Unit 5: Comparing Linear, Quadratic, & Exponential Functions

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

Learning Target #1: Comparing Functions in Multiple Representations

- Compare and contrast characteristics of linear, quadratic, and exponential models
- Recognize that exponential and quadratic functions have variable rates of changes whereas linear functions have constant rates of change
- Observe that graphs and tables of exponential functions eventually exceed linear and quadratic functions
- Find and interpret domain and range of linear, quadratic, and exponential functions
- Interpret parameters of linear, quadratic, and exponential functions
- Calculate and interpret average rate of change over a given interval
- Write a function that describes a linear, quadratic, or exponential relationship
- Solve problems in different representations using linear, quadratic, and exponential models

Timeline for Unit 5

Monday	Tuesday	Wednesday	Thursday	Friday
9	**10**	**11** **Unit 5 Day 1:** Distinguishing between Linear, Quadratic, and Exponential Equations, Tables, and Graphs	**12** **Day 2** Unit 5 Review	**13** **Day 3** Unit 5 Test

Day 1 – Distinguishing Between Linear, Quadratic, & Exponential Functions

You should refer to all your graphic organizers about Linear, Quadratic, and Exponential Functions throughout this entire unit.

Identifying Types of Functions from an Equation

Classify each equation as linear, quadratic, or exponential:

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

b. $y = 5^x$

c. $f(x) = 2$

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

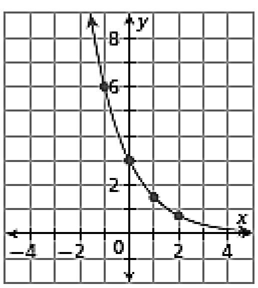
e. $y = 7(.25)^{3x}$

f. $y = 4x^2 + 2x - 1$

Identifying Types of Functions from a Graph

Determine if the following graphs represent an exponential function, linear function, quadratic function, or neither.

a.



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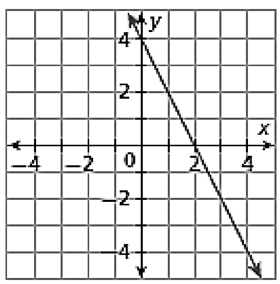

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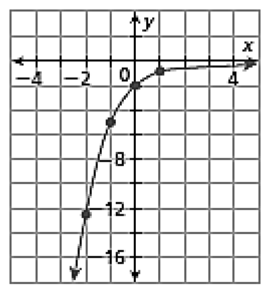

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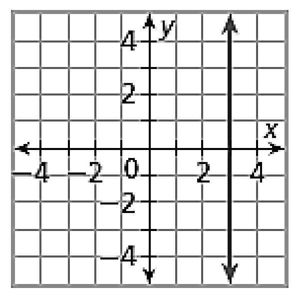

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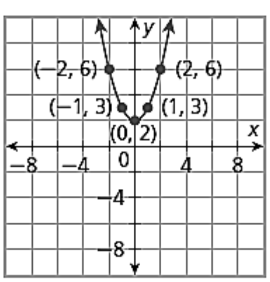

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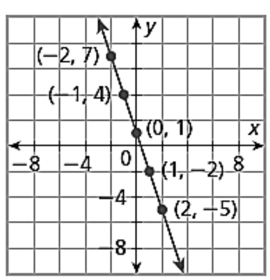
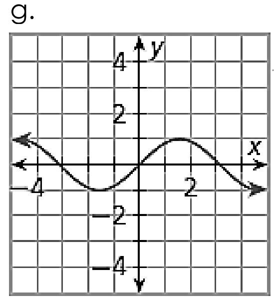


g.



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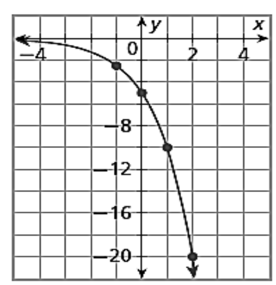


Identifying Types of Functions from a Table

Remember with linear functions, they have **constant** (same) **first differences** (add same number over and over).

Quadratic Functions have **constant second differences**.

Exponential functions have **constant ratios** (multiply by same number over and over).

	x	y	
	2	4	
+3	5	3	−1
+3	8	2	−1
+3	11	1	−1

Linear

x	y	first differences	second differences
0	3		
1	2	−1	
2	3	+1	+2
3	6	+3	+2
4	11	+5	+2

	x	$f(x) = 2(3)^x$	
	1	6	
+1	2	18	×3
+1	3	54	×3
+1	4	162	×3

Function
Quadratic Function

Exponential Function

Determine if the following tables represent linear, quadratic, exponential, or neither and explain why.

a.

x	y
−2	7
−1	4
0	1
1	−2
2	−5

b.

x	y
−1	1.5
0	3
1	6
2	12

c.

x	y
−1	−9
1	9
3	27
5	45

d.

x	y
−2	6
−1	3
0	2
1	3
2	6

e.

Volleyball Tournament	
Round	Teams Left
1	16
2	8
3	4
4	2

f.

x	$f(x) = 2(3)^x$
1	6
2	18
3	54
4	162

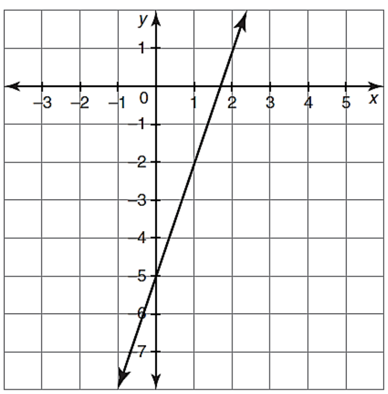
Writing Equations from a Graph or Table

Linear Functions	Quadratic Functions	Exponential Functions
y = mx + b y = (*slope*)x + *y-intercept* slope = # you add/sub each time y-intercept: starting amount or y-value when x = 0	**y = a(x – h)² + k** y = *opens*(x – *x-value*)² + *y-value* *(h, k) is vertex* **y = a(x – p)(x – q)** y = *opens*(x – *zero*)(x – *zero*) *You then have to multiply your equation out to get to standard form.*	**y = abˣ** y = *y-intercept*(*constant ratio*)ˣ y-intercept: starting amount or y-value when x = 0 constant ratio = # you multiply by each time

For each table or graph below, identify if it is linear, quadratic, or exponential. Then write an equation that represents it.

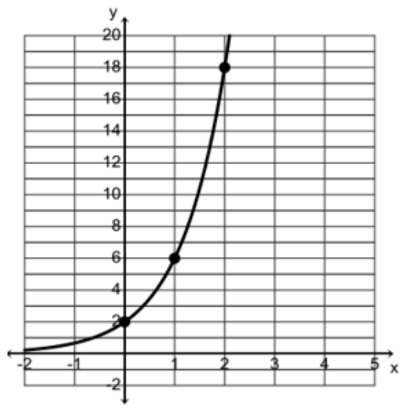
a. Type: ____________________

Equation: ____________________



b. Type: ____________________

Equation: ____________________



c. Type: ____________________

Equation: ____________________

x	–3	–2	–1	0	1	2	3
y	0	5	8	9	8	5	0

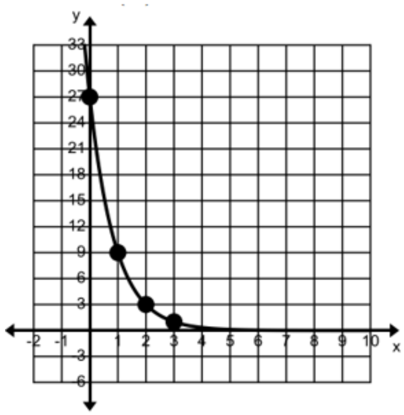
d. Type: ____________________

Equation: ____________________

x	–3	–2	–1	0	1	2	3
y	–16	–13	–10	–7	–4	–1	2

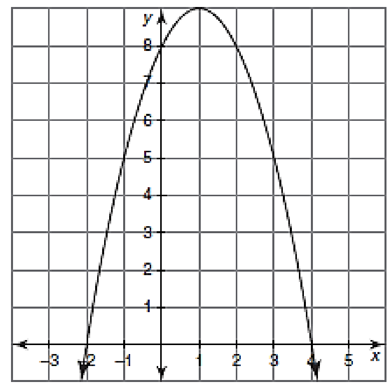
e. Type: ____________________

Equation: __________________



f. Type: ____________________

Equation: __________________



g. Type: ____________________

Equation: __________________

x	–3	–2	–1	0	1	2	3
y	–14	–9	–4	1	6	11	16

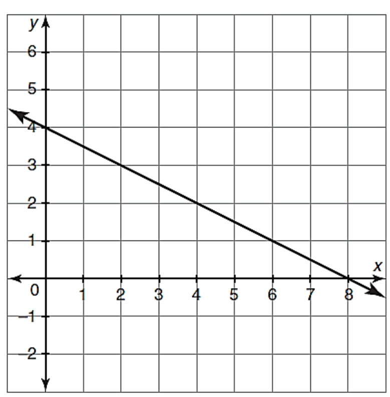
h. Type: ____________________

Equation: __________________

x	–3	–2	–1	0	1	2	3
y	4	8	16	32	64	128	256

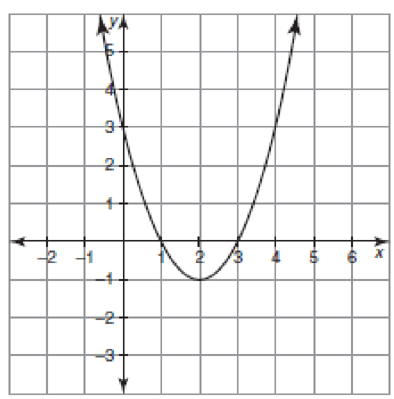
i. Type: ____________________

Equation: __________________



j. Type: ____________________

Equation: __________________



k. Type: ____________________

Equation: __________________

x	–3	–2	–1	0	1	2	3
y	3	0	–1	0	3	8	15

l. Type: ____________________

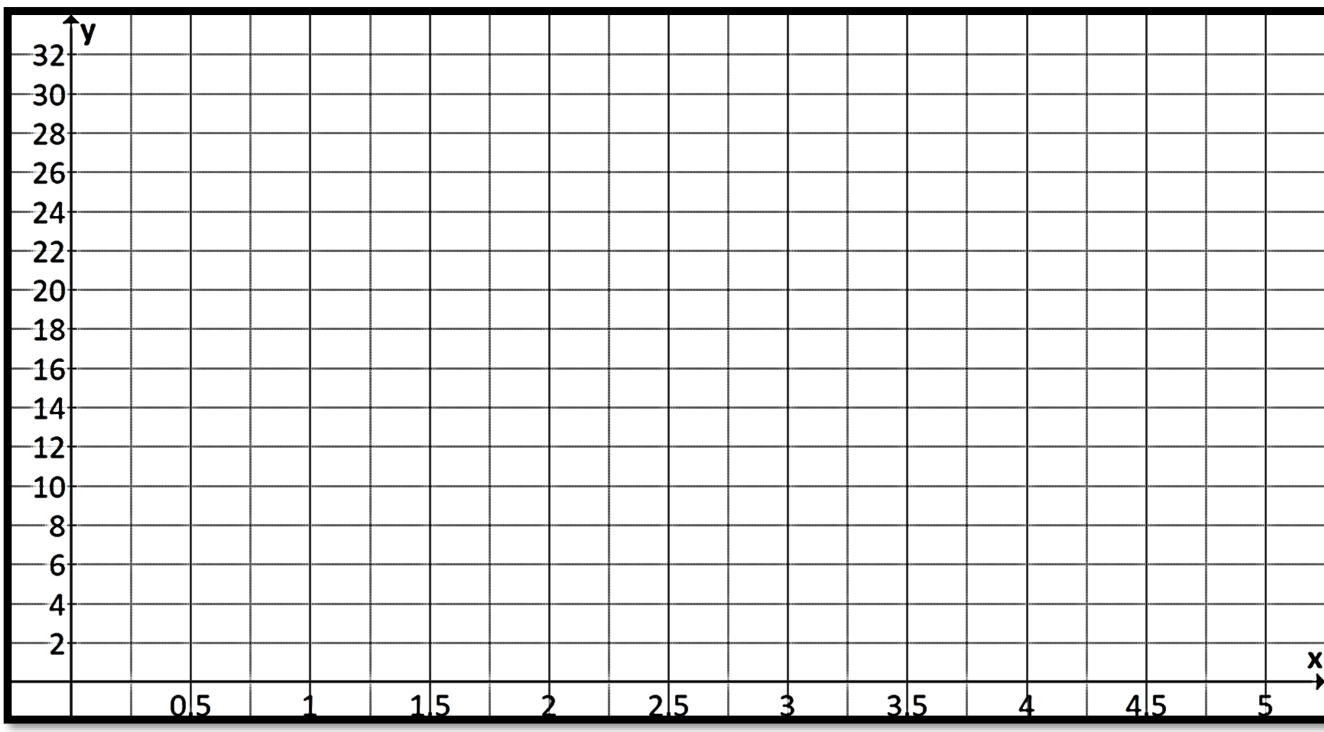
Equation: __________________

x	0	1	2	3	4	5
y	$\frac{1}{16}$	$\frac{1}{4}$	1	4	16	64

Day 2 – Comparing Graphs and Tables of Functions

For the following functions, create a table and graph each function in a different color.

x	$y = 2x$	x	$y = x^2$	x	$y = 2^x$
0		0		0	
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	



Looking at the graphs above:

a) Which function shows a constant rate of change in its y values? How is this displayed on your graph?

b) Which function is largest between $1 < x < 2$? How is this displayed on your graph?

c) Eventually, which type of function shows the most rapid rate of growth in its y values? How is this displayed on your graph?

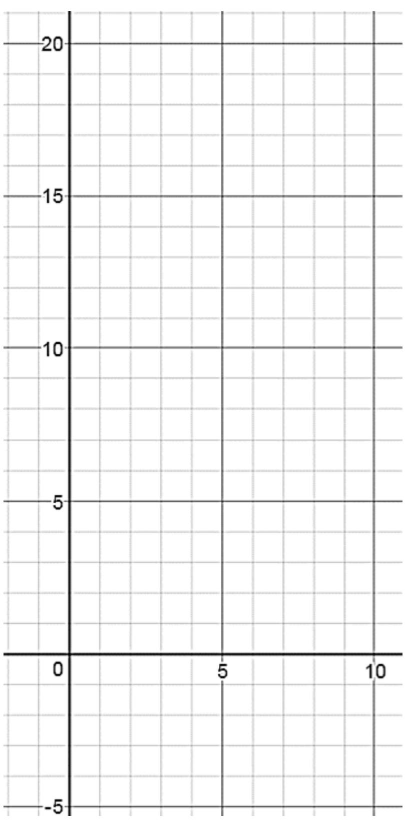
Scenario 2: Consider the following equations: $f(x) = 5x^2 + 4$ and $g(x) = 2^x$.

x	F(x)	G(x)
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

a. As x increases, will the value of f(x) always be greater than the value of g(x)?

b. Will an exponential function eventually always succeed a quadratic function?

Scenario 3: Consider the equations $f(x) = 2x + 3$ and $g(x) = 0.5x^2 – 3$ and $h(x) = 1.5^x$.



x	F(x)	G(x)	H(x)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

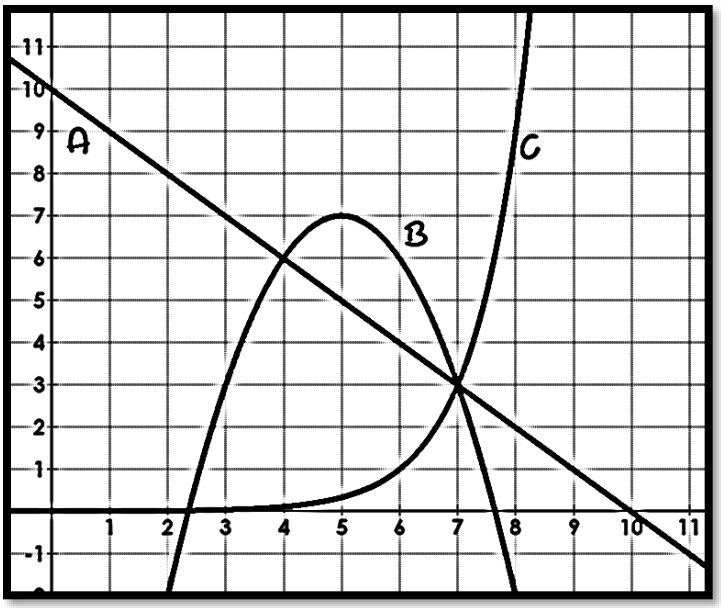
a. Will the growth rate of g(x) ever exceed the growth rate of f(x)?

b. Will the growth rate of h(x) ever exceed the growth rate of f(x)?

c. Will the growth rate h(x) ever exceed the growth rate of g(x)?

Important Takeaway
The graphs and tables of a function increasing
__________________ will ALWAYS eventually exceed a function
increasing _____________________ or _____________________

Scenario 4: Use the graph below to answer the following questions:



a. Which function has the largest x-intercept?

b. Which function has the largest y-intercept?

c. List the functions in order from smallest to biggest when x = 2:

d. List the functions in order from smallest to biggest when x = 5:

e. List the functions in order from smallest to biggest when x = 7:

f. List the functions in order from smallest to biggest when x = 9:

g. List the functions in order from smallest to biggest when x = 15:

h. Which functions have a positive rate of change throughout the entire graph?

i. Which functions have a negative rate of change throughout the entire graph?

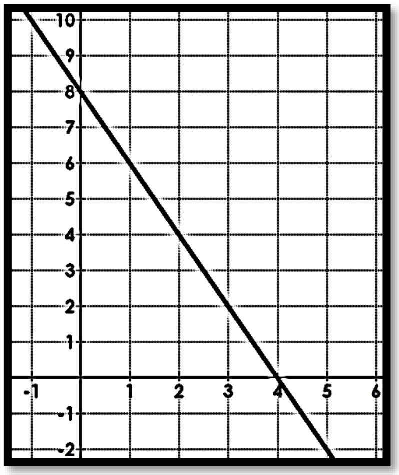
j. Which graph has a rate of change that is negative and positive?

k. Which function has the largest ROC from [3, 5]?

l. Which function has the largest ROC from [7, 8]?

Scenario 5: Consider the following:

f(x)



g(x)

x	$g(x)$
–2	–10
–1	–8
0	–6
1	–4

a. Write an equation for each representation.

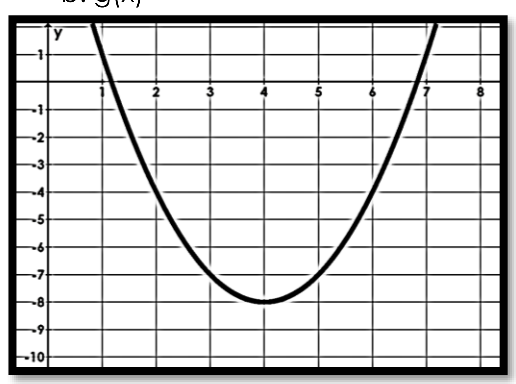
b. Compare the y-intercepts and rates of changes for both functions:

Scenario 6: Consider the following representations:

a. f(x)

X	-4	-3	-2	-1	0	1
y	0	-5	-8	-9	-8	-5

b. g(x)



a. Which quadratic function has the smaller minimum value? Explain why.

b. Which quadratic function has the bigger y-intercept? Explain why.

c. Name the x-intercepts for each function (estimate if necessary):

f(x):

g(x):