

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) $f(0) =$

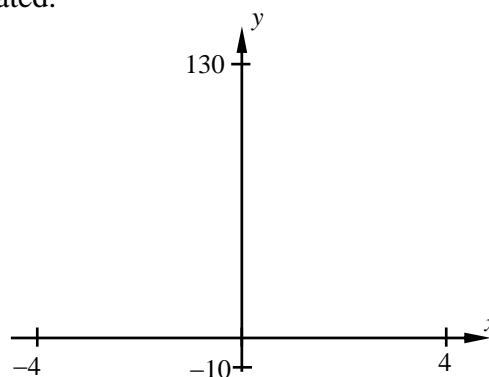
(iii) $f(-1) =$

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

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

(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

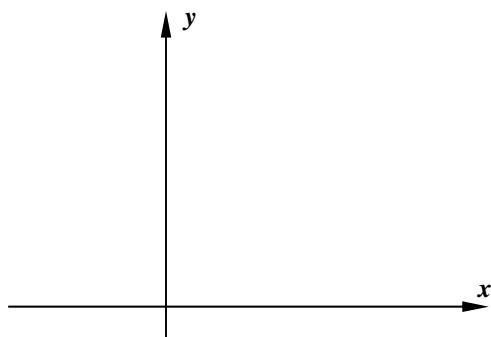
A general exponential function has the form: $y = a(b)^x$, where a is the **y-intercept** and b is the **base** or **multiplying factor**. Sometimes b is known as the **growth factor**.



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** $-2 \leq x \leq 4$ and $-10 \leq y \leq 100$. 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) $y = 8\left(\frac{2}{3}\right)^x$

(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



INTRODUCTION TO EXPONENTIAL FUNCTIONS

COMMON CORE ALGEBRA I HOMEWORK

FLUENCY

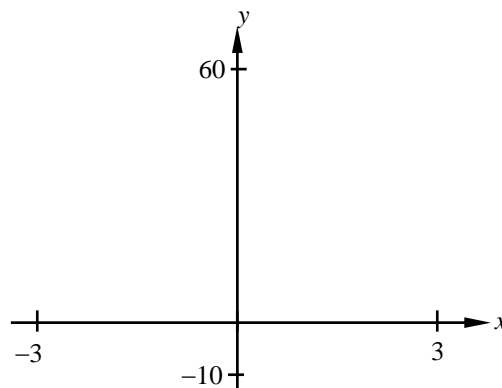
1. Consider the exponential function $f(x) = 10(2)^x$.

(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 $-1 \leq x \leq 2$ 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.

$$f(0) =$$

$$f(1) =$$

$$f(2) =$$

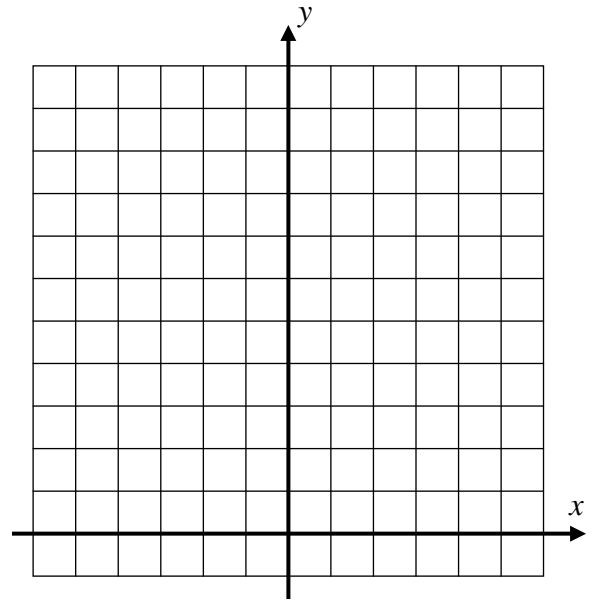
$$f(3) =$$

- (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 $-3 \leq x \leq 3$.

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:

