Essential Question: How can we determine if a function is linear, exponential or quadratic?

Do Now:

a) When tables are used to model functions, we typically have just a few sample values of the function and therefore have to do some detective work to figure out what the function might be. What type of function (*linear, exponential or quadratic*) do you think each table models? *Be ready to justify your response.*

x	$f(x)$
0	6
1	12
2	18
3	24
4	30
5	36

x	$g(x)$
0	0
1	14
2	24
3	30
4	32
5	30

x	$h(x)$
0	1
1	3
2	9
3	27
4	81
5	243

b) Three cars start traveling at the same time. The distance traveled in t minutes is y miles. Graph the distances of each car over the first minute on your calculator. Use the indicated window setting.

Window Setting
Xmin = 0
Xmax = 1
Xscl = 0.025
Ymin = 0
Ymax = 1
Yscl = 0.025

Car 1

t	$y = t$

Car 2

t	$y = 2^t - 1$

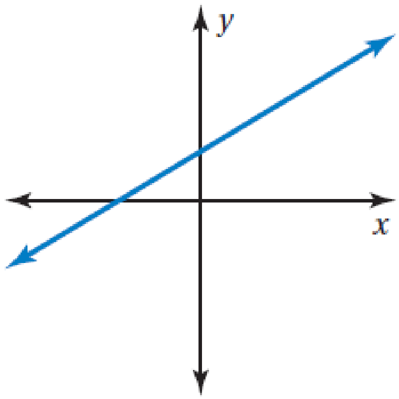
Car 3

t	$y = t^2$

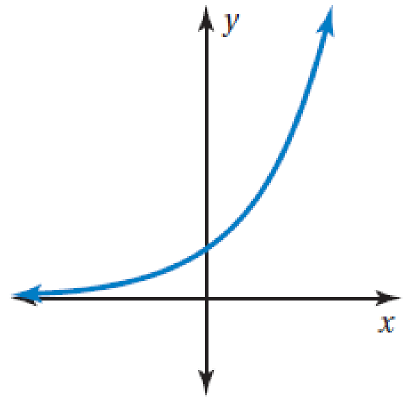
Which car is moving at a constant rate? Explain your reasoning.

Which car accelerated the most during the first minute? Explain your reasoning.

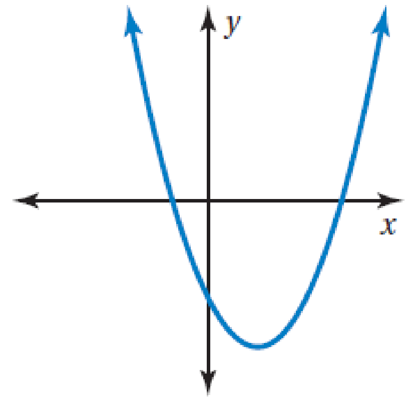
Linear Function | **Exponential Function** | **Quadratic Function**



Line
$y = mx + b$



Curve
$y = ab^x$



Parabola
$y = ax^2 + bx + c$

<u>Identifying Functions Using Differences or Ratios</u>

One method for identifying functions is to look at the ***difference*** or the ***ratio*** of different values of the dependent variable.

If the ***difference*** between values of the dependent variable is the same each time we change the independent variable by the same amount, then the function is **<u>linear</u>**.

+1 +1 +1 +1

x	−2	−1	0	1	2
y	1	3	5	7	9

+2 +2 +2 +2

The *y*-values have a common *difference* of 2.

If the ***ratio*** between values of the dependent variable is the same each time we change the independent variable by the same amount, then the function is **<u>exponential</u>**.

+1 +1 +1 +1

x	−2	−1	0	1	2
y	1	2	4	8	16

×2 ×2 ×2 ×2

The *y*-values have a common *ratio* of 2.

Differences can also be used to identify **<u>quadratic</u>** functions. For a quadratic function, when we increase the x values by the same amount, the difference between y values will *not* be the same. However, <u>the difference of the differences</u> of the y values will be the same.

+1 +1 +1 +1

x	−2	−1	0	1	2
y	−1	−2	−1	2	7

−1 +1 +3 +5 ← First differences

+2 +2 +2 ← Second differences

Tell whether the table of values represents a linear, an exponential, or a quadratic function.

1.

x	−2	−1	0	1	2
y	0	0.5	1	1.5	2

2.

x	−1	0	1	2	3
y	0.2	1	5	25	125

3.

x	−2	−1	0	1	2
y	0.75	1.5	3	6	12

4.

x	2	3	4	5	6
y	2	4.5	8	12.5	18

5. Match the function to the situation.

A. $p(x) = -16x^2 + 30x + 160$ B. $f(x) = 10x$ C. $q(x) = 2^x$

_______The population of bacteria doubled every month, and the total population vs. time was recorded.

_______A ball was launched upward from the top of a building, and the vertical distance of the ball from the ground vs. time was recorded.

_______Melvin saves the same amount of money every month. The total amount saved after each month was recorded.

6. Analyze these data sets. Match the function on the right to the table. Use the function to fill in the missing data.

Table A

x	y
0	6
1	10
2	14
3	
4	22
5	

Table B

x	y
0	6
1	15
2	18
3	15
4	
5	

Table C

x	y
-1	$\frac{1}{6}$
0	1
1	
2	36
3	
4	1296

Table D

x	y
-1	
0	6
1	8
2	6
3	0
4	
5	-24

Equations:

$f(x) = 6^x$

$h(x) = -3(x-2)^2 + 18$

$g(x) = -2(x+1)(x-3)$

$r(x) = 4x + 6$

TAKE AWAY!

How can I tell the difference between linear, exponential and quadratic functions from a table of values?

A **common difference** can be calculated if the function is ______________________________________.

A **common ratio** can be calculated if the function is ____.

A **common second difference** can be calculated if the function is _______________________________.