Algebra 1 Unit 8: Quadratic Functions Notes

Unit 8: Quadratic Functions

Learning Goal 8.3 – Applications of Quadratic Functions

After completion of this unit, you will be able to…

- Calculate average rate of change from a graph, table, or equation.
- Calculate the vertex from a word problem and use it to answer real world questions
- Compare quadratic functions using multiple representations

Timeline for Unit 8

Monday	Tuesday	Wednesday	Thursday	Friday
20 ***No School***	**21** Day 1 – Transformations of Quadratic Functions	**22** Day 2 – Characteristics of Quadratic Functions	**23** Day 3 – Characteristics of Quadratic Functions	**24** Day 4 – **8.1 Learning Assessment**
27 Day 5 – Graphing in Vertex Form Graphing in Standard Form	**28** Day 6 – Graphing in Factored Form Practice	**29** Day 7 – Writing Equations of Parabolas	**30** Day 8 – Comparing Different Forms of Quadratics	**31** Day 9 – **8.2 Learning Assessment**
3 Day 10 – Average Rate of Change	**4** Day 11 – Applications of the Vertex	**5** Day 12 – Comparing Different Quadratic Functions	**6** Day 13 – Comparing Different Quadratic Functions	**7** Day 14 – **8.3 Learning Assessment**

Tutoring Times

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Mrs. Jackson 7:45 – 8:15 Room 1210	Mr. Phillips 7:45 – 8:15 Room 1206	Mrs. Jackson & Mr. Webb 7:45 – 8:15 Room 1210 Room 1205	Mr. Watson & Mr. Phillips 7:45 – 8:15 Room 1208 Room 1206	Mr. Watson 7:45 – 8:15 Room 1208
PM	NONE	Mrs. Petersen 3:30 – 4:30 Room 1210	NONE	NONE	NONE

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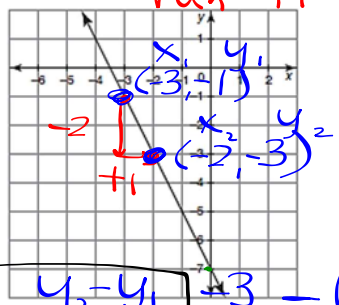
Algebra 1 Unit 8: Quadratic Functions Notes

Day 10: Average Rate of Change

Review: Find the slope (average rate of change) for the following problems:

a. $m = \frac{rise}{run} = \frac{-2}{+1} = -2$



b. $m = \frac{\Delta y}{\Delta x} = \frac{-18}{-2} = 9$

x	y	
3	27	-18
5	45	-18
7	63	-18
9	81	

c. (-9, 5) & (-3, 1)

x_1, y_1, x_2, y_2

$m = \frac{y_2 - y_1}{x_2 - x_1}$

$m = \frac{1 - 5}{-3 - -9}$

$m = \frac{-4}{6} = \frac{-2}{3}$

$(3, -1)$ $(2, -3)$

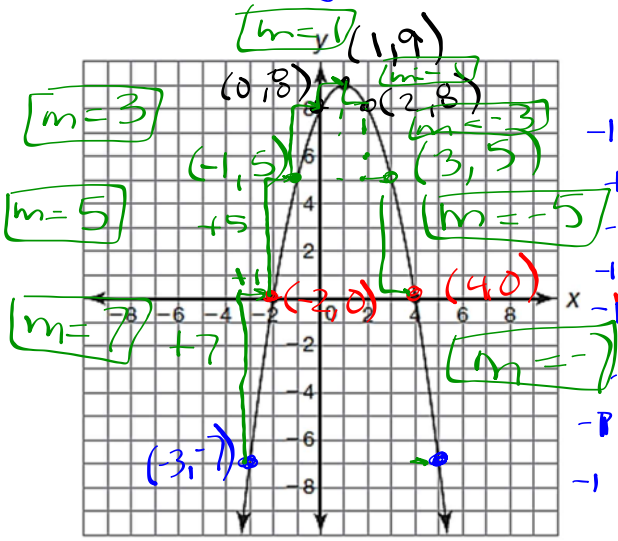
$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - (-1)}{2 - (-3)} = \frac{-3+1}{-2+3} = \frac{-2}{1} = -2$

When you calculate the slope of linear function, its slope is ALWAYS constant (the same)

Investigating the "Slope" of a Quadratic Function

The graph of $y = -x^2 + 2x + 8$ is given. Fill in the table of values on the right. Then determine the slope from one point to the next point.

y-int.



X	Y	
-3	-7	-7
-2	0	-5
-1	5	-3
0	8	-1
1	9	+1
2	8	+3
3	5	+5
4	0	+7
5	-7	

What do you notice about the ~~rate of change~~ as you go from one point to the next?

all different (not the same)

What do you notice if you find the difference of all the slopes?

Algebra 1 Unit 8: Quadratic Functions Notes

First versus Second Differences

Quadratic Functions have **constant second differences.** Second differences can be calculated by finding the rate of change with the first differences. Linear functions have **constant first differences.** Since quadratic functions do not have constant first differences, they do not have a slope that remains constant for the entire graph of a parabola.

Degrees
0 = constant
1 = linear
2 = quad.
3 = cubic

a. $y = 2x$ — linear

x	y = 2x	First Differences	Second Differences
−3	−6		
		+2	
−2	−4		
		+2	
−1	−2		
		+2	
0	0		
		+2	
1	2		
		+2	
2	4		
		+2	
3	6		

b. $y = 2x^2$ — quadratic (not constant)

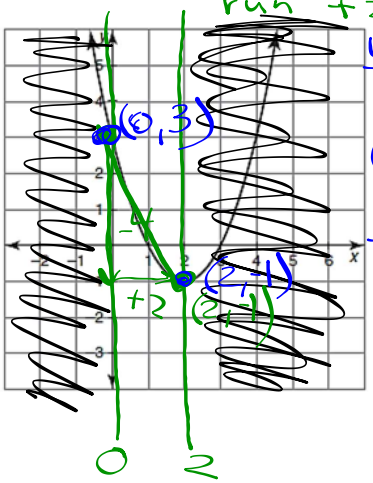
x	y = 2x²	First Differences	Second Differences
−3	18		
		−10	
−2	8		+4
		−6	
−1	2		+4
		−2	
0	0 (VERTEX)		+4
		+2	
1	2		+4
		+6	
2	8		+4
		+10	
3	18		

constant

Therefore, you are never asked to find the slope of a quadratic function, but rather the **average rate of change** on a given interval. The average rate of change of a quadratic function will be different for each interval you are asked to find, just like in your investigation problem.

Practice: For the problems below, find the average rate of change for the given intervals:

Calculate average rate of change on interval **0 ≤ x ≤ 2.**



$\frac{\text{rise}}{\text{run}} = \frac{-4}{+2} = -2$

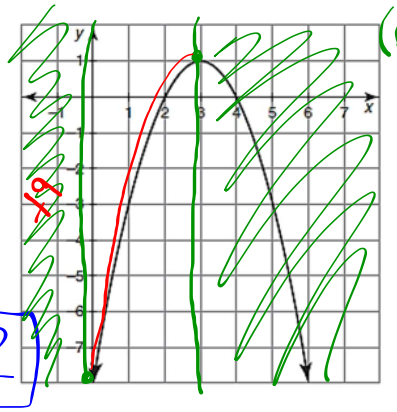
$\frac{y_2 - y_1}{x_2 - x_1}$

$(0, 3)\ (2, -1)$

$\frac{-1 - 3}{2 - 0}$

$\frac{-4}{2} = -2$

Calculate average rate of change on interval **0 ≤ x ≤ 3.**



(0, −8) (3, 1)

$\frac{9}{3}$ ROC 3

Algebra 1 Unit 8: Quadratic Functions Notes

Average Rate of Change without a Graph

If you are asked to calculate the average rate of change on an interval without a graph, you will have to come up with two points to calculate the slope.

You will get your two points by taking the bounds of your interval and substitute those x-values into your equation to find the y-values. Then use the slope formula to calculate the slope.

Remember slope is: $\frac{rise}{run}$ or $\frac{y_2 - y_1}{x_2 - x_1}$

Practice: Calculate the average rate of change of the function $y = (x-4)^2$ on the given intervals:

$1 \le x \le 3$

x	$y=(x-4)^2$
1	$(1-4)^2$ $(-3)^2 = 9$
3	$(3-4)^2$ $(-1)^2 = 1$

$ROC = \frac{8}{-2}$ $ROC = -4$ (+8, −2)

$x = 1$: $y = (1-4)^2 = 9$ → $(1, 9)$ (x_1, y_1)

$x = 3$: $y = (3-4)^2 = 1$ → $(3, 1)$ (x_2, y_2)

$ROC = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1-9}{3-1} = \frac{-8}{2} = -4$

Practice: Calculate the average rate of change of the function $y = x^2 + 4x - 12$ on the given intervals:

$-2 \le x \le 4$

x	y
−2	−16
4	20

$\frac{y_2 - y_1}{x_2 - x_1}$ $\frac{20 - -16}{4 - -2} = \frac{20+16}{4+2} = \frac{36}{6}$ 3 6

$-3 \le x \le -6$

x	y
−3	−15
−6	0

(−3, −15) (−6, 0)

$\frac{0 - -15}{-6 - -3} = \frac{0+15}{-6+3} = \frac{15}{-3} = -5$