

Write your questions
and thoughts here!

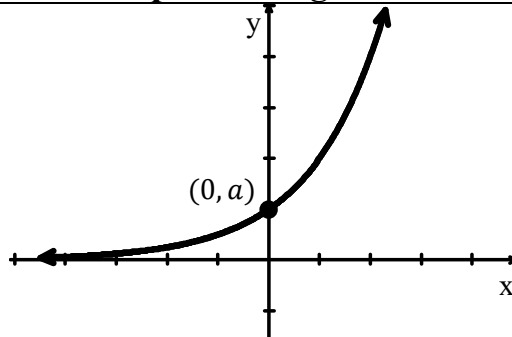
General Form of an Exponential Function

An exponential function has the general form

$$f(x) =$$

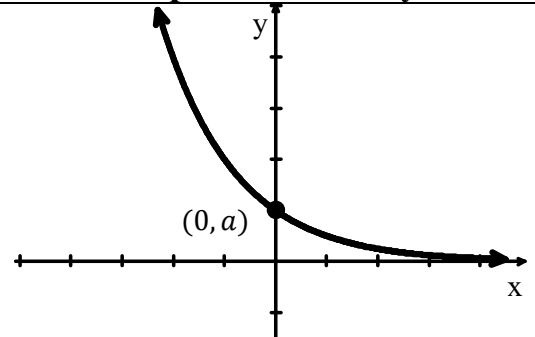
Where the initial value is _____. Also, _____ and _____.

Exponential growth



when $a > 0$ and $b > 1$.

Exponential decay



when $a > 0$ and $0 < b < 1$.

Identify if the exponential function is growth or decay and justify your response.

1. $f(x) = 2(0.6)^x$
Exponential
Growth or Decay

2. $f(x) = 2\left(\frac{7}{5}\right)^x$
Exponential
Growth or Decay

3. $f(x) = \frac{4}{3}\left(\frac{1}{6}\right)^x$
Exponential
Growth or Decay

4. $f(x) = 0.2(1.3)^x$
Exponential
Growth or Decay

Examine the function $f(x) = 3(2)^x$. What are we doing to the initial value 3 when the input value is $x = 5$?

$$f(5) = 3(2)^5$$

$$f(x) = 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$$

The following values are output values of an exponential function of the form $f(x) = a \cdot b^x$, where a and b are constants. Write the function along with the input value that represents the output value.

5. $4 \cdot 4 \cdot 4 \cdot 1.5$

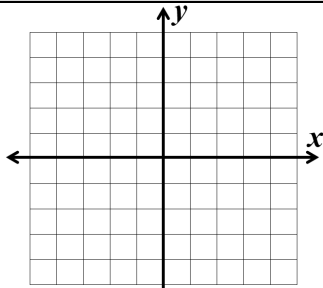
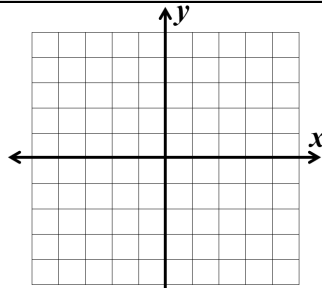
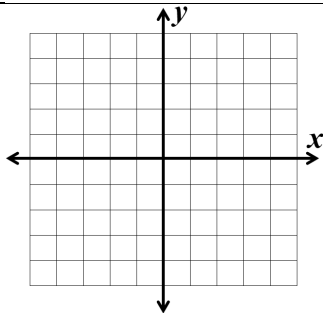
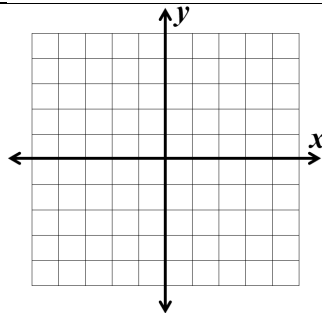
$f(x) =$ where $x =$

6. $0.8 \cdot 3.2 \cdot 0.8$

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

Write your questions and thoughts here!

Using your knowledge of exponential functions, sketch the general shape of each exponential function with the given parameters.

	$b > 1$	$0 < b < 1$
$a > 0$		
$a < 0$		

Characteristics of Exponential Functions

Exponential Functions have the following characteristics.

- They are **always increasing** or **always decreasing**.
 - There are no extrema. (Except on a closed interval.)
- Their graphs are **always concave up** or **always concave down**.
 - Their graphs do not have inflection points.
- If the input values increase or decrease without bound, the end-behavior can be expressed as

$$\lim_{x \rightarrow \pm\infty} ab^x = \quad \text{or} \quad \lim_{x \rightarrow \pm\infty} ab^x = \quad \text{or} \quad \lim_{x \rightarrow \pm\infty} ab^x =$$

Answer the questions for each exponential function.

7. $f(x) = 5(0.9)^x$

- Is the function increasing or decreasing?
- Is the function concave up or concave down?
- Find $\lim_{x \rightarrow -\infty} f(x) =$
- Find $\lim_{x \rightarrow \infty} f(x) =$

8. $f(x) = -6(2)^x$

- Is the function increasing or decreasing?
- Is the function concave up or concave down?
- Find $\lim_{x \rightarrow -\infty} f(x) =$
- Find $\lim_{x \rightarrow \infty} f(x) =$

Additive Transformation of an Exponential Function

Let $g(x) = f(x) + k$. This just means we take a function f and add something to it to shift the graph up or down. The function f is having k added to it to create g .

If the output values of g are proportional over equal-length input-value intervals, then f is exponential.

2.3 Exponential Functions

AP Precalculus

2.3 Practice

Identify if the function is exponential growth or decay and justify your response.

1. $f(x) = 9(3.1)^x$ Exponential Growth or Decay	2. $f(x) = 6.8(0.4)^x$ Exponential Growth or Decay	3. $f(x) = 2.1(0.06)^x$ Exponential Growth or Decay	4. $f(x) = 8\left(\frac{11}{5}\right)^x$ Exponential Growth or Decay
5. $f(x) = 1.5\left(\frac{3}{4}\right)^x$ Exponential Growth or Decay	6. $f(x) = \frac{7}{6}\left(\frac{6}{7}\right)^x$ Exponential Growth or Decay	7. $f(x) = \frac{12}{17}\left(\frac{17}{12}\right)^x$ Exponential Growth or Decay	8. $f(x) = 18(5.6)^x$ Exponential Growth or Decay

The following values are output values of an exponential function of the form $f(x) = a \cdot b^x$, where a and b are constants. Write the function along with the input value that represents the output value.

9. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 7$ $f(x) =$ where $x =$	10. $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot 6$ $f(x) =$ where $x =$	11. $5 \cdot 5 \cdot 5$ $f(x) =$ where $x =$	12. $(-2) \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$ $f(x) =$ where $x =$
---	--	--	---

Answer the questions for each exponential function.

13. $f(x) = 7(2)^x$ a. Is the function increasing or decreasing? b. Is the function concave up or concave down? c. Find $\lim_{x \rightarrow -\infty} f(x) =$ d. Find $\lim_{x \rightarrow \infty} f(x) =$	14. $f(x) = -4(5)^x$ a. Is the function increasing or decreasing? b. Is the function concave up or concave down? c. Find $\lim_{x \rightarrow -\infty} f(x) =$ d. Find $\lim_{x \rightarrow \infty} f(x) =$
15. $f(x) = (0.2)^x$ a. Is the function increasing or decreasing? b. Is the function concave up or concave down? c. Find $\lim_{x \rightarrow -\infty} f(x) =$ d. Find $\lim_{x \rightarrow \infty} f(x) =$	16. $f(x) = -6(0.8)^x$ a. Is the function increasing or decreasing? b. Is the function concave up or concave down? c. Find $\lim_{x \rightarrow -\infty} f(x) =$ d. Find $\lim_{x \rightarrow \infty} f(x) =$

17. $f(x) = 6\left(\frac{1}{9}\right)^x$

- a. Is the function increasing or decreasing?
- b. Is the function concave up or concave down?
- c. Find $\lim_{x \rightarrow -\infty} f(x) =$
- d. Find $\lim_{x \rightarrow \infty} f(x) =$

18. $f(x) = -(0.4)^x$

- a. Is the function increasing or decreasing?
- b. Is the function concave up or concave down?
- c. Find $\lim_{x \rightarrow -\infty} f(x) =$
- d. Find $\lim_{x \rightarrow \infty} f(x) =$

2.3 Exponential Functions

2.3 Test Prep

19.

x	0	1	2	3	4
$f(x)$	40	20	10	5	$\frac{5}{2}$

The exponential function f is defined by $f(x) = ab^x$, where a and b are positive constants. The table gives values of $f(x)$ at selected values of x . Which of the following statements is true?

- (A) f demonstrates exponential decay because $a > 0$ and $0 < b < 1$.
- (B) f demonstrates exponential decay because $a > 0$ and $b > 1$.
- (C) f demonstrates exponential growth because $a > 0$ and $0 < b < 1$.
- (D) f demonstrates exponential growth because $a > 0$ and $b > 1$.

20. The function h is a function of the form $h(x) = a \cdot b^x$, where $a \neq 0$ and $b > 1$. The function h is also given by $h(x) = f(x) + 2$. Which of the following statements is true.

- (A) The output values of both f and h are proportional over equal-length input-value intervals.
- (B) The output values of f only, not h , are proportional over equal-length input-value intervals.
- (C) The output values of h only, not f , are proportional over equal-length input-value intervals.
- (D) The output values of neither f nor h are proportional over equal-length input-value intervals.