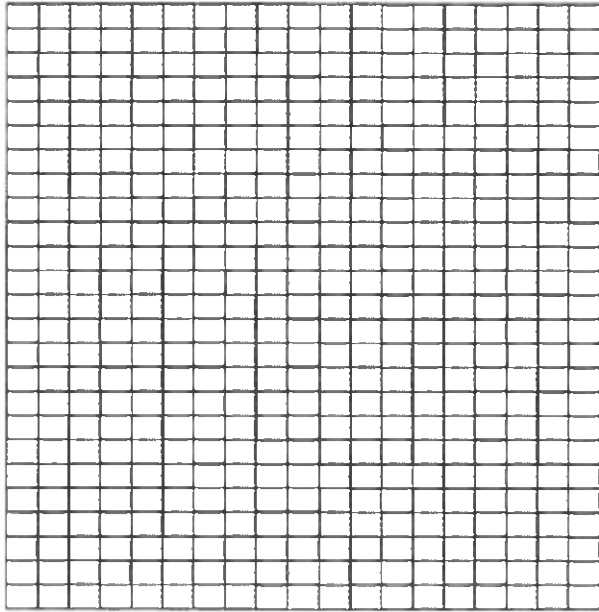
Equation A

x	0	1	2	3	4
y	-2	-5	-8	-11	-14

Equation B

$$f(x) = 3x + 2$$

7. Graph the function: $y = \begin{cases} -2, & \text{if } x < 3 \\ 2, & \text{if } x \geq 3 \end{cases}$.



8. Find the end behavior of the function $P(x) = -7^x$

As $x \rightarrow -\infty$, $P(x) \rightarrow \underline{\hspace{2cm}}$ and as $x \rightarrow +\infty$, $P(x) \rightarrow \underline{\hspace{2cm}}$

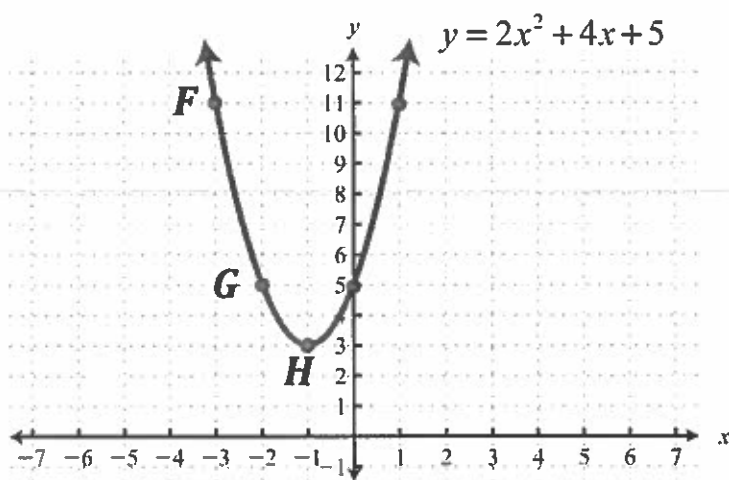
9. Simplify $\left(r^{\frac{7}{8}}\right)^8$. Show your work.

10. Simplify $\frac{x^{\frac{3}{5}}}{x^{\frac{1}{2}}}$ and write the expression in radical form. Show your work.

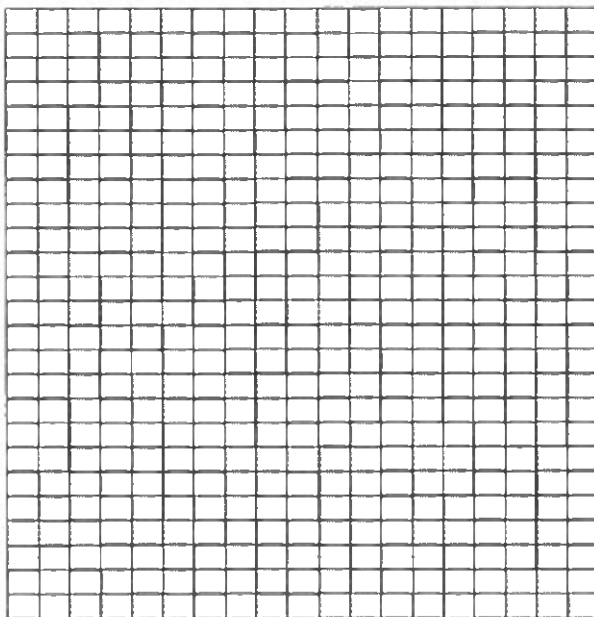
11. Identify the domain and range for the function below.

$$y = \sqrt{x} + 7$$

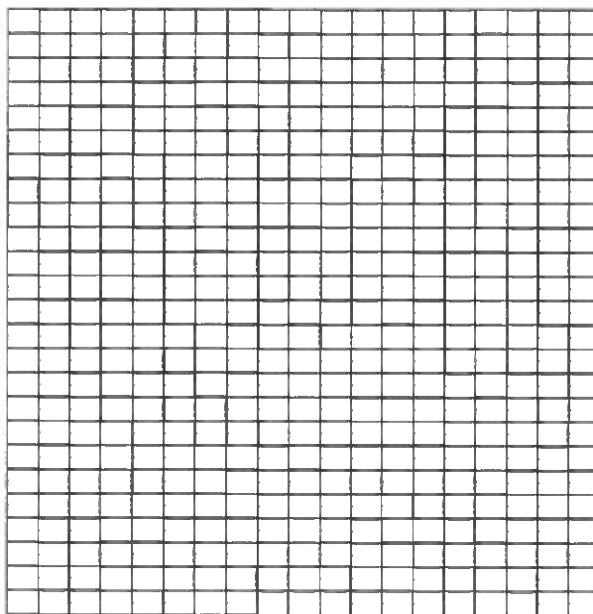
12. Find the average rate of change between points F and G and between G and H . Identify the range and domain for the function.



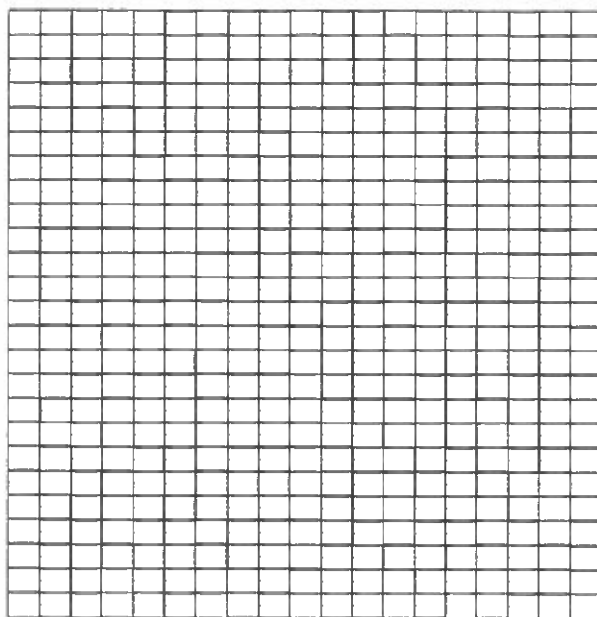
13. Graph the absolute-value function, $f(x) = |x + 6|$. Label the axis of symmetry and the vertex. Find the intercepts, and give the domain and range.



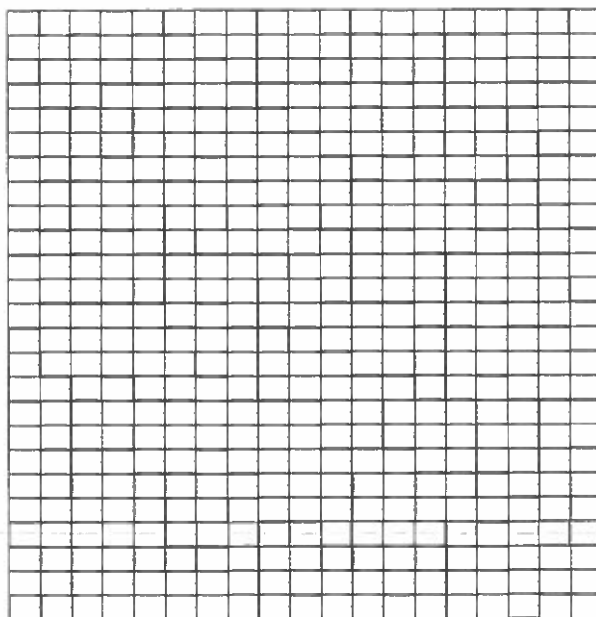
14. Graph the function $f(x) = 5\sqrt{x+2}$.



15. Graph the function $f(x) = \sqrt{x} - 2$.



16. Graph $f(x) = 3^x$.



17. The equation $f(x) = 2|x - 2| + 5$ represents an absolute-value function. The table represents g , a second absolute-value function.

x	$g(x)$
-3	6
-2	5
-1	4
0	3
1	4
2	5
3	6

Find and compare the minimum values of the functions. Explain how you use the equation for $f(x)$ and the table for $g(x)$ to determine your answers.