Do Now: INTRODUCTION TO EXPONENTIAL FUNCTIONS
Exercise 1 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**.   ← use calculator!

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) $f(2) =$ 32   (ii) $f(0) =$ 8   (iii) $f(-1) =$ 4
    x y
    (2, 32)   (0, 8)   (-1, 4)

(b) Calculate the average rate of change of f over the interval $-1 \le x \le 0$.   **SLOPE**
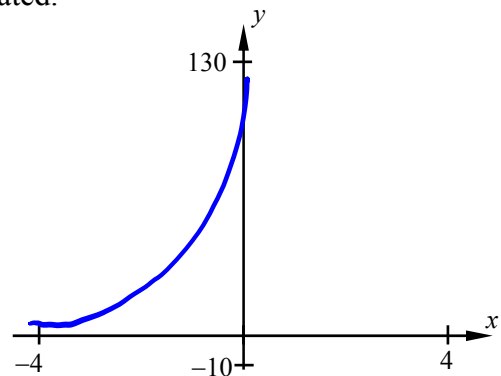
$m = \dfrac{y - y}{x - x}$ $\dfrac{8 - 4}{0 - {}^-1} = \boxed{4}$

x	y
$^-1$	4
0	8

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

x	y
0	8
2	32

$m = \dfrac{y - y}{x - x} = \dfrac{32 - 8}{2 - 0} = \boxed{12}$

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

It is NON-LINEAR because it does not have a constant rate of change.

(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 $g(x) = 54\left(\dfrac{1}{3}\right)^x$. *Put in calc. y=*
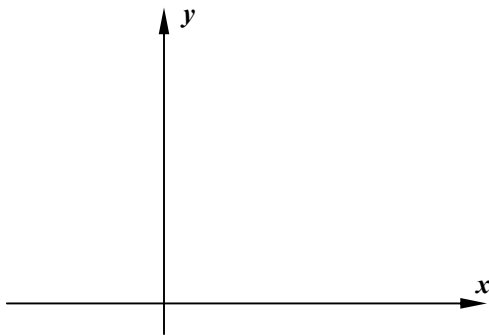
(a) Evaluate $g(0)$. What point does this indicate on the graph of g?

$g(0) = 54$

x	y
0	54

(0, 54)

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

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

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

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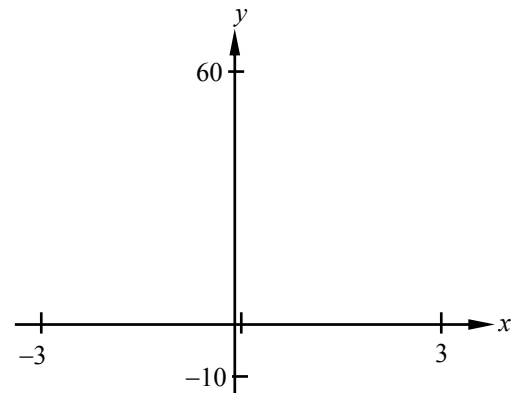
2. Which of the following is a decreasing exponential function whose y-intercept is 20?

(1) $y = 20\left(\dfrac{4}{3}\right)^x$ (3) $y = -2x + 20$ → LINEAR $(y = mx + b)$

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

$$y = \underset{y\text{-int}}{a}(\underset{\substack{\text{Less than}1 \\ \text{(Decreasing)}}}{b})^x$$

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) $y = 2(5)^x$

LINEAR

x	0	1	2	3	4
y	2	10	50	250	1250

y-int = 2   ×5 ×5 ×5 ×5

COMMON CORE ALGEBRA I, UNIT #6 – EXPONENTS, EXPONENTS, EXPONENTS – LESSON #4
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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.
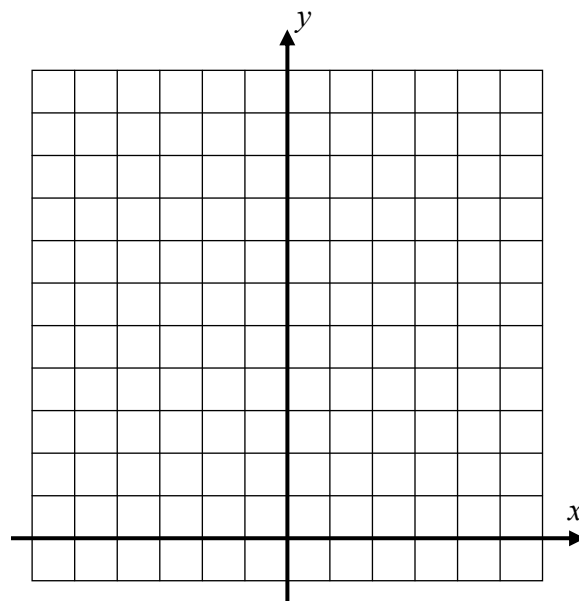
$f(0) =$ $f(1) =$

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

(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) $y = 22\left(\dfrac{3}{4}\right)^x$ (c) $y = 256\left(\dfrac{5}{2}\right)^x$

REASONING

6. Which of the following could be the equation of the exponential function shown graphed below? Explain your choice.
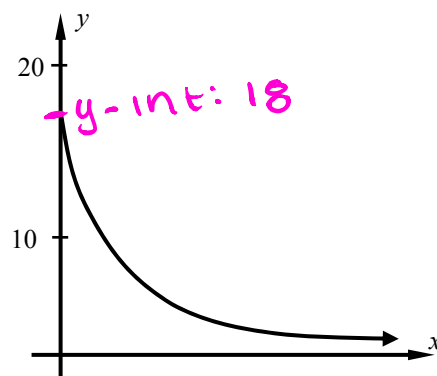
(1) $y = 15(1.25)^x$ (3) $y = 50(1.04)^x$

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

Explanation: graphed on calculator to match it.

y-int: 18

"I can use the properties of exponents and percents and identify basic exponential functions."

① $\dfrac{(3xy^4)^2}{2x^4y^5} = \dfrac{3^2x^2y^8}{2x^4y^5}$

$\dfrac{9\cancel{x^2}y^8}{2\cancel{x^4}y^5} = \boxed{\dfrac{9y^3}{2x^2}}$

② Increase 530 by 5.6%

$100\% + 5.6\% = \boxed{105.6\%}$

$1.056(530) = \boxed{559.68}$

③ Decrease 764 by 11%.

$100\% - 11\% = .89\%$

$.89(764) = \boxed{679.96}$

④ Consider the function $g(x) = 2(5)^x$.

a) evaluate $g(0)$.

x	y
0	2

$g(0) = 2$

b) evaluate $g(3)$.

x	y
3	250

$g(3) = 250$

c) Find the avg. Rate of change on interval $0 \le x \le 3$.

$m = \dfrac{y-y}{x-x} = \dfrac{2-250}{0-3} = \dfrac{248}{3} = \boxed{82.\overline{6}}$

x	y
0	2
3	250

d) Find the avg. Rate of change

on interval $3 \leq x \leq 5$.

x	y
3	250
5	6250

$$m = \frac{y-y}{x-x} = \frac{6250-250}{5-3} = \boxed{3000}$$

e) what does parts c & d tell us about this function?