Name: _____ Date: _____

INTRODUCTION TO EXPONENTIAL FUNCTIONS
COMMON CORE ALGEBRA I

So far we have concentrated on **linear functions** which are characterized by having a **constant rate of change**. In the last lesson, we looked at **exponential growth and decay**. In this lesson we will more formally introduce the concept of an **exponential function**.

***Exercise* #1:** Consider the exponential function $f(x) = 8(2)^x$. Answer the following.

(a) Evaluate each of the following and indicate what point must lie on the graph of $f(x)$ based on each:

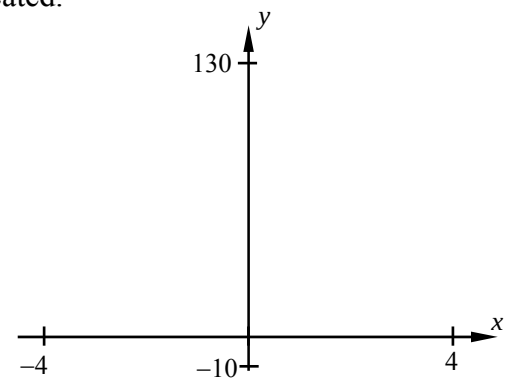
(i) $f(2) =$ (ii) $f(0) =$ (iii) $f(-1) =$

(b) Calculate the average rate of change of f over the interval $-1 \le x \le 0$.

(c) Calculate the average rate of change over the interval $0 \le x \le 2$.

(d) What does comparing answers from (b) and (c) tell you about this function? Explain.

(e) Using your calculator, draw a sketch of this function on the axes below using the window indicated.



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 or decay factor**.

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

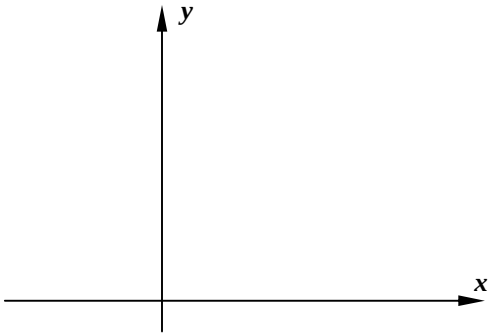
***Exercise* #2:** Consider the function $g(x) = 54\left(\frac{1}{3}\right)^x$.

(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 _____
(grow)

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

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

(a) $y = 8\left(\frac{2}{3}\right)^x$ (b) $f(x) = 125(1.5)^x$ (c) $P(t) = 56\left(\frac{3}{2}\right)^t$

The equations of exponential functions are relatively easy to determine, if you understand this lesson so far. See what you can do in the next exercise.

***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

Name: _____ Date: _____

INTRODUCTION TO EXPONENTIAL FUNCTIONS
COMMON CORE ALGEBRA I HOMEWORK

FLUENCY

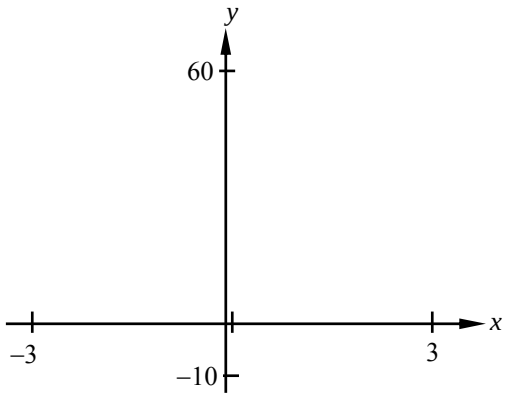
1. Consider the exponential function $f(x) = 10(2)^x$.

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

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

   (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.

   (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) $y = 20\left(\frac{4}{3}\right)^x$ (3) $y = -2x + 20$

   (2) $y = 20\left(\frac{1}{2}\right)^x$ (4) $y = \left(\frac{1}{3}\right)^x + 20$

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

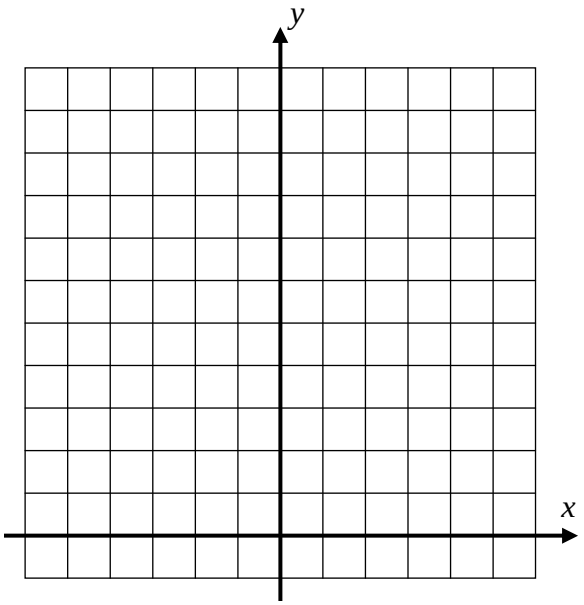
   (1) $y = 10x + 2$ (3) $y = 5(2)^x$

   (2) $y = 8x + 2$ (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 $f(x)$.

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

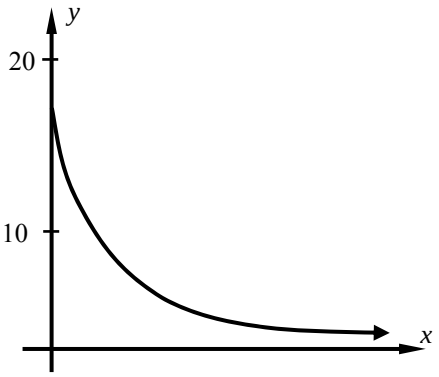
(c) Using the points you found in (a) and (b), graph this function for the domain interval $-3 \le x \le 3$.

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) $y = 256\left(\frac{5}{2}\right)^x$

REASONING

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: