# 9.1 – Exponential Growth

**Name:**_____ **1**

If the variable is not in the _____, then it is _____ an exponential function.

$$y = a(b)^x$$

_____          _____

Condition 1: $a \neq 0$

Condition 2: The base $(b)$ is a positive number other than 1.

Identify if the following functions are exponential. If they are, state the initial value and the growth/decay factor. If they're not, explain why not.

$f(x) = 2^x$          Is it exponential?          $a =$          $b =$
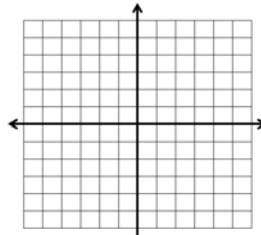
$f(x) = 4x^{-2}$          Is it exponential?          $a =$          $b =$

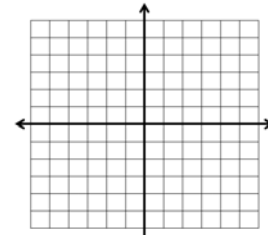$f(x) = -3(2.6)^x$          Is it exponential?          $a =$          $b =$

$f(x) = 10(6)^{-x}$          Is it exponential?          $a =$          $b =$

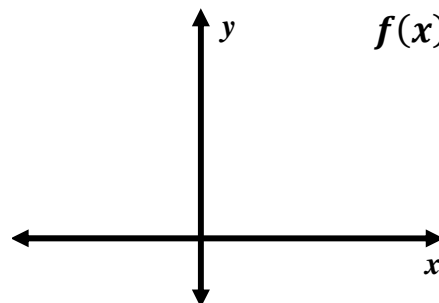$f(x) = 2(5)^e$          Is it exponential?          $a =$          $b =$

Linear vs. Exponential:

$f(x) =$          $f(x) =$

## EXPONENTIAL GROWTH FUNCTIONS:

If _____, then the graph will "grow" away from the asymptote as you move left to right.

$y$          $f(x) = a(b)^x$

$b > 1$

The x-axis $(y = 0)$ is an _____ of the graph. An asymptote is an imaginary line that a graph approaches more and more _____.

$x$

Domain:
Range:

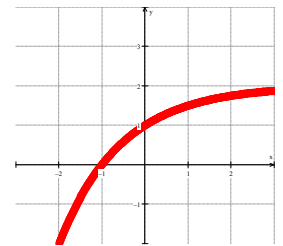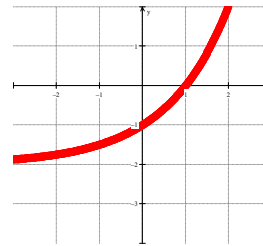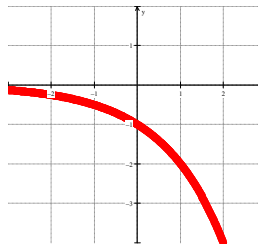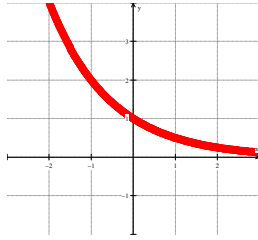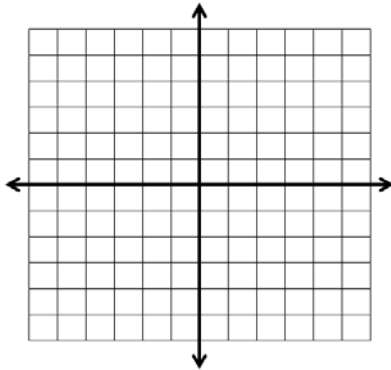Write your questions and thoughts here!

Are the following graphs exponential **_growth_** functions?

1. Graph $y = \frac{1}{2} \cdot 2^x$

| $x$ | $y$ |
|-----|-----|
|     |     |

Domain:

Range:

For exponential functions that are in the form $y = a(b)^x$, the graph will go through:
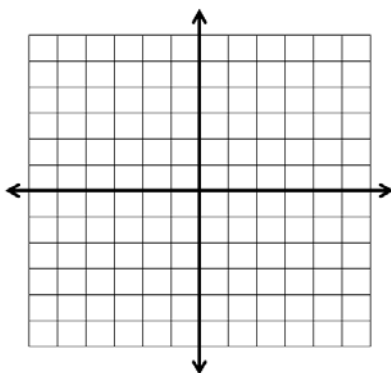
$$(\quad , \quad) \text{ and } (\quad , \quad)$$

and have an asymptote on the $x$-axis (that's the line $y = 0$)

Try these examples on your own:

2. Graph $y = \frac{1}{2} \cdot 3^x$

3. Graph $y = -(2)^x$

Domain:                Range:

Domain:                Range:
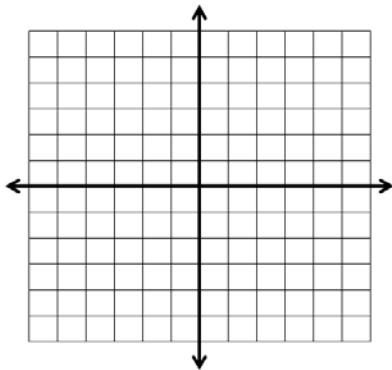
**TRANSLATIONS**

$$y = ab^{x - h} + k$$

To graph the function above, identify points for the graph of $y = a(b)^x$, and then translate the graph horizontally (left/right) by ____ units and vertically (up/down) by ____ units.

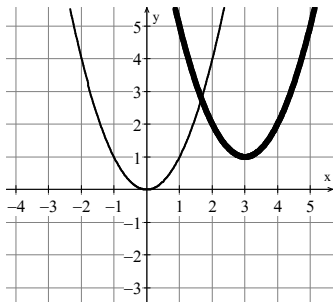4. Graph $y = 2 \cdot 3^{x-1} - 4$

Domain:

Range:

Now summarize what you learned!

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## Algebra Skillz:

1. Below are graphs of $f(x) = x^2$ (thin line) and its translation (bold line). Write an equation of the translation.

Simplify the fraction by rationalizing the denominator.

2. $\dfrac{1}{\sqrt{2}}$

3. $\dfrac{3}{2\sqrt{3}}$

Solve by factoring.

4. $x^3 - 7x^2 + 12x = 0$

5. $6x^2 + 13x - 5 = 0$

# 9.1 Practice – Exponential Growth

Name: _____

No graphing calculator for these problems!

1) $y = -6(3)^x$

2) $y = 3\left(\frac{5}{2}\right)^{-x}$

3) $y = 7x^{-3}$

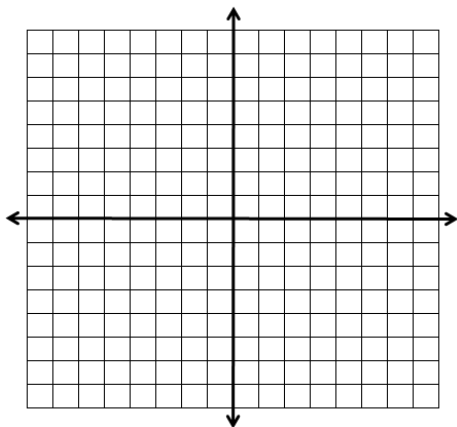4) $y = 3(-4)^x$

5) $y = 92x^{103}$

6) $y = 14(-8)^x$

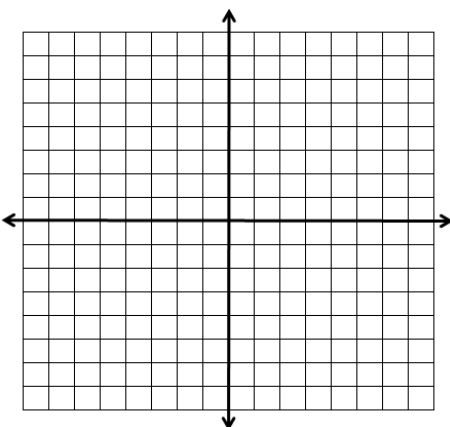7) $y = -5(12)^{2x}$

8) $y = 13(32)^{-2x}$

For 9 -17, sketch the graph of each exponential function by doing the following:  Sketch the asymptote, label at least **two distinct coordinate points** on each graph, and write the domain and range of each function.

9. $y = 2(4)^x$
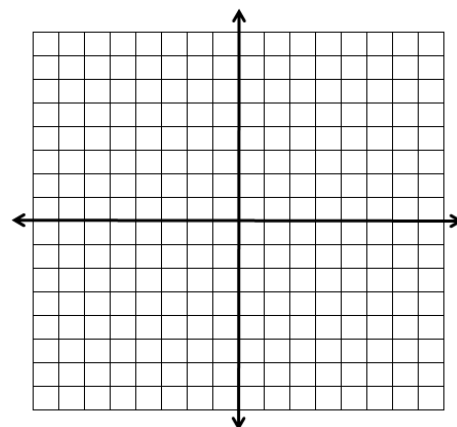
10. $y = -(3)^x$

11. $y = -2(3)^x$
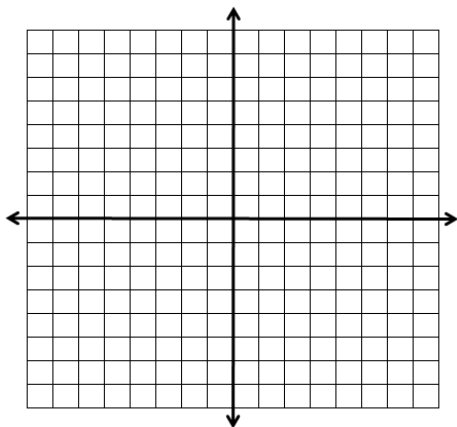
Domain:        Range:

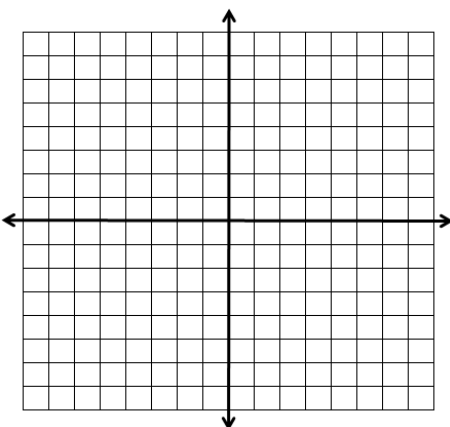Domain:        Range:

Domain:        Range:

12. $y = 4(2)^x - 3$

13. $y = -3(2)^{x-1}$

14. $y = 3(3)^{x+2} - 4$

Domain:        Range:
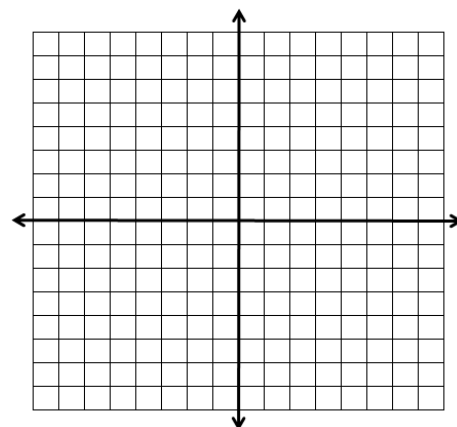
Domain:        Range:

Domain:        Range:

15. $y = (2)^{x+4} + 1$
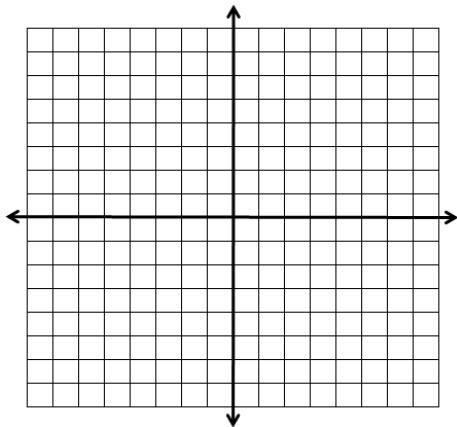
Domain:        Range:

16. $y = -2(2)^{x-2} + 2$
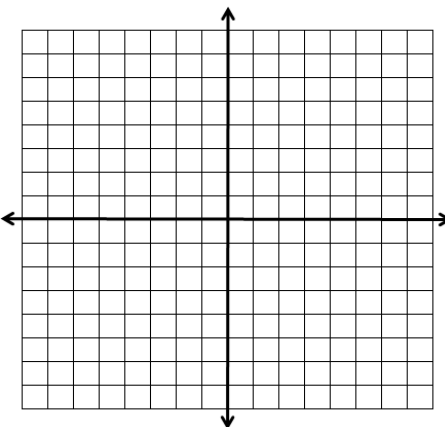
Domain:        Range:

17. $y = 2(3)^{x+1} - 5$
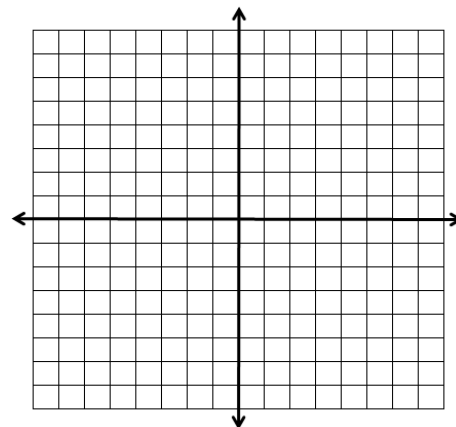
Domain:        Range:

1. Simplify: $(3^{2x+3})(3^{x-6})$

(A) $(3)^{3x-3}$
(B) $(3)^{2x^2-18}$
(C) $(9)^{2x^2-9x-18}$
(D) $(9)^{3x-3}$

2. If $f(x) = 4(3)^{x-1} + 2$, find $f(0)$.

# *9.1 Application and Extension*

| 1. Is the following an exponential function? If no, why not? | 2. Write down three coordinate points for the graph of $f(x) = 3(2)^{x-1} + 2$ |
|---|---|
| $$y = 6(-3)^{2x}$$ | |

Recall from your notes that $y = a(b)^x$ represents an exponential function where the initial value is **a** and the growth factor is **b**.

**Example**: Mr. Kelly had 2 friends at the start of $9^{th}$ grade. This grew by 3% every month (which means a growth factor of **1.03**). The model that represents this function is: $F = 2(1.03)^m$

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3. The student body at K-Town high school is raising money for the "Get Sully a Date" campaign. The *Algebros* contribute $50 to get things started. After that, the students increase the balance by 45% a week (a growth factor of **1.45**).
   a. Write a ***model*** that represents this situation.

   b. Using your model from part a, how much money will the students raise after a semester (18 weeks)?

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4. Mr. Brust has played in a recent Faculty vs. Student basketball game. During the first quarter, he had 6 turnovers. His total number of turnovers increased by 13% each quarter (a growth factor of **1.13**).
   a. Write a ***model*** that represents this situation.

   b. Using the model, calculate how many turnovers he will have halfway through the $4^{th}$ quarter.

   c. How many quarters would he have to play to have 100 turnovers? (Hint: You have not learned how to solve for a variable in the exponent yet. Instead, graph the line $y = 100$ with a graphing calculator and see where it intersects your model.)

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5. After *www.flippedmath.com* was created, the number of hits was tracked. The table shows the number $y$ of hits in each of the first 10 months where $x$ is the month number.

| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|----|
| y | 22 | 39 | 70 | 126 | 227 | 408 | 735 | 1322 | 2380 | 4285 |

   a. Enter the values into two separate lists on a graphing calculator.

   STEP 1: Hit `STAT` and then option 1.
   STEP 2: Enter $x$-values into List 1.
   STEP 3: Enter $y$-values into List 2.

   b. Calculate an exponential model and write the equation below. (Round to 3 decimals.)

   STEP 1: Hit `STAT`, then right for the "CALC" menu.
   STEP 2: Scroll down until you can choose "ExpReg"
   STEP 3: Hit Enter and calculate the "**a**" and "**b**".

   $y =$ _____

   c. According to your model from part b, how many hits do you expect in the $12^{th}$ month?

   d. According to your model in part b, how many hits would there be in the $41^{st}$ month? What is wrong with this number?