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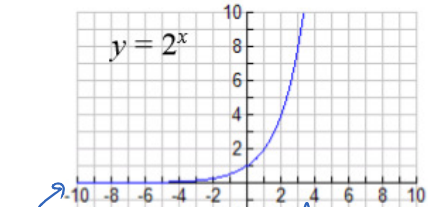
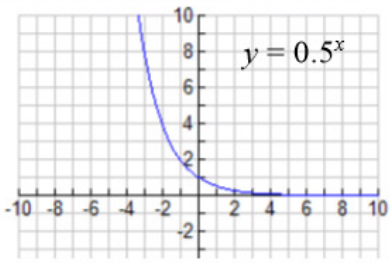
Exponential Relationships

The generalization for an exponential relation is $y = b^x$, where b represents the (1st) common ratio.

Compare the two types of exponential relationships in the chart below.

Exponential Growth	**Exponential Decay**
 approaches zero but never get there	
When b is **greater than 1**, the relation is growing because the graph moves **up to the right**. (The graph increases slowly and then more rapidly.)	When b is **between 0 and 1**, the relation is decaying because the graph moves **down to the right**. (The graph decreases rapidly and then more rapidly.)
The value of b is considered the **growth factor**.	The value of b is considered the **decay factor**.
What will the x-intercept be? To find the x-intercept, let $y =$ 0 and solve: $y = 2^x$, $0 = 2^x$, never true. 2^{-10} = tiny # but not zero	
What will the y-intercept be? To find the y-intercept, let $x =$ 0 and solve: $y = 2^0$, $y = 1$	

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Example 1

Use the table of values to answer the questions below.

x	y	1st ratios
0	1	3÷1=3
1	3	9÷3=3
2	9	3
3	27	3
4	81	3

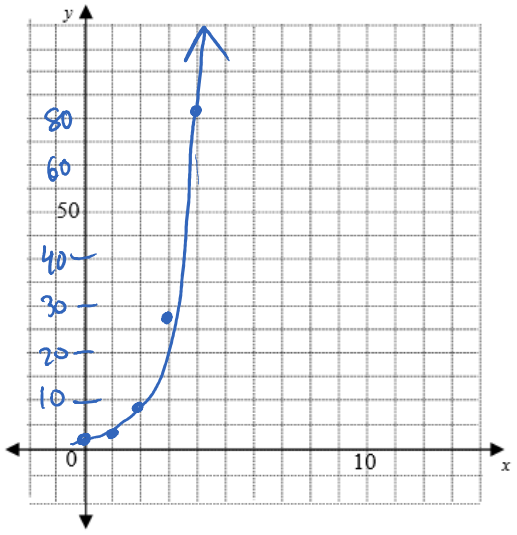
a. Is the relationship is exponential? Give a reason for your answer.

exponential since 1st ratios constant

b. State the equation for the relationship.

$y = 3^x$

c. Graph the relationship.



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Example 2

A small garden centre propagates tulip bulbs. The gardener begins with 100 bulbs. Each bulb produces several new bulbs. Three of these are kept for the next round. Write an equation to represent the number of new bulbs.

Round	Number of New Bulbs	
0	100	100
1	100x3	100x3
2	100x3x3	$100x3^2$
3	100x3x3x3	$100x3^3$
n		$100x3^n$

1. Start with the initial number of bulbs: 100
2. Multiply by the growth factor for each round: 3
3. Do you notice a pattern? Will it help you to create an equation for the situation?

The generalization for exponential growth and decay is $y = ab^x$.

- *a* = initial value
- *b* = the growth/decay factor (common ratio)
- *y* = the value after *x* periods of exponential growth/decay

So equation for this question is: $y = 100(3)^x$

Example 3

Suppose you have $500 in the bank and you deposit it into a savings account that pays 2% interest per year.

a) Find the equation that models this exponential growth

$y = a(b)^x$

$ → $y = 500(1.02)^x$ ← yrs

0.02 ↑ need 1 to grow

b) Find the amount of money you will have after 3 years.

$y = 500(1.02)^3$

$y = \$530.60$