

Average Rate of Change: Linear, Quadratic, and Exponential Functions

_____ functions have a common _____ with a _____ rate of change.

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How to solve for Average rate of change: $m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$

Example 1: Find the average rate of change over the interval $[-1, 2]$

a) $y = 2x + 3$

b) $y = x^2 - 1$

c) $y = 2^x + 1$

Which functions has the greatest average rate of change over the interval $[-1, 2]$?

Example 2: Find the average rate of change from $x = 2$ to $x = 5$ for each function.

a) $y = 2x + 3$

b) $y = x^2 - 1$

c) $y = 2^x + 1$

Which function has the greatest average rate of change from 2 to 5?

Conclusion: In general, as $x \rightarrow \infty$, which function eventually grows at the fastest rate?

Example 3: Find the average rate of change over the interval $[-1, 2]$ for each continuous function displayed by the tables below.

a)

x	-1	0	1	2	3
$a(x)$	-3	-2	1	6	13

b)

x	-1	0	1	2	3
$b(x)$	1	3	5	7	9

c)

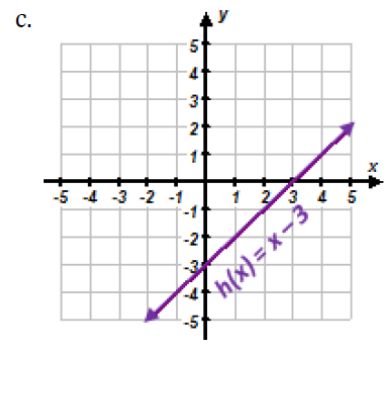
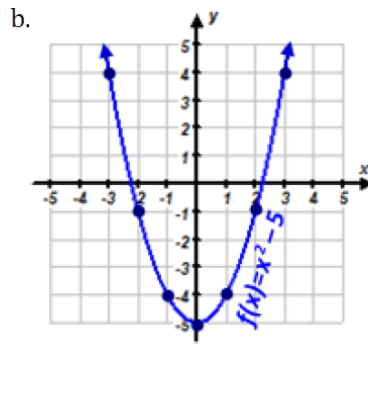
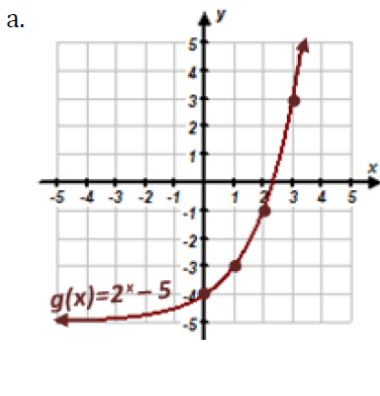
x	-1	0	1	2	3
$c(x)$	-2	-1	1	5	13

Which function has the greatest average rate of change?

Example 4: Based on any interval of x in the table provided, which function will always have the greatest average rate of change?

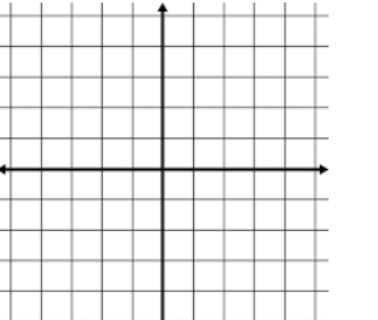
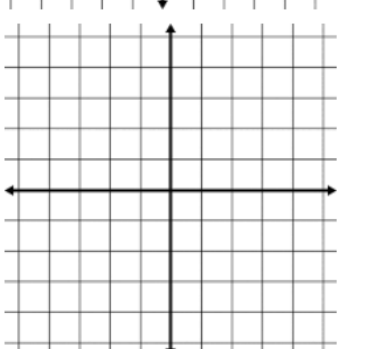
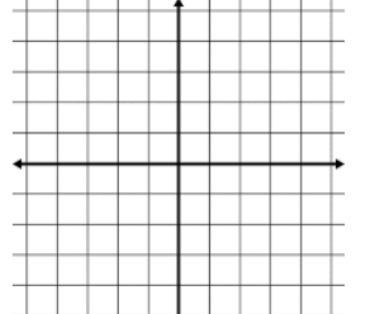
x	$f(x)$	$g(x)$
-1	-2	-4
0	0	0
1	3	8
2	7	24

Example 5: Determine the average rate of change for each graph over the interval $[1, 3]$.



Can you determine which interval for x would produce the same average rate of change for all three functions?

TRANSFORMATIONS ORGANIZER

Function	Transformations	Equation	Graph
<p>Linear Function</p> <p>Parent Function: $y = x$</p> <p>Transformed: $y = mx + b$</p>	<p>y-intercept: _____</p> <p>Slope: _____</p> <p>M = _____</p>	<p>$y = \frac{3}{2}x + 1$</p> <p>y-int: _____</p> <p>Slope: _____</p>	
<p>Quadratic Function</p> <p>Parent Function: $y = x^2$</p> <p>Transformed: $y = a(x - h)^2 + k$</p> <p>$y = x^2 + k$</p>	<p>a: _____</p> <p>h: _____</p> <p>k: _____</p>	<p>$y = -2(x - 1)^2 - 2$</p> <p>a: _____</p> <p>h: _____</p> <p>k: _____</p>	
<p>Exponential Function</p> <p>Parent Function: $y = ab^x$</p> <p>Transformed: $y = ab^{x-h} + k$</p>	<p>a: _____</p> <p>b: _____</p> <p>h: _____</p> <p>k: _____</p>	<p>$y = 2\left(\frac{1}{2}\right)^{x+2} + 1$</p> <p>a: _____</p> <p>b: _____</p> <p>h: _____</p> <p>k: _____</p>	

REFLECTIONS: Multiply leading coefficient by negative (-). Causes graph to flip.

RECALL: Decide whether the following functions are linear, exponential, quadratic, or neither.

1.

x	y
-3	14
-2	10
-1	6
0	2
1	-2
2	-6
3	-10

2.

x	y
-3	21
-2	12
-1	5
0	0
1	-3
2	-4
3	-3

3.

x	y
-3	$1/9$
-2	$1/3$
-1	1
0	3
1	9
2	27
3	81

Let's remind ourselves of the following transformations for each function! Are they similar in any way?

1. $f(x) = 2x + 4$

2. $f(x) = 0.5(3)^{x-1} - 3$

3. $f(x) = -(x+8)^2$

Type of Function: _____

Type of Function: _____

Type of Function: _____

Horizontal Shift: _____

Horizontal Shift: _____

Horizontal Shift: _____

Reflection: none x-axis y-axis

Reflection: none x-axis y-axis

Reflection: none x-axis y-axis

Vertical Shift: _____

Vertical Shift: _____

Vertical Shift: _____

Dilation: none stretch shrink

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Determine if the following functions are linear, exponential, or quadratic, then **describe** all of the transformations that occur.

4. $f(x) = x - 10$ (1 transformation)

5. $f(x) = 2(4)^x$ (1 transformation)

6. $f(x) = \frac{1}{2}x^2$ (1 transformation)

7. $f(x) = -x + 7$ (2 transformations)

8. $f(x) = (x+3)^2 - 2$ (2 transformations)

9. $f(x) = -\frac{1}{3}(2)^x - 4$ (3 transformations)

10. $f(x) = 4(2)^{x-3} + 8$ (3 transformations)

11. $f(x) = -0.9(x-10)^2 + 1$ (4 transformations)

Match the graphs at the bottom of the paper with the given functions.

_____ 1. $a(x) = -2x$

_____ 2. $b(x) = 2^{x-1} - 3$

_____ 3. $c(x) = \frac{1}{2}x + 2$

_____ 4. $d(x) = (x-1)^2 - 3$

_____ 5. $e(x) = -2x^2$

_____ 6. $f(x) = -2^x$

_____ 7. $g(x) = x - 3$

_____ 8. $h(x) = -\left(\frac{1}{2}\right)^x + 2$

_____ 9. $i(x) = 0.5(x+1)^2 + 2$

