Name _____ Date _____

8.6 Comparing Linear, Exponential, and Quadratic Functions

For use with Exploration 8.6

Essential Question How can you compare the growth rates of linear, exponential, and quadratic functions?

1 EXPLORATION: Comparing Speeds

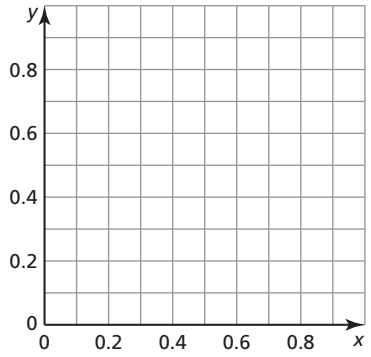
Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Three cars start traveling at the same time. The distance traveled in t minutes is y miles. Complete each table and sketch all three graphs in the same coordinate plane. Compare the speeds of the three cars. Which car has a constant speed? Which car is accelerating the most? Explain your reasoning.

t	$y = t$
0	
0.2	
0.4	
0.6	
0.8	
1.0	

t	$y = 2^t - 1$
0	
0.2	
0.4	
0.6	
0.8	
1.0	

t	$y = t^2$
0	
0.2	
0.4	
0.6	
0.8	
1.0	



2 EXPLORATION: Comparing Speeds

Work with a partner. Analyze the speeds of the three cars over the given time periods. The distance traveled in t minutes is y miles. Which car eventually overtakes the others?

t	$y = t$
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	

t	$y = 2^t - 1$
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	

t	$y = t^2$
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	

Communicate Your Answer

3. How can you compare the growth rates of linear, exponential, and quadratic functions?

4. Which function has a growth rate that is eventually much greater than the growth rates of the other two functions? Explain your reasoning.

Name _____ Date _____

8.6 Notetaking with Vocabulary

For use after Lesson 8.6

In your own words, write the meaning of each vocabulary term.

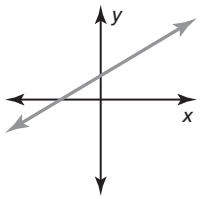
average rate of change

Core Concepts

Linear, Exponential, and Quadratic Functions

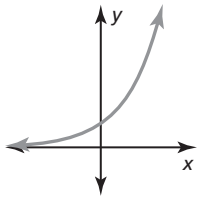
Linear Function

$y = mx + b$



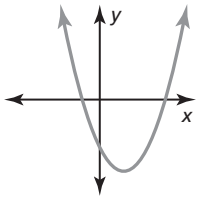
Exponential Function

$y = ab^x$



Quadratic Function

$y = ax^2 + bx + c$



Notes:

Differences and Ratios of Functions

You can use patterns between consecutive data pairs to determine which type of function models the data. The differences of consecutive y-values are called *first differences.* The differences of consecutive first differences are called *second differences*.

- **Linear Function** The first differences are constant.
- **Exponential Function** Consecutive y-values have a common *ratio*.
- **Quadratic Function** The second differences are constant.

In all cases, the differences of consecutive x-values need to be constant.

Notes:

Name_____ Date _____

8.6 Notetaking with Vocabulary (continued)

Comparing Functions Using Average Rates of Change

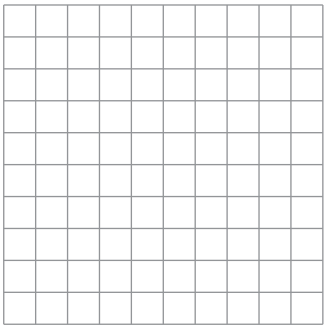
- Over the same interval, the average rate of change of a function increasing quadratically eventually exceeds the average rate of change of a function increasing linearly. So, the value of the quadratic function eventually exceeds the value of the linear function.
- Over the same interval, the average rate of change of a function increasing exponentially eventually exceeds the average rate of change of a function increasing linearly or quadratically. So, the value of the exponential function eventually exceeds the value of the linear or quadratic function.

Notes:

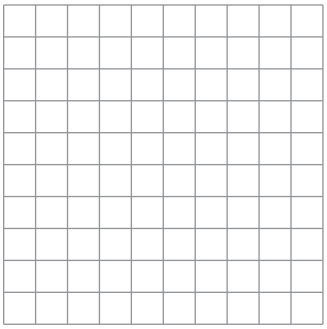
Extra Practice

In Exercises 1–4, plot the points. Tell whether the points appear to represent a *linear*, an *exponential*, or a *quadratic* function.

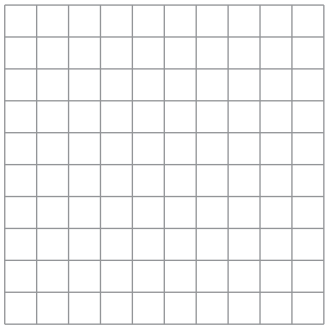
1. $(-3, 2), (-2, 4), (-4, 4), (-1, 8), (-5, 8)$



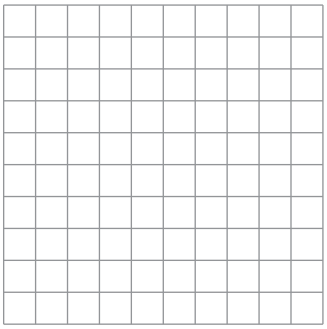
2. $(-3, 1), (-2, 2), (-1, 4), (0, 8), (2, 14)$



3. $(4, 0), (2, 1), (0, 3), (-1, 6), (-2, 10)$



4. $(2, -4), (0, -2), (-2, 0), (-4, 2), (-6, 4)$



Name _____ Date _____

8.6 Notetaking with Vocabulary (continued)

In Exercises 5 and 6, tell whether the table of values represents a *linear*, an *exponential*, or a *quadratic* function.

5.

x	−2	−1	0	1	2
y	7	4	1	−2	−5

6.

x	−2	−1	0	1	2
y	6	2	0	2	6

In Exercises 7 and 8, tell whether the data represent a *linear*, an *exponential*, or a *quadratic* function. Then write the function.

7. $(-2, -4), (-1, -1), (0, 2), (1, 5), (2, 8)$

8. $(-2, -9), (-1, 0), (0, 3), (1, 0), (2, -9)$

9. A ball is dropped from a height of 305 feet. The table shows the height h (in feet) of the ball t seconds after being dropped. Let the time t represent the independent variable. Tell whether the data can be modeled by a *linear*, an *exponential*, or a *quadratic* function. Explain.

Time, *t*	0	1	2	3	4
Height, *h*	305	289	241	161	49