Exponential functions are all about **multiplication**. The basic form of an exponential function is given below.

**EXPONENTIAL FUNCTIONS**

A general exponential function has the form: $y = a(b)^x$, where $a$ is the $y$-**intercept** and $b$ is the **base** or **multiplying factor**. Sometimes $b$ is known as the **growth factor**.

Let's work some more with exponential functions to develop a better sense for them.

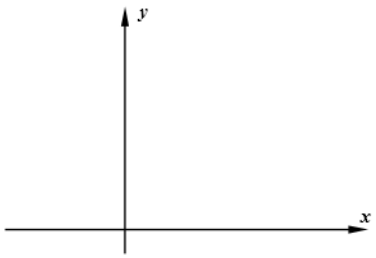
***Exercise* #2:** Consider the function $g(x) = 54\left(\frac{1}{3}\right)^x$.

(a) Evaluate $g(0)$. What point does this indicate on the graph of $g$?

(b) Without the use of your calculator, determine the values of $g(1)$ and $g(2)$.

(c) Using your graphing calculator, sketch a graph of this function using the **WINDOW** $-2 \le x \le 4$ and $-10 \le y \le 100$. Mark the $y$-intercept.

(d) Why is this exponential function always **decreasing** while the one in Exercise #1 is always increasing?




**INCREASING VS. DECREASING EXPONENTIALS**

$y = a(b)^x$ will **increase** if _____

$y = a(b)^x$ will **decrease** if _____

***Exercise* #3:** For each of the following exponential functions, give its $y$-intercept and tell whether it is increasing or decreasing.

(a) $y = 8\left(\frac{2}{3}\right)^x$

Decreasing
y-int: 8

(b) $f(x) = 125(1.5)^x$

Increasing
y-int: 125

(c) $P(t) = 56\left(\frac{3}{2}\right)^t$

Increasing
y-int: 56

***Exercise* #4:** Find the equation of the exponential function, in $y = a(b)^x$ form, for the function given in the table below. Show or explain your thinking.

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $y$ | 10 | 30 | 90 | 270 | 810 |

(0, 10) ×3

When given **coordinates (or a table of values)**, you have two strategies for finding an exponential functions:

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

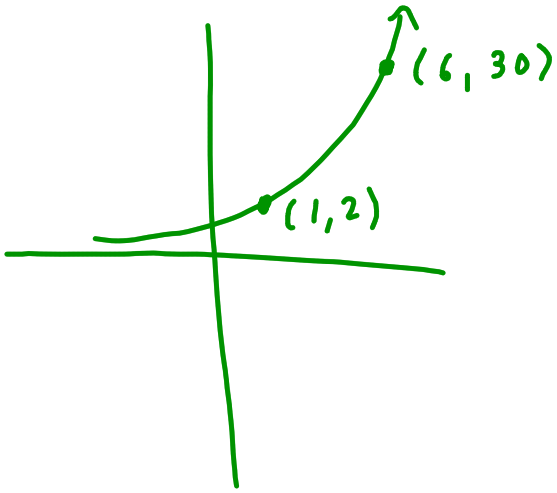
$y = 10(3)^x$


$y = 5(2)^x$

2.

| x | y |
|---|---|
| 0 | 5 |
| 1 | 10 |
| 2 | 20 |
| 3 | 40 |

×2 ×2


(6, 30)
(1, 2)

Name: _____ Date: _____

# Introduction to Exponential Functions
## Homework

1. Consider the exponential function $f(x) = 10(2)^x$.

(a) Find the value of $f(0)$. What point does this represent on the graph of $y = f(x)$?

$10(2)^0$

$10 \cdot 1 = 10$

(b) Is this an increasing or decreasing exponential function? How can you tell based on its equation?

increasing

# growth factor > 1

(c) Is this function's average rate of change over the interval $-1 \le x \le 2$ greater or less than that of the linear function $g(x) = 10x + 7$? Justify.

$\frac{\Delta y}{\Delta x}$

$10(2)^x$

$(-1, 5)$

$(2, 40)$

$\frac{\Delta y}{\Delta x} = \frac{40-5}{2+1}$

$= \frac{35}{3}$

$= 11.6$

$10x + 7$

$(-1, -3)$

$(2, 27)$

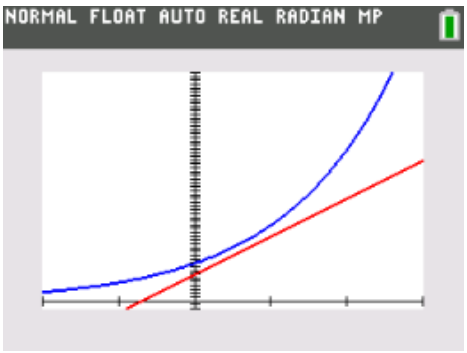
$\frac{\Delta y}{\Delta x} = \frac{-3-27}{-1-2}$

$= \frac{-30}{-3}$

$= 10$

GREATER

(d) Using your calculator, sketch a graph of this function on the axes shown below. Use the window indicated. Mark the $y$-intercept.




2. Which of the following is a decreasing exponential function whose $y$-intercept is 20?

(1) $y = 20\left(\frac{4}{3}\right)^x$

(2) $y = 20\left(\frac{1}{2}\right)^x$

(3) $y = -2x + 20$

(4) $y = \left(\frac{1}{3}\right)^x + 20$

3. Which of the following functions would best describe the data in the table?

(1) $y = 10x + 2$

(2) $y = 8x + 2$

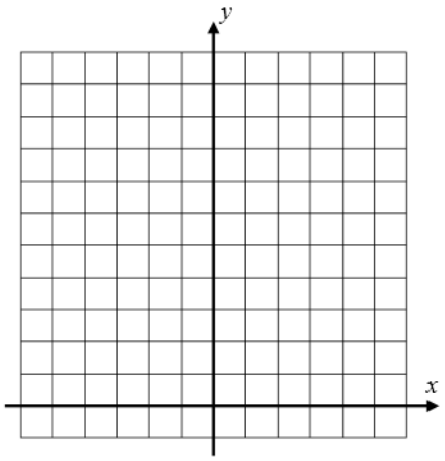
(3) $y = 5(2)^x$

(4) $y = 2(5)^x$

| $x$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $y$ | 2 | 10 | 50 | 250 | 1250 |

4. Graphing a basic exponential can be challenging because of how quickly they grow (or decay). In this exercise, we will graph one of the most basic.

$$f(x) = 2^x$$




(a) Evaluate each of the following and state the coordinate point that occurs on the graph of $f(x)$ based on the calculation.

$f(0) =$ $f(1) =$

$f(2) =$ $f(3) =$

(b) Evaluate each of the following. Remember your facts about negative exponents and give the point on the graph of $f(x)$.

$f(-1) =$ $f(-2) =$ $f(-3) =$

(c) Using the points you found in (a) and (b), graph this function for the domain interval $-3 \le x \le 3$.

5. Classify each of the following exponential functions as either increasing or decreasing and give the value of their $y$-intercepts.

(a) $y = 125(1.25)^x$ (b) $y = 22\left(\frac{3}{4}\right)^x$ (c) $y = 256\left(\frac{5}{2}\right)^x$

6. Which of the following could be the equation of the exponential function shown graphed below? Explain your choice.

(1) $y = 15(1.25)^x$ (3) $y = 50(1.04)^x$

(2) $y = 18(0.75)^x$ (4) $y = 40(0.45)^x$

Explanation: